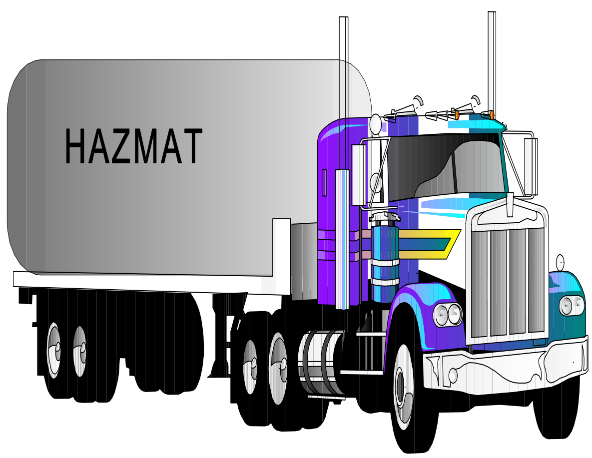
TRAINING FOR SAFE TRANSPORTATION OF HAZARDOUS MATERIALS (HM 126F)

STUDENT MANUAL - PART I

◆ AWARENESS TRAINING ◆

◆ SAFETY TRAINING ◆



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CALIFORNIA-ARIZONA CONSORTIUM TEACHING APPROACH AND INSTRUCTOR EXPECTATIONS

Welcome to this class which is offered by a member institution of the California-Arizona Consortium (CC).

We would like you to know that our classes consist of diverse groups of workers with a wide range of working experiences. Our instructors make a special point of drawing upon your experiences so that you can learn from each other in class. That is a major aspect of how we teach.

Consequently, both students and instructors have the responsibility to create an atmosphere of mutual respect at all times in our classes. In addition, any information shared by students about a particular worksite is to be kept confidential and not to be shared outside the classroom.

In order to receive certification for successful completion of this class, CAC Instructors expect you to:

1. Participate in all learning activities to the satisfaction of our instructors;

2. Attend all of the course (and sign in/sign out on appropriate sheets); and

3. Take any required hands-on or written tests to demonstrate proficiency.

If the instructor(s) does not think you are meeting expectations in any of these areas, the instructor(s) reserves the right to ask you to withdraw from the class.

NOTICE

This manual is designed to provide information with regard to the subject matter involved.

The sponsor seeks to review the covered subjects in as objective a manner as possible. There is no intent to either attack or defend any accepted practices, regulatory controls, or programs.

The state-of-the-art and the related regulatory programs are still subject to substantial review and change, as well as significant differences of opinion. The entire responsibility for complying with the law and remaining current lies with employers and their employees. Accordingly, no representation can be made or responsibility undertaken by the sponsor regarding the completeness, accuracy or continuing validity of the information in this publication or matters discussed during the training course.

This publication is not intended to take the place of legal or other professional assistance. If legal advise or other expert assistance is required in regard to specific problems confronting your business, the services of competent professionals should be sought.

Table of Contents

MODULE 2

TOXICITY

Objectives:

- Participants will be able to list the three main exposure chain routes.
- Participants will be able to define acute and chronic exposure.
- Participants will be able to generally describe the toxic effects of acute and chronic exposure to chemical hazards products.
- Participants will be able to list situations where toxic exposure is most likely.

HAZARDOUS SUBSTANCES:
FORMS OF CHEMICAL HAZARDS

1. **SOLIDS**

    a. **Particulate (dusts, fibers); fume (metal or plastic)**

    b. **Typically breathing hazards: size of particle is important**

2. **LIQUIDS**

    a. **Aerosols and mists: breathing hazard**

    b. **Liquid splash: dermal hazard**

3. **VAPORS & GASES**

    a. **Vapor pressure and density important**

    b. **Breathing hazards**

        - **Toxic hazard**

        - **Oxygen deficiency hazard**

            - **Simple asphyxiant: CO_2, N_2, He = displace oxygen molecules**

            - **Chemical asphyxiant: CN, H_2S = chemical interference with O_2 use by body**

FORMS OF CHEMICAL HAZARDS

As with any substance on earth, a chemical hazard may take the form of a SOLID, a LIQUID or a GAS. As a substance is cooled or heated it changes form. For example, the vapors given off by solvents are simply the gaseous form of the solvent. The hotter the workplace (or the more heat used in the process), the more that solvent will evaporate and give off harmful vapors.

1. SOLIDS

The solids of greatest concern to health are DUSTS, FIBERS, and FUMES. These types of solids can be inhaled directly into the lungs, where they may damage the lungs or pass into the blood stream to harm other parts of the body.

DUSTS are solid particles generated by handling, crushing, or grinding materials such as rock, metal, coal, wood, or grain. Dust particles range in size from 0.1 to 25 micrometers. Only dusts of less than five micrometers remain airborne long enough to be inhaled. These fine particles cannot be seen without a microscope, but they may be perceived as a "haze." Any process that produces dusts suspended in the air should be considered hazardous until industrial hygiene testing proves it safe.

FIBERS are dust particles whose shape is long and narrow rather than rounded. If the length is three or more times the width of a particle, it is called a fiber. The most notorious fiber in industry is the asbestos fiber.

FUMES are formed when very hot vapors - usually metallic vapors - cool rapidly and condense into very fine solid particles. Gases and vapors are not fumes, although the terms are often mistakenly used interchangeably. Fumes are produced mainly in industrial high-heat operations, like welding, melting, and furnace work. Fumes are often mixed with hazardous gases, like ozone and nitrogen oxides, which are taken in by the lung at the same time.

AEROSOL is the general term for any airborne particle, whether solid or liquid.

PARTICLE SIZE is important in determining the degree of harm a dust will do. Generally only particles smaller than five micrometers are able to enter the inner recesses of the lung (the alveoli). However, an agent which causes an allergic response, such as ragweed pollen (about 20 micrometers), does its damage to the upper respiratory system.

2. LIQUIDS

MISTS or SPRAYS are fine suspensions of liquid droplets. Examples are the oil mist produced during cutting and grinding operations, acid mists from electroplating, acid or alkali mists from pickling operations, paint spray mist, and fog or rain.

Mists are like dusts in one important way. The finer the spray, the farther the droplets penetrate into the lungs. Most mists, such as paint spray, are mixtures of several ingredients - solvent, pigment, stabilizing agents, and the propellant.

DERMAL HAZARD: Any liquid splash or spill may enter the body through the skin, and then enter the bloodstream to do damage.

3. VAPORS & GASES

A GAS is a fluid that expands to fill the space that contains it. A gas can travel quickly far from its point of origin. Many gases are highly flammable; many are very reactive, both chemically and within the body.

A VAPOR is the technical name for the gaseous form of a liquid that always exists above that liquid - just as water vapor always exists over water. The closer a liquid is to its BOILING POINT, the more it vaporizes. Liquids with boiling points just above room temperature vaporize readily, and are called VOLATILE.

VAPOR PRESSURE is the pressure (in millimeters of mercury) at any given temperature of a vapor when it is in equilibrium with its liquid form. The higher the vapor pressure, the greater a chemical's potential as a fire and health hazard. A typical high vapor pressure solvent is acetone (VP = 400 mm), a typical low pressure is cellosolve (VP = 3.8 mm).

DENSITY of a vapor is important in determining whether it will tend to rise to the ceiling (density less than 1) or sink to the floor or bottom of a tank (density greater thean 1). Gasoline is a vapor which moves quickly along the ground, sometimes igniting far from the liquid source.

BREATHING HAZARDS

There are two main types of hazards caused by vapors and gases:

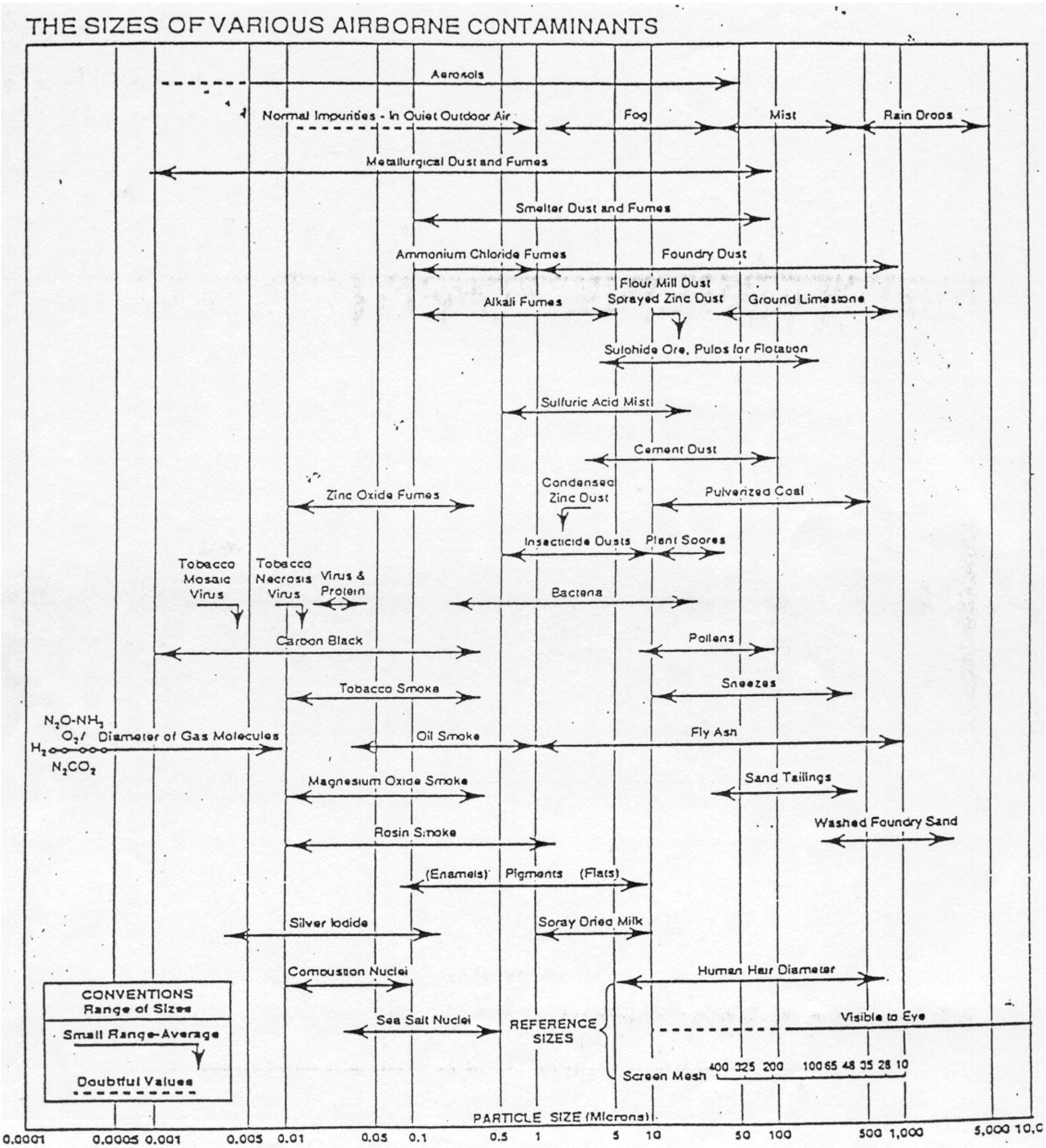
1) Toxic hazards

These substances do damage to the lungs or enter the body and travel to a site where damage is done.

2) Oxygen deficiency hazards

A SIMPLE ASPHYXIANT simply takes the place of oxygen molecules in the lung. Inert gases such as carbon dioxide, nitrogen and helium are examples.

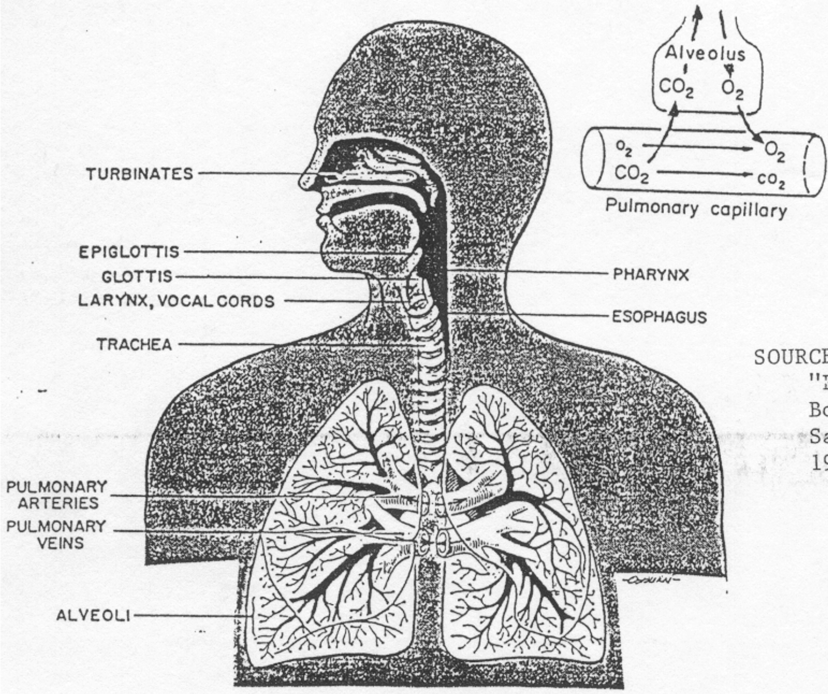
A CHEMICAL ASPHYXIANT prevents the cells in the body from taking in the necessary oxygen. Examples are cyanide and hydrogen sulfide.



The sizes of various airborne contaminants. (1 micron = 1 micrometer.)

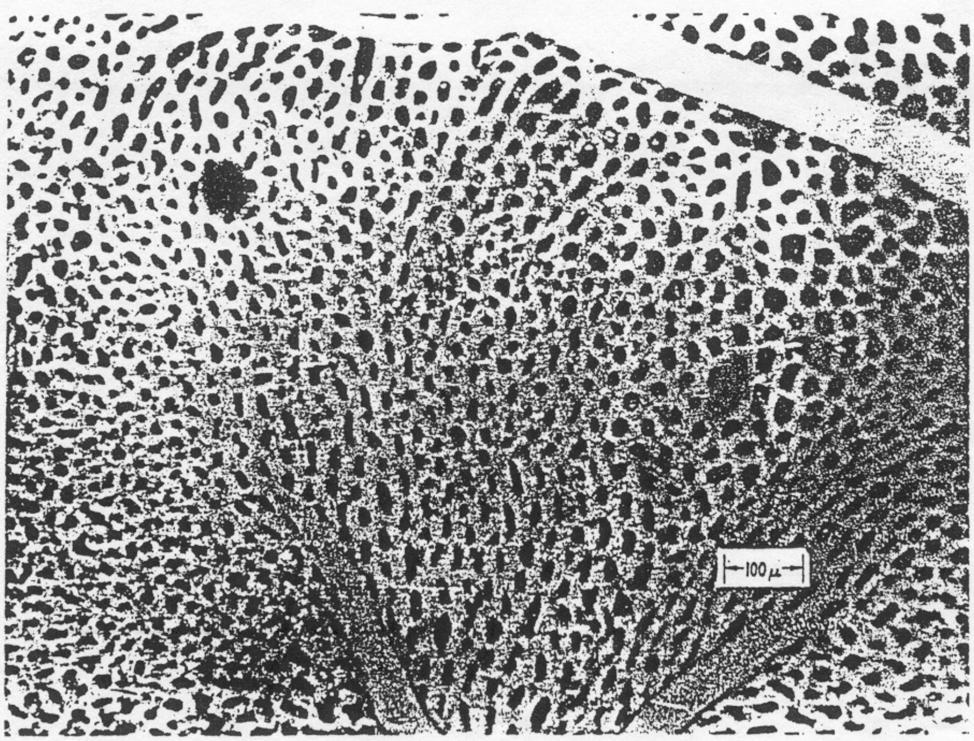
CAN GET INTO THE LUNGS

Courtesy Mine Safety Applian

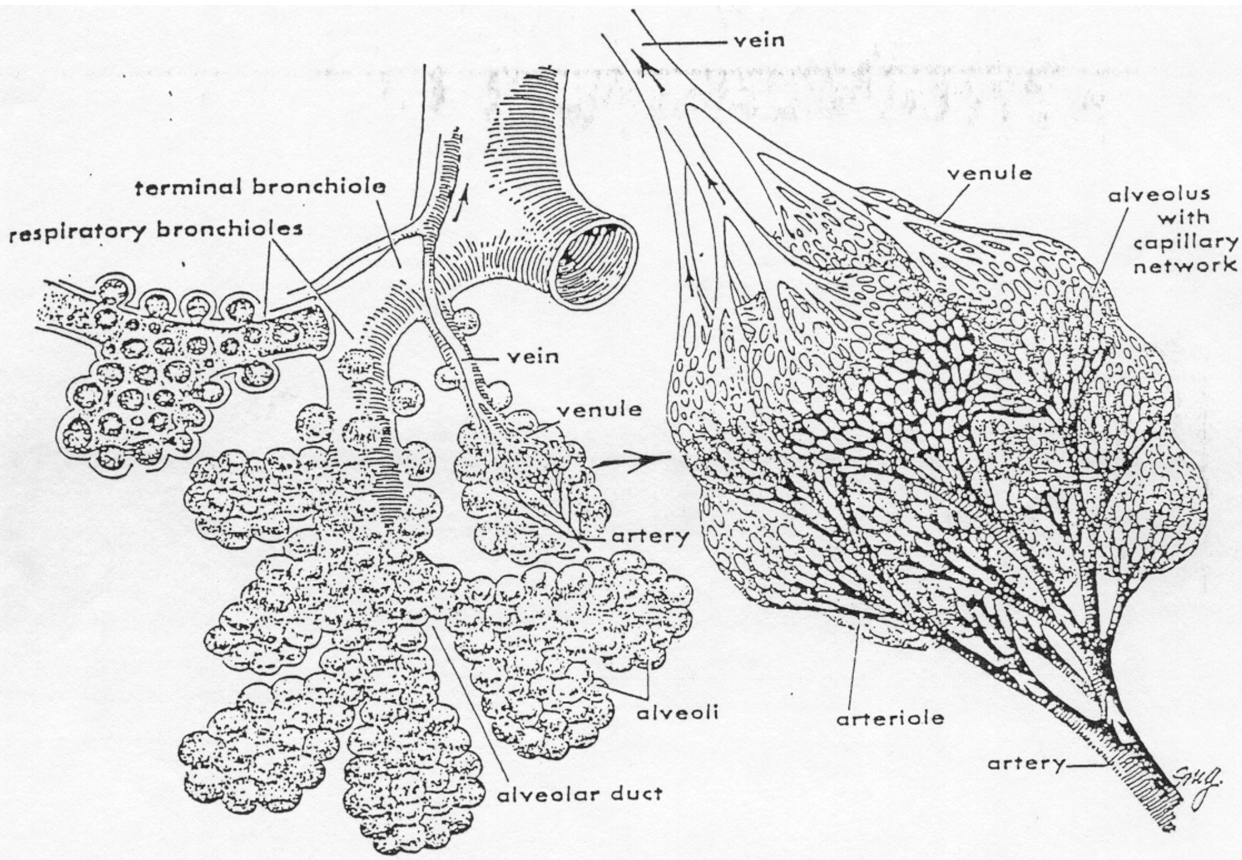


SOURCE: Arthur C. Guyton, M.D., "Physiology of the Human Body," Fifth Ed., W. D. Saunders Co., Philadelphia. 1979.

The respiratory system, showing the respiratory passages and function of the alveolus to oxygenate the blood and to remove carbon dioxide.



Surface view of capillaries in an alveolar wall. (From Maloney and Castle: *Resp. Physiol.*, 7:150, 1969. Reproduced by permission of ASP Biological and Medical Press, North-Holland Division.)



Schematic representation of respiratory units of the lungs.

SOURCE: James E. Crouch, Ph.D., "Functional Human Anatomy," Lea & Febiger, Philadelphia. 1972.

ROUTES OF EXPOSURE

The various FORMS of chemicals and hazardous substances may enter your body through:

1. **Your LUNGS - by inhalation or breathing;**

2. **Your SKIN - by direct contact or absorption through the skin into the body;**

3. **Your DIGESTIVE TRACT - by ingestion or swallowing substances into the body.**

THE LUNGS

Inhalation or breathing through the lungs is the MOST IMPORTANT EXPOSURE ROUTE in the workplace. If your alveoli (the tiny sacs at the bottom of the lungs) were flattened out, they would cover an area the size of a tennis court. This huge surface area is only one single cell thick. This allows a chemical to travel into the bloodstream FAST.

THE SKIN

Contact with a chemical by the skin, called DERMAL CONTACT, may cause two effects:

1. **Local effects on the skin itself.**
   The three types of effects to the skin are:

   a) **Irritant - Many chemicals cause an immediate reddening, rash, or other irritation to the skin upon contact.**

   b) **Tissue damage - Chemicals such as corrosives, including acids or bases, eat into the skin and cause damage to the tissue beneath it.**

   c) **Allergic effects - Some chemicals, such as nickel, chromium, formaldehyde, turpentine, and isocyanates, cause the skin to become hypersensitive after repeated exposures. This is called SENSITIZATION DERMATITIS.**

2. **Systemic (internal) effects from absorption through the skin.** **Many solvents are absorbed through the skin, circulated through the bloodstream, and then cause damage at a site within the body. Chemicals which are noted for their systemic effect upon absorption by the skin are marked with an "S" in the TLV Booklet.**

BY INGESTION

In the workplace, many people may unknowingly eat or drink harmful chemicals. Toxic compounds are then absorbed from the gastrointestinal tract into the blood. PERSONAL HYGIENE is essential in the workplace:

a. **Always wash up before eating or smoking.**

b. **Eat and smoke in clean areas only.**

Dusts that were filtered out in your upper respiratory tract are moved to your mouth cavity by mucous and ciliary (cilia are small, hairlike projections) transport and may be swallowed. In workplaces where dust levels are very high, this has been an important factor. One example is lead exposure in radiator shops.

Generally, INGESTION IS THE LEAST IMPORTANT ROUTE -- as long as personal hygiene is always maintained.

CHEMICAL HAZARD AWARENESS

OBJECTIVES:

Trainees will be able to:

1. **Draw a dose response curve and distinguish between the following parts of the curve:**

   - the effective dose
   - the LD 50
   - the LD 100
   - the concentration or "y" axis
   - the number of people or the "x" axis

2. **List the five toxic effects of chemicals.**

TOXICOLOGY

Definition: the study of the harmful effects of chemicals on living things.

TOXIC EFFECTS: Undesirable changes in the body. A toxic effect is a RESPONSE to an exposure to a chemical. The kind of response (or how severe the response is) depends on the DOSE received.

DOSE = how much of the chemical are you receiving over what period of time?

Dose = Chemical Concentration X Time of exposure

Example of Dose/Response Concept:

Dose = Concentration	X Time ----------	Response
1 qt. of 12% ethanol (alcoholic beverage)	15 mins.	brain effects ("drunk")
1 qt. of 12% ethanol	annually	no observed effect
1 qt. of 12% ethanol	daily	chronic organ damage

TOXICITY: the ability of a substance to cause an unwanted response or effect when a certain dose is received by the body (or at a specific site within the body).

DOSE - RESPONSE

All studies of toxicology are based on the DOSE-RESPONSE RELATIONSHIP. This is an attempt to relate the amount of a substance given to a test animal (the dose) to the effect shown by the animal (the response).

The simplest toxicology study relates the percent of test animals which die upon exposure (mortality) to the dose given. The dose is usually expressed in mg/kg (for ingestion or inoculation), in mg/M^2 (for skin exposure), or in mg/M^3 (for inhalation). The response is expressed in % of animals which have died.

After this information is put on a DOSE-RESPONSE CURVE, the LD-50 can be found. LD-50 (lethal dose - 50%) is the dose of a substance which causes the death of 50% of a group of experimental animals. The important thing for hazard awareness is that SMALL LD50 VALUES MEAN THAT THE CHEMICAL IS MORE TOXIC.

The slope of the dose-response curve is another important piece of information for toxicologists. If the curve is very steep, the margin of safety for exposure to that material is very small. If the margin of safety is small, the toxicologist would recommend setting a lower safe exposure level for humans.

(The following pages illustrate the dose-response curve).

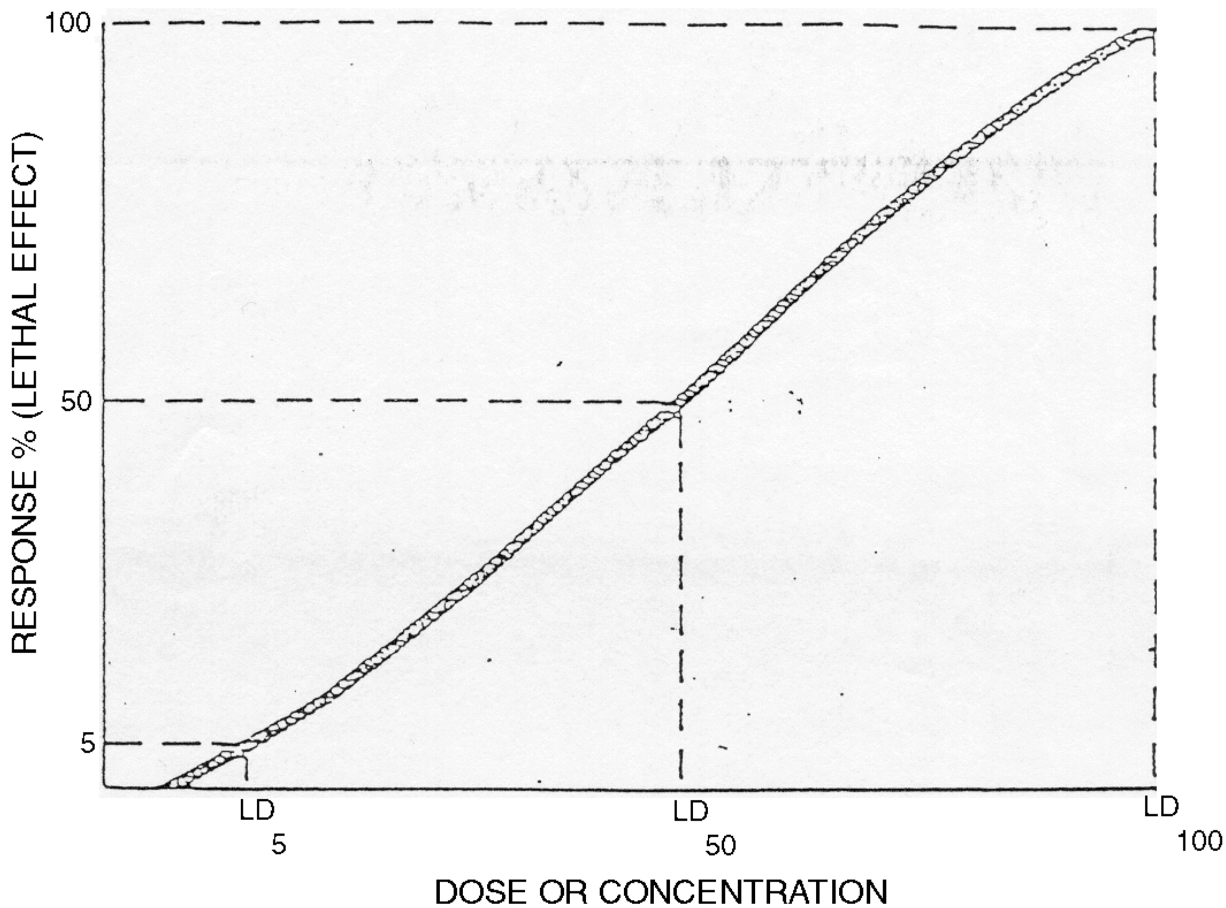


FIGURE 15-1. Dose - response curves for a chemical agent administered to a uniform population of test animals.

Note: Figure taken from "Fundamentals of Industrial Hygiene," Third Edition, Barbara A. Plog, Ed., National Safety Council, 1988, Page 362.

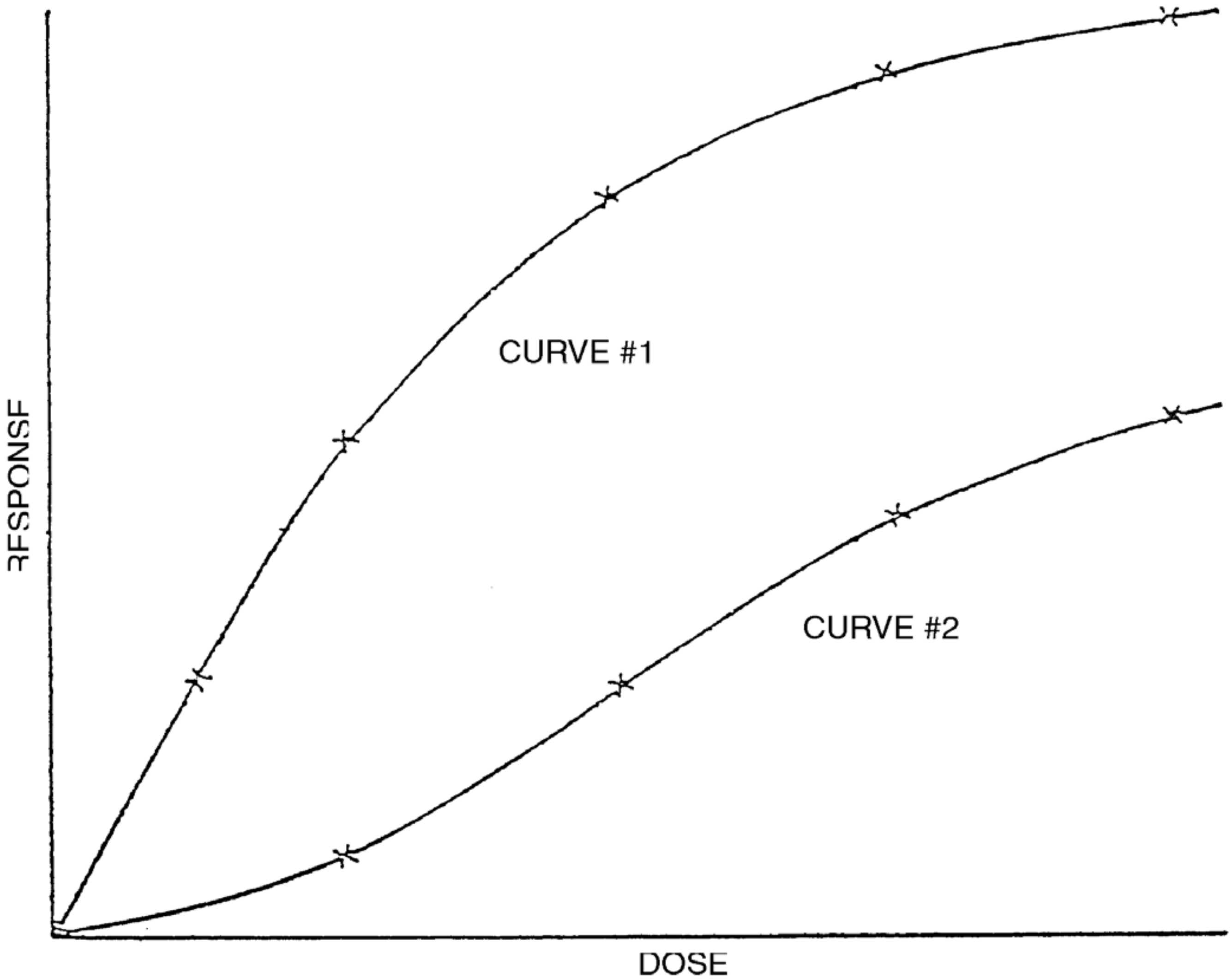


Figure 15-4. The slope of the dose-response curve provides useful information. If the dose-response curve is very steep, the margin of safety for exposure to that material is slight.

Note: Figure taken from "Fundamentals of Industrial Hygiene," Third Edition, Barbara A. Plog, Ed., National Safety Council, 1988, Page 362.

HOW LD_{50} RELATES TO TOXICITY

Table 1 — **Toxicity Classes**
Hodge and Sterner Scale

		Routes of Administration			
		Oral LD_{50}	Inhalation LC_{50}	Dermal LD_{50}	
Toxicity rating	Commonly used term	(Single dose to rats) mg/kg	(Exposure of rats for 4 hours) ppm	Single application to skin of rabbits mg/kg	Probable lethal dose for man
1	Extremely toxic	1 or less	10	5 or less	1 grain (a taste, a drop)
2	Highly toxic	1-50	10-100	5-43	4 ml (1 tspful)
3	Moderately toxic	50-500	100-1000	44-340	30 ml (1 fl oz)
4	Slightly toxic	500-5000	1000-10,000	350-2810	600 ml (1 pt)
5	Practically non-toxic	5000-15,000	10,000-100,000	2820-22,590	1 liter (1 qt)
6	Relatively harmless	15,000 or more	100,000	22,600 or more	1 liter (1 qt)

Table 2 **Toxicity Classes**
Gosselin, Smith and Hodge

Probable Oral LETHAL Dose (Human)

Toxicity Rating or Class	Dose	For 70-kg. person (150 lbs.)
6 Super toxic	Less than 5 mg/kg	1 grain (a tasteless than 7 drops)
5 Extremely toxic	5-50 mg/kg	4 ml (between 7 drops and 1 tsp.)
4 Very toxic	50-500 mg/kg	30 ml (between 1 tsp. and 1 fl. oz.)
3 Moderately toxic	0.5-5 g/kg	30-600 ml (between 1 fl. oz. and 1 pt.)
2 Slightly toxic	5-15 g/kg	600-1200 ml (between 1 pt. and 1 qt.)
1 Practically nontoxic	Above 15 g/kg	More than 1200 ml (more than 1 qt.)

TOXICITY VS. HAZARD

After performing various animal tests, and compiling data from human exposures, toxicologists determine the TOXICITY of a substance, its POTENTIAL TO CAUSE AN UNWANTED RESPONSE. Remember, however, THE DOSE MAKES THE POISON. It is only when the body is exposed to a toxic substance (i.e., one receives a dose) that the substance becomes a poison or hazard.

In short: HAZARD = TOXICITY X EXPOSURE (DOSE)

ACUTE AND CHRONIC EFFECTS

An ACUTE EFFECT is one which appears (is detected by medical procedures or felt as symptoms) within a short time, such as within minutes or hours. In contrast, a CHRONIC EFFECT or illness develops slowly and may last for a long time. Chronic poisoning is due to continued exposure over months and years to a harmful agent. The symptoms of chronic poisoning are usually different from the symptoms of acute poisoning by the same agent.

In short: Be aware of both the ACUTE and CHRONIC effects of a hazardous substance.

TYPES OF TOXIC HEALTH EFFECTS

There are five types of effects which hazardous substances may have on the body. A single agent may, of course, have more than one type of effect at the same time.

1. ASPHYXIANTS

As discussed in the section on the lung, a SIMPLE ASPHYXIANT displaces the oxygen necessary to maintain life. Examples are: carbon dioxide, ethane, helium, hydrogen, methane, and nitrogen.

A CHEMICAL ASPHYXIANT prevents the uptake of oxygen by the cells of the body. Three important examples are:

- **a) Carbon monoxide - prevents oxygen transport by combining with hemoglobin.**
- **b) Hydrogen cyanide - inhibits the enzyme system needed by cells to make use of oxygen.**
- **c) Hydrogen sulfide - paralyzes the respiratory center of the brain.**

At high levels, all three of these substances can cause almost instant collapse and unconsciousness.

2. IRRITANTS

An irritant is a material that causes inflammation to a part of the body by direct contact. The two types are RESPIRATORY IRRITANTS and SKIN IRRITANTS.

- **a) RESPIRATORY IRRITANTS cause injury to the nose, mouth, throat and lungs. Materials that are very water-soluble affect mainly the nose and throat (e.g., ammonia, formaldehyde). Less water soluble materials act deeper in the lungs (e.g., nitrogen dioxide, phosgene). Examples of chemicals which affect both the upper and lower lung are chlorine and ozone.**

  Respiratory tract irritation can be minor, such as a tightening of the chest or bronchitis. But it may also be very serious, as in the case of pulmonary edema and death.

- **b) SKIN IRRITANTS may cause contact dermatitis, a redness, itching and drying of the skin. Examples are organic solvents and detergents. Very corrosive agents can cause skin ulcers and destroy tissue. Chromium and nickel are examples.**

3. ALLERGIC SENSITIZERS

Some individuals become sensitized to certain chemicals, such that repeated exposures cause an immune reaction. Allergic sensitizers generally affect the skin and respiratory tract. The symptoms are often the same as irritants, e.g., dermatitis or bronchitis. As with irritants, the response may be much more serious, even causing death. Examples include: isocyanates, formaldehydes, phenol resins, and epoxy resins.

4. SYSTEMIC POISONS

a) BLOOD SYSTEM (HEMOLYTIC) TOXINS - These agents damage blood components or depress blood cell formation. Examples include benzene, methylene chloride, arsine, phosphorus, and napthalene.

b) NEUROTOXINS - These compounds damage the nerve cells (neurons) or inhibit their function by acting on a part of the nerve cell. Typical symptoms include dullness, muscle tremor, restlessness, convulsions, loss of memory, epilepsy, and loss of muscle coordination. Examples include mercury, insecticides, hexachlorophene, and lead.

c) LIVER (HEPATO-) TOXINS - These compounds cause liver damage, including jaundice and liver enlargement. Examples include alcohols, carbon tetrachloride, and nitrosamines.

d) KIDNEY (NEPHRO-) TOXINS - These agents damage the kidney, causing swelling and increased serum proteins in the urine. Examples include halogenated hydrocarbons and heavy metals.

5. CARCINOGENS, TERATOGENS AND MUTAGENS

a) CARCINOGENS - Carcinogens cause cancer. Cancer is the development of malignant growths or neoplasms at any site in the body. The development of cancer may be delayed for 20 - 30 years. Examples include vinyl chloride, asbestos, ethylene dibromide, and acrylonitrile.

b) TERATOGENS - Teratogens are agents that cause physical defects in the developing embryo or fetus. In the 1960's methyl mercury was the first industrial chemical shown to be a teratogen. Examples include thalidomide, anesthetic gases, and ionizing radiation.

c) MUTAGENS - Mutagens are agents which cause a change (mutation) in the genes by altering the DNA. Mutation of the reproductive cells may cause birth defects. Mutation of other cells may cause cancer or a teratogenic

response to the exposed person or her child. Examples include ethylene oxide, benzene, hydrazine, and ionizing radiation.

CHEMICAL HAZARD AWARENESS

OBJECTIVES:

Trainees will be able to:

1. **Define the term "time-weighted average," and distinguish between the Threshold Limit Value (TLV) and the Permissible Exposure Limit (PEL) and their respective sources and uses.**

2. **Identify potential negative health effects posed by worksite chemicals by looking up the TLVs and PELs for these chemicals.**

CHEMICAL EXPOSURE TERMINOLOGY

Concentration:

mg/m^3 =

ppm =

Time:

8 Hour Time Weighted Average =

Exposure Limits:

TLVs =

PELs =

STEL =

CEILING =

IDLH =

PERMISSIBLE EXPOSURE LEVELS

Objectives

Participants will be able to:

- Distinguish between "permissible exposure limits" (PELs) and "recom mended exposure limits" (RELs) and "threshold limit values (TLVs).
- Identify the order in which PELs, RELs, and TLVs should be considered when established permissible exposure limits.
- Describe the different approaches to establishing permissible exposure limits for known airborne contaminants.
- List the three major labeling systems that identify hazardous substances and their limitations.

OSHA PERMISSIBLE EXPOSURE LIMITS (PELs)

- OSHA regulations establish PELs for over 600 substances.
- PELs generally focus on exposure by inhalation.
- PELs are legal standards; must be considered first when setting exposure limits.

Regulatory agencies, trade associations, and professional organizations have developed regulations and guidelines for worker exposure to hazardous substances. They are used to evaluate potential exposure hazards during the safety planning and site inspections. The guidelines should also be used in planning for the appropriate personal protective equipment (PPE) if it will be necessary to conduct activities in areas where exposure is likely.

The exposure limits normally focus on exposure by inhalation because the other routes of exposure — injection, ingestion, and dermal absorption — are normally controlled by work practices and personal hygiene. In addition, it is difficult to establish exposure limits for these routes. The Occupational Health and Safety Administration (OSHA) has established "Permissible Exposure Limits" (PELs) for over 600 substances. These standards are codified as 20 CFR 1910.1000 (amended 1/19/89).

The PEL for a substance is the 8-hour "ceiling concentration" above which employees may not be exposed. PELs are legally enforceable standards and apply to private and government sector employees. They should be considered first when settling exposure limits.

NIOSH STANDARDS

- NIOSH develops and recommends health and safety standards to OSHA.
- Publishes IDLH concentrations.
- Publishes Recommended Exposure Limits (RELs).
- RELs should be considered second when establishing exposure limits.

The National Institute for Occupational Safety and Health (NIOSH) is a division of the U.S. Department of Health and Human Services. NIOSH is responsible for researching, developing and recommending health and safety standards for OSHA. NIOSH researches information for use in developing OSHA PEL standards, although many recommended exposure limits have not been adopted. These are called the Recommended Exposure Limits (RELs). For each REL, NIOSH publishes a criteria document that is the basis for their recommendation. RELs are not enforceable.

Approximately 150 chemicals have been assigned RELs. In accordance with OSHA 1910.120, RELs are considered second when establishing a specific exposure limit.

NIOSH has also developed the Immediately Dangerous to Life and Health (IDLH) concentrations which can be used as a reference in selecting a respirator. The IDLH concentrations represent the maximum concentrations from which one could escape within 30 minutes without symptoms of impairment or irreversible health effects. RELs and IDLH values are listed in the NIOSH/OSHA *Pocket Guide to Chemical Hazards*, NIOSH/OSHA, DHHS Publication #85-114, February 1987.

THRESHOLD LIMIT VALUES

- ACGIH establishes the Threshold Limit Values (TLVs) for about 600 substances.

- Three separate levels of TLVs:

  - TLV-TWA (time-weighted average)
  - TLV-STEL (short-term exposure limit)
  - TLV-C (ceiling value)

- TLVs should be considered third when establishing exposure limits.

The American Conference of Governmental Hygienists (ACGIH) establishes exposure limits called Threshold Limit Values (TLVs) and publishes a revised listing annually in their booklet, *Threshold Limit Values and Biological Exposure Indices*. The booklet lists approximately 600 substances and is revised annually. The TLVs refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. According to OSHA CFR 1910.120, the PEL is considered first when establishing an exposure limit, followed by the REL, and TLV values.

There are three separate levels of TLVs. The TLV-TWA (time-weighted average) is the average concentration of a chemical to which most chemical workers can be exposed over a 40-hour week and a normal 8-hour work day without showing any adverse effects. The TLV-TWA permits exposure to concentrations above the limit, however, elevated concentrations must be compensated by periods of exposure below the limit. The TLV-STEL (short-term exposure limit) is a 15-minute, time-weighted exposure. Excursions above the TLV-STEL should be at least 60 minutes apart, no longer than 15 minutes in duration, and should not be repeated more than 4 times a day. Because the excursions are calculated into the 8-hour, time-weighted average, exposure during the rest of the day must be lower to compensate. Finally, the TLV-C represents a ceiling value that should not be broached even instantaneously. *These three values should be considered in third order when establishing exposure limits.*

NOTES

TLV-C is typically used for substances that are fast-acting, and dangerous in even short exposures. It is good practice to select the lowest of these three values as the action limit.

RECAP - TLVs, PELs, RELs

TLV: Threshold Limit Value

- **an 8-hr time weighted average concentration of a contaminant that should not be exceeded**
- **considers toxicity, type of health effect, epidemiological data, industrial use data, and technological feasibility**
- **intended to protect nearly all healthy or average workers for a work-lifetime exposure**
- **issued by the American Conference of Governmental Industrial Hygienists (ACGIH)**
- **TLVs are updated bi-annually**

PEL: Permissible Exposure Limits

- **an 8-hr time weighted average concentration of a contaminant that is not be exceeded**
- **most OSHA PELs were based on the 1968 TLVs - until 1989, when Federal OSHA adopted the 1987 TLVs.**
- **OSHA enforceable standards**
- **No established program for updating**

REL: Recommended Exposure Limit

- **8-hr time weighted average concentration that should not be exceeded**
- **does not have to take technical and economic feasibility into account is health-based**
- **many are more protective than OSHA PELs or ACGIH TLVs**
- **are updated on case-by-case basis**
- **issued by NIOSH**

ESTABLISHING EXPOSURE LIMITS

- For specific chemicals and compounds (gasoline) use PELs, RELs, or TLVs.
- When specific contaminants are unknown, use total atmospheric con- concentrations following EPA emergency response team action levels:

Concentration	Protective Clothing and Equipment
- Background	Level D
- 5 ppm above background	Level C
- 5-500 ppm	Level B
- >500 ppm	Level A

When the identities and concentrations of airborne contaminants are known, the PEL, REL, and TLV can be used to establish the permissible exposure limit. In unknown situations, such as may exist at an abandoned UST site, total atmospheric concentrations (with a number of conservative restrictions) can be used to establish limits until the airborne contaminants can be identified and quantified. In these instances, it may be appropriate to use the EPA Emergency Response Team (EPA-ERT) action levels (listed above).

NOTES

The EPA-ERT action levels are guidelines only. Obviously, for some contaminants they would be inadequate, for others, far too stringent. However, when used with some common sense, they are good, general protection levels for unknown contaminants.

Action levels were developed by EPA to provide basic guidelines for decision-making in unknown situations. They address the four major site hazards: oxygen deficiency, explosive atmospheres, radioactive environments, and toxic atmospheres. ***If any of these hazards are suspected, monitoring with site screening instruments should be conducted prior to site entry.***

INFORMATION SOURCES AND STANDARDS FOR CHEMICAL EXPOSURES

1. **Federal OSHA Standards 29 CFR 1910.1000 Air Contaminants - list of PELs**
2. **ACGIH - Threshold Limit Values**
   Documentation of the TLVs

3. **AIHA - Workplace Environmental Exposure Level (WEEL) Guides**

4. **NIOSH Criteria Documents and Health Hazard Evaluations - provides RELs (Recommended Exposure Limits for chemical substances)**

5. **Material Safety Data Sheets - from your employer who gets them from chemical manufacturers**

6. **References:**

   - **NIOSH Pocket Guide to Chemical Hazards**
   - **CHRIS Manual (U.S. Coast Guard)**

TELEPHONE: GETTING INFORMATION ON CHEMICALS

Source or Information	**Telephone Number**
Hazard Evaluation System & Information Service (HESIS):	**(415) 540-3014 (M-F 1-5 p.m.)**
Community Hotline:	**1-800-233-3360**
Federal OSHA:	**1-800-648-1003**
ADOSH Consultation:	**602-542-5795**
RCRA/Superfund Hotline:	**1-800-424-9346**
EPA's Small Business Ombudsman Hotline:	**1-800-368-5888**
UCLA-LOSH:	**213-825-3877**

MODULE 3

FIRES AND EXPLOSIONS

Objectives

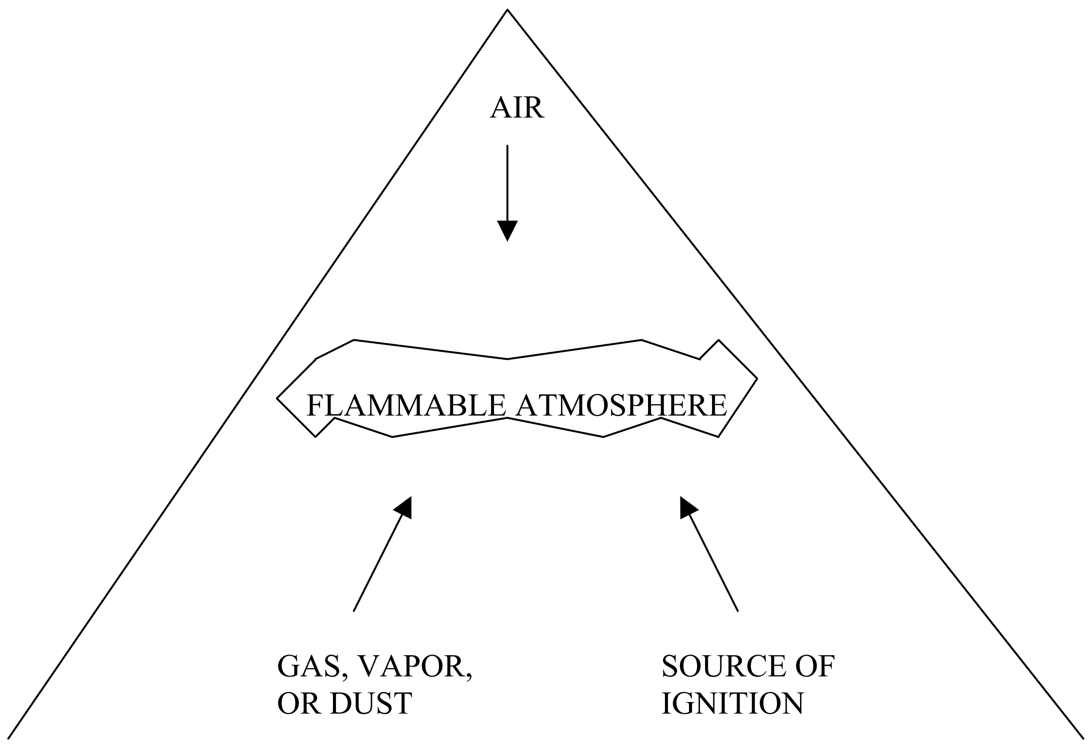
Participants will be able to:

- Name the three primary elements of the fire triangle.
- List the four fire physical characteristics.
- Define flash point and flammability and discuss their significance.
- Describe flammable characteristics of petroleum products.
- Describe the causes of explosions and define explosivity limits UEL and LEL.
- Describe general safety, measures in the presence of explosive gases, vapors, or ignitable liquids.
- Name the effective method for controlling the "fuel" point of the fire triangle.
- Identify the effective methods for controlling the "oxygen" point of the triangle.
- Name several potential sources of ignition, static electricity, and sparks.
- List methods for reducing static electricity and sparking.
- Describe several situations in which fire and explosion potential are most prevalent.

Flammable Atmospheres

Two things make an atmosphere flammable: (1) the oxygen in the air and (2) a flammable gas, vapor, or dust in the proper mixture. Different gases have different flammable ranges. If a source of ignition (e.g., a sparking or electrical tool) is introduced into a space containing a flammable atmosphere, an explosion will result.

An oxygen-enriched atmosphere (above 21%) will cause flammable materials, such as clothing and hair, to burn violently when ignited. Therefore, **never use pure oxygen to ventilate a confined space**. Ventilate with normal air.



The Ignition Triangle

THE FIRE TRIANGLE

- For a fire to burn, three primary elements must coexist in appropriate ranges.

Fire is a rapid and persistent chemical reaction accompanied by the emission of heat and light. Three primary elements, represented by the fire triangle, must be present for a fire to burn: **oxygen, fuel** and **a source of ignition**.

Each side of the fire triangle represents one of the necessary elements of fire. The center of the triangle represents the optimal fuel-to-oxygen ratio with enough heat to ignite the mixture. If any of the elements are removed, however, there can be no fire (this is represented by the corners of the triangle). For example, if the wood on a campfire is consumed or removed, the fuel supply is no longer sufficient to sustain combustion.

NOTES

A more modern fire triangle would have these three elements: oxidizer, fuel, and energy source. Energy can be produced by chemical reaction, mechanical action, or electrical discharge. All these factors may come into play at UST sites.

It is important to understand that it is not the liqud which burns. Vapors are produced, which are heated and broken into simpler compounds (such as methane) which will readily oxidize. The flame above a solid material is also the result of the burrning of heated gases. Surface burning may occur after all the volatile materials are driven off, as in the case of burning charcoal. Surface burning also occurs when metals burn.

Once started, a fire will continue until the fuel or oxygen concentration falls below a minimum value. A fire commonly results from the combination of some combustible material with oxygen, but the oxidizer does not have to be O_2. The oxygen may be part of a chemical compound such as nitric acid or ammonium perchlorate. Combustion may also occur, in some cases, without oxygen being involved (e.g., brake fluid can be ignited by chlorine).

NOTES

Oxidation can occur with any chemical material that can easily yield oxygen, or a similar element. Similar compounds include fluorine, chlorine, and bromine. However, simply because a compound contains these elements does not make it a strong oxidizer. Carbon dioxide has two oxygens, but is not an oxidizer.

FIRE CHARACTERISTICS

- Flammability
- Ignition temperature
- Flash point

Combustion is the burning of any substance, whether gaseous, liquid, or solid.

Flammability is the ability of a material to generate a sufficient concentration of combustible vapors to be ignited. The flammable range is the range of vapor-air mixtures which will support combustion. It is bounded by the upper flammable limit (UFL) or the highest concentration of a product that is flammable and the lower flammable limit (LFL) or lowest concentration of a product that is flammable. Concentrations outside this range that are too vapor-rich or too vapor-poor, will not ignite.

NOTES

Combustion and flammability have technical and regulatory definitions. It is important to understand this difference. The technical, or scientific definition is given above. The Department of Transportation has its own definitions for flammable and combustible. By the DOT definition, flammable means any liquid with a flash point of 100°For less. Combustible is any liquid with a flash point greater than 100°F. This is a strictly regulatory definition. What's the difference between material with a flash point of 99°Fand one with a flash point of 102°F?

Ignition temperature is the minimum temperature to which a substance in air must be heated in order to initiate, cause, self-sustained combustion independent of the heating element.

NOTES

Ignition temperature is also referred to as "auto-ignition temperature." Ignition temperature is important in many applications, but not so much for determining fire hazard, strangely enough. For instance, gasoline is much more of a fire hazard than diesel, yet the auto-ignition temperature of diesel is at least 100°Fless than gasoline! The availability of vapor is the key to hazard, not the ignition temperature.

Flash point is the minimum temperature at which a substance produces sufficient flammable vapors to support a flame when an ignition source is present. Table 4-1 delineates fire hazard properties of various flammable liquids, gases, and volatile solids.

Table 4-1 delineates fire hazard properties of various flammable liquids, gases, and volatile solids.

TABLE 4-1
Fire Hazard Properties of Some Flammable Liquids, Gases, and Volatile Solids (abstracted from NFPA 325-M-1984, p. 9-95, 1984)

Chemical	Flash point °F(°C)	Ignition temperature °F(°C)	Flammable limits % by volume LEL	UEL	Specific gravity (Water=1)	Vapor density (Air=1)	Boiling point °F(°C)
Benzene	**12 (-11)**	**928 (498)**	**1.3**	**7.9**	**0.9**	**2.8**	**176 (80)**
Fuel Oil, No. 6	**150-170 (66-132)**	**765 (407)**			**1**		
Gasoline[1] C_5H_{12} to C_9H_2O	**-45 (-43)**	**536 (280)**	**1.4**	**7.6**	**0.8**	**3-4**	**100-400 (38-204)**
Gasoline[1] aviation	**-50 (0-48)**	**824 (471)**	**1.3**	**7.1**			
Toluene	**40 (4)**	**896 (480)**	**1.2**	**7.1**	**0.9**	**3.1**	**231 (111)**
m-xylene	**81 (27)**	**982 (527)**	**1.1**	**7.0**	**0.9**	**3.7**	**282 (139)**

[1]Values may vary for different gasoline grades.

FLASH POINT/FLAMMABILITY RELATION

- Highly flammable - flash point <100°F
- Moderately flammable - flash point >100°F but <200°F
- Relatively inflammable - flash point >200°F

The relative flammability of a substance is based on its flash point.

Flash point is defined as the minimum temperature at which a substance produces sufficient flammable vapors to ignite when an ignition source is present. An ignition source could be the spark from static electricity, an electrical tool, or a wayward cigarette butt. NOTE: In the case of liquids, it is not the liquid itself that burns, but the vapor above it.

NOTES

Flash point is the single most important factor to look at in determining fire hazards. The National Fire Protection Association (NFPA) determines flash points. If the temperature of a liquid has reached the flash point, or higher it will be ignited by a spark, if the fuel/air mixture is right. There is a value called the "Fire Point." The "Fire Point" is the temperature the liquid must reach to generate enough vapors to sustain a flame. For practical purposes, however, we are only concerned with the flash point. If the liquid is at the flash point, and an ignition source is present, there will be a fire.

FLAMMABLE CHARACTERISTICS OF GASOLINE

- Readily generates flammable vapors at atmospheric temperatures (NFPA = 3).
- Flash point: -45°F.
- Flammability limits: LFL = 1.4% and UFL = 7.6%.

Gasoline is one of the dangerous petroleum products because it readily generates flammable vapors at atmospheric temperatures (down to -45°F) and generates these vapors within an UST. It is this vapor, not liquid gasoline itself, that burns or explodes when mixed with air and an ignition source. The relatively low flash point of gasoline means almost any source of ignition can cause an explosion.

NOTES

Much of the nomenclature in the petroleum industry is rather vague. For instance, fuel oils can be classified as middle, heavy or residual distillates. Jet fuel, may range between kerosene-like blends with middle distillate properties, to blends much more like gasoline, a light distillate. Don't get hung up on the light-middle-heavy-residual distillate terminology. It is general. Look at the properties of the fuel or oil of concern.

The concentrations of vapors in USTs storing gasoline is normally too rich to burn (i.e., is above the upper flammability limit). However, if the temperature of the liquid gasoline is in the -10°Fto -50°Frange and if the system is at equilibrium, the concentration of vapors will be within the flammable range. In practice, however, the liquid is exposed to air which dilutes the vapors. The dilution takes place above the surface of the liquid, thus increasing the chance that the concentration of the fuel will pass through the explosive range, even if the concentration immediately above the liquid is too rich to burn.

Gasoline has a National Fire Protection Association (NFPA) Standard of 3. The NFPA developed Standard 704M, a five-step ranking system from 0 (lowest) to 4 (highest), to identify relative health hazards. The NFPA standard addresses three categories: (1) flammability, (2) health, and (3) reactivity. Gasoline is rated 3 in the NFPA category for flammability. An NFPA value of 3 indicates that gasoline is a liquid that readily ignites under typical ambient conditions.

FLAMMABLE CHARACTERISTICS OF MIDDLE DISTILLATE FUELS

Kerosene, aviation fuels, diesel fuels, and Fuel Oils Nos. 1 and 2:

- Diesel fuels and fuel oils (Nos. 1 and 2) are relatively nonflammable (NFPA = 2).
- Kerosene grades Jet-A/A-1, JP-5/7/8 are relatively nonflammable (NFPA = 2).
- Jet B and JP-4 (gasoline/kerosene blends) present a higher degree of fire hazard (NFPA = 3).

Middle distillates, which include kerosene, aviation fuels, diesel fuels, and Fuel Oils No. 1 and 2, have a wide range of flammability.

The diesel fuels and fuel oils are relatively nonflammable. They required limited heating at ambient temperatures to ignite. The lower flammability limit (LEL) for diesel fuel is 1.3%. The upper flammability limit (UFL) is 6%.

Aviation fuels are divided into the kerosene grades (Jet A, A-1, JP-5, 7 and 8) and the "wide cut" blends of gasoline and kerosene (J-4 and Jet B). Wide cuts are lighter blends and more closely resemble gasoline. The kerosene grades are relatively nonflammable, but the wide cut blends represent a significantly higher fire hazard.

NOTES

Jet A F.P. = 100-150°F; LFL = 0.7% with significant variability; UFL = 5% with significant variability.

JP-4 F.P. = 20°F (variable); LFL = 1.3% (variable); UFL = 8.0% (variable).

The vapor space in a tank storing a low vapor pressure liquid, such as kerosene, contains a mixture too lean to burn (i.e., below the LFL). The vapor space of UST storing materials such as JP-4 and Jet B (and other liquids of similar vapor pressure between 2 and 4 psi) presents a fire hazard because the vapors are normally in the flammable range.

FLAMMABLE CHARACTERISTICS OF RESIDUAL FUELS

Fuel Oils such as Nos. 4, 5, and 6:

- Relatively nonflammable; (NFPA = 2).
- Flash points:

  Nos. 4 and 5 = 130°F to 335°F
  No. 6 = 150°F to 270°F

- LFL:

  Nos. 4 and 5 = 1%
  No. 6 = 1%

- UFL:

  Nos. 4 and 5 = 5%
  No. 6 = 5%

Residual fuels (Fuel Oils Nos. 4, 5, and 6) are defined as the product remaining after the removal of appreciable quantities of the more volatile components of crude oil. They have a high flash point; ignition will not occur until the liquid reaches a temperature of 130°F or higher. They are not as dangerous as gasoline, however, they do pose a threat.

FLAMMABLE CHARACTERISTICS OF USED OILS
• Significant variability exists. • Approximately 30% of 1,000 samples tested had a flash point under 140°F.

Used oils in general are relatively nonflammable, yet they pose special dangers. The characteristics of used oils are not uniform because the oils take on additional characteristics and components through their use. Thus, used oils may contain toxins or other dangerous products that a worker may be unaware of.

NOTES

All values and associated hazards are based on certain conditions. For instance, a used oil may be difficult to ignite, but if a nearby fire heats the oil it may ignite and burn fiercely. Also while diesel is not typically a flash hazard, if the fuel is spilled on hot concrete or metal, or stored in direct sunlight, the heat may be sufficient to make diesel a serious hazard.

For instance, the "other products" (often solvents) found in used oil can greatly reduce its flash point, making it much more flammable. Virgin lubricating oil has a flash point of 350°F. By comparison, when 1,000 samples of waste oils were tested, 30% of them had a flash point under 140°F.

The components of some used oils, particularly chlorinated solvents, pose a special toxicological hazard in a fire because of their ability to release toxic fumes.

EXPLOSIONS
• Rapid chemical reactions producing large quantities of gas and heat. • Explosivity is expressed in units (%) by volume of material in air — levels the same as for flammability (i.e., LEL/UEL). • Not always the result of combustion; may occur when compressed vapors expand and burst a container.

Explosions are rapid chemical reactions that produce large quantities of gas and heat, a shock wave, and noise. Explosivity is expressed as a percentage of a given material in a volume of air. The lower explosivity limit (LEL) is the lowest concentration of a product

that is explosive. The upper explosivity limit (UEL) is the highest concentration of a product that is explosive.

NOTES

UEL and LEL, for all intents and purposes, are the same as UFL and LFL. Bear in mind that the difference between a fire and an explosion is not a large one. It can simply be the speed of the reaction. Any material that can burn, if placed under sufficient heat, and confined as in a tank, can explode with tremendous force.

Generally, explosions can do serious harm much more rapidly than toxic exposure. Explosions/fire are the most immediate hazard during tank removal or closure activities, and/or when release investigation techniques are performed in a confined space.

Explosions are not necessarily the result of combustion. In a closed container (such as an UST), flammable liquids expand when heated. Gasoline, for example, expands about 0.06% in volume for every 10°F increase in temperature. When the pressure inside the UST exceeds the designed pressure resistance, a "pressure release explosion" can occur.

Although not directly related to standard petroleum products, Boiling Liquid Expanding Vapor Explosions (BLEVEs) are important due to their tremendous destructive force. BLEVEs occur when compressed gases (e.g., LPG) are stored as liquids at temperatures above their normal boiling points. If the vessel is exposed to a fire, the rapid buildup of pressure, coupled with heat-induced weakening of the tank sides, results in a sudden and violent rupture, with the superheated liquid vaporizing and creating a fireball.

PRESCENCE OF EXPLOSIVE VAPORS OR IGNITABLE LIQUIDS

- Use only explosion-proof cameras.
- Remove batteries from flash cameras, or do not use.
- Do not smoke or use matches or lighters.
- Immediately change clothing saturated with oil.

If a worker discovers that vapors or liquids are present in a confined structure and a rapid assessment indicates the potential for an explosion or fire, the worker should take general safety measures at once.

- **All persons should be kept away from the danger area, except those properly trained and equipped.**

- **The local fire department should be alerted.**

- **A trained operator of a combustible gas indicator should determine the concentration of vapors present. Oxygen levels must also be monitored.**

- **Persons in the area should not smoke, start/use vehicles or equipment with internal combustion engines, or touch electrical switches or extension cords.**

- **Instruments used at HW or UST sites must not contribute to the potential for an explosion or fire. Insurance and safety organizations have developed codes for testing electrical devices used in hazardous situations, and an electrical instrument certified for use in hazardous locations will indicate this. If an instrument does not have an approved rating, it should not be used in a hazardous or potentially hazardous situation.**

PURGING

Effective method for controlling the "fuel" point of the fire triangle.

- Purging replaces flammable vapors in the tank with air.

- Purging reduces the flammable vapors in the tank (<LEL).

- Effectiveness of purging must be checked with monitoring equipment.

Purging is an effective method for controlling the fuel point of the fire triangle because it reduces the atmosphere within the tank. Purging or ventilating the tank dilutes the flammable vapors in the tank with air, thereby reducing the flammable mixture of fuel and oxygen.

An eductor-type air mover, typically driven by compressed air, draws vapors out of the tank and forces fresh air into the tank. The fill (drop) tube should remain in place to ensure proper ventilation of the tank bottom. Discharge vapors should be dispersed 12 feet from the tank in order to ensure that flammable vapors are being vented effectively into the upper atmosphere.

Most petroleum products have a flammable range of 1-10% by volume in air, the amount of fuel vapor necessary to become flammable in the presence of oxygen and an ignition source. Below a fuel vapor level of 1% (the lower explosive limits or LEL), the mixture of fuel and oxygen is too small to support combustion. The goal of purging a tank is to reduce the flammable vapors in the tank well below the lower explosive limit.

Purging should not be undertaken on hot, humid days or on nonwindy days because the still air will not disperse the flammable vapors. In order to maintain safe conditions, site work should be put off for a day.

Purging is a temporary procedure. Product trapped in bottom sludge and wall scale regenerates flammable vapors inside the tank. Therefore, when purging, lower the flammable concentration to 20% of the accepted LEL value of the mixture. Tank should be constantly monitored to ensure that the LEL value does not exceed 20%.

Use a Combustible Gas Indicator (CGI) to measure the reduction in the concentration of flammable vapors during purging. Periodically test the percentage LEL inside the tank, in the excavation, and any other below grade areas.

CAUTION: ***In air purging, with plenty of oxygen present, the concentration of vapors in the tank begin in the flammable range, or may go from too rich through the flammable range before a safe concentration is achieved. It is especially important to ensure all ignition sources have been removed from the area before beginning this process.***

American Petroleum Institute Recommended Practice 1604, "Removal and Disposal of Used Underground Petroleum Storage Tanks."

RP 1604 is widely accepted as a "standard" and contains the purging and inerting procedures required and accepted by the Arizona State Fire Marshal and by many local fire departments. Appendix A summarizes RP 1604, Section 4, "Removal of Underground Tanks" is reproduced therein.

INERTING
Effective method for controlling the "oxygen" point of the triangle. • Displaces oxygen in the tank with an inert or nonreactive gas. • Reduces oxygen below the level needed to support combustion. • Common inerting materials: - Dry ice (CO_2) - Compressed nitrogen • Test with oxygen meter to ensure effectiveness.

Inerting controls the oxygen element of the fire triangle. Inerting reduces the concentration of oxygen needed to support combustion (<12-14% oxygen by volume) by replacing the oxygen with an inert gas.

NOTES

Compressed CO_2 is sometimes used, but any compressed gas must be introduced slowly, to prevent generation of static electricity.

Common inerting materials include dry ice (CO_2) and compressed nitrogen. During the inerting process, gases should be introduced under low pressure in order to avoid producing static electricity. If pressure cylinders are used, they must be grounded to prevent static electricity. In the case of CO_2, it is best applied in solid, dry ice form.

NOTES

Fifteen to 20 pounds of dry ice per 1,000 gallons of tank is recommended. The ice should be crushed and spread as evenly as possible. Using dry ice may take longer than using compressed gases, since there is very little momentum for the vapors released from it.

It is important to recognize that the inert gas does not "neutralize" the flammable vapors in the tank; it simply displaces the oxygen. Moreover, air may re-enter the tank causing explosive vapors to again be present. To measure the effectiveness of the inerting procedure, test the air inside the tank with an oxygen indicator. Eight percent or less oxygen by volume is a safe and acceptable level.

SOURCES OF IGNITION

Sources of ignition include:

- Sparks generated by tools, monitoring instruments, combustion engines, cigarette lighters, etc.;
- Static electricity;
- Smoking cigarettes;
- Electrical appliances; and
- Lightning.

"Source of ignition" is the easiest point of the fire triangle to control.

There are many possible sources of ignition during handling and transfer of petroleum products. These sources include static electricity; sparks generated by tools, excavating equipment, monitoring equipment, and engines in the area; smoking cigarettes; or even electrical appliances or lightning. Any one of these is enough to complete the fire triangle with a source of ignition.

SPARKS

Sparks can be generated by:

- Static electricity.
- Striking the tank with a metal instrument (hammer, backhoe).
- Striking a rock with a metal during excavation.

The primary manifestation of static electricity is the discharge or sparking of accumulated charges. Under the right conditions, these sparks can be the ignition source for a fire or explosion. Sparks can also be self-generated by humans or created through induction.

Sparks can be generated at by static electricity, striking metal on metal (i.e., hammer on the tank), or striking metal on rock as when digging with a backhoe. Sparks are also created by the ignition of electrical or combustion engines and pumps, use of nonintrinsically safe monitoring instruments, and lightning. Precautions need to be taken to eliminate the possibility of fire explosions being caused by these activities.

STATIC ELECTRICITY

Sources of static electricity include:

- Filling a tank with petroleum (by movement against piping surface and by splashing);
- Settling of rust or sludge particles;
- Motorized equipment;
- Self-generation by humans; and
- Induction.

The static charge resulting from flowing liquids is of primary importance during the transfer of petroleum products. Static electricity is generated by the separation of like and unlike bodies. When liquid flows, charging occurs because absorbed ions are separated from free ions that are carried into the body of the liquid by turbulence. For example, static results from liquid dropping into a tank during product deliveries, liquid flowing through a hose when product is pumped from the tank, or compressed gas or air being released into the tank atmosphere.

During transfer, static electricity can be generated by the flow of fuel through small holes into the tank. The movement of the fuel against the pipe also generates a static charge. Furthermore, static electricity can be generated by the settling of rust or sludge particles.

Motorized equipment used during tank installation, testing, and closure may generate static electricity. In order to minimize such risk personnel should ground all equipment during operation.

Static changes may be formed by induction. It is not as common as other methods (with regards to USTs), but can happen.

For simplicity's sake, it can be said that bringing a charged object near another, uncharged object may result in the unchanged object becoming charged.

Like charges repel, unlike charges attract. Consider a charged rod brought near two neutral globes, touching each other.

1. Objects neutral.

2. Charged rod caused polarization to occur in spheres.

3. Separate objects, and both are charged, one positive, one negative.

REDUCING STATIC ELECTRICITY AND SPARKING

Two effective methods:

- Bonding equalizes static electricity by creating a conductive connection between two entities (e.g., UST and tank truck).

- Grounding diverts static electricity into the earth to eliminate its buildup.

Bonding and grounding are two effective methods to reduce the potential for electrostatic charge generation and sparking, and the subsequent potential for fires and explosions.

Bonding entails running a conductive line from one metal object to another. This equalizes static electricity by creating a conductive connection between two entities which lessens the likelihood of sparks jumping from metal to metal. Cargo tanks should be electrically bonded to the fill stem, piping or steel loading rack. Also, all metal parts of the fill pipe assembly should form a continuous electrically conductive path downstream from the point of bond connection.

NOTES

Bonding ensures that individual components of a system do not build up charges. In essence, you slow down the charge buildup by distributing it over a bigger area. However, the entire bonded system will eventually build a significant charge. Bonded systems should also be grounded.

Grounding entails running a conductive line from a metal object to the ground. This will dissipate any charge on the outside surface of the tank by having it flow into the ground.

FIRE AND EXPLOSION POTENTIAL

The threat of fire and explosion is most prevalent when handling and transferring petroleum products during the following UST-related activities:

- Tank/Pipe Installation/Upgrade
  - Explosion can occur during pressure testing.
- Petroleum Release Investigation
- Leak Detection Testing
  - Presence of leaking products or vapors.
- Installation of Monitoring Wells/Sampling
  - Drilling into buried utility lines.

Assuming an UST is well maintained, the greatest fire and explosion hazard occurs during the transfer of the product to or from storage and during the cleaning and removal of USTs.

Although the handling and transfer of petroleum products has been safely undertaken for decades, UST workers should not believe that this transfer is risk- and hazard-free.

The transfer of flammable and explosive products (liquids and vapors) may occur during tank testing or repair, tank upgrades, tank closure or removal, tank refilling or corrective actions. UST workers should be aware of the risks associated with these activities.

Due to the danger of violent rupture, use extreme caution when performing pipe and tank testing during tank installation. Do not pressure test any piping or tanks that contain flammable or combustible liquids. Do not exceed internal tank pressures of 5 pounds psig

during pressure testing. Install a pressure relief valve at 6 pounds psig. Use a pressure gauge with a range of 10-15 psig, and test both the inner and outer shells of double-wall tanks. Avoid standing near endcaps of an UST during pressure testing. The endcaps are the most vulnerable to explosion.

FIRE AND EXPLOSION POTENTIAL (continued)

- In-Place Tank Closure
  - Presence of product or vapors while draining the tank.
- Tank/Pipe Removal
  - Even though vapors are removed, product may still be trapped in sludge.
- Used Tank/Pipe Disposal
  - Vapors can still be regenerated from inert or purged tank.

Whether a tank is to be removed from the ground, or closed in place, product trapped in the sludge at the bottom of the tank or absorbed in the tank wall, or trapped under the scale, is a continuous source of vapor regeneration. Cleaning the tank will decrease the amount of vapor regeneration.

After the tank is purged or inerted, to make it safe for handling, the sludge can be washed to one end of the tank and pumped out while the tank is still in the excavation. If the scale is stubbornly caked on, the contractor may have to enter the tank for manual cleaning. Make sure appropriate safety procedures are followed, and a continuous stream of fresh air is introduced into the tank. Make sure the contractor blocks the tank to prevent any movement. If tank sludge contains sufficient lead or other substances to be considered a hazardous waste, dispose of it in an environmentally approved manner consistent with the Resource Conservation and Recovery Act (RCRA).

Tanks should be removed from the site as promptly as possible after vapor-freeing procedures have been completed, preferably the same day. If the tank remains onsite overnight or longer, additional vapor may be regenerated from any liquid, sludge, or wall scale remaining in the tank. Regardless of when they are removed, tanks should be checked with an explosimeter prior to movement/handling, to ensure that 20% of the LEL is not exceeded.

If a leak has occurred, contaminated soil and free product will also generate vapors outside of the tank. An explosimeter should be used to check explosive levels in the excavation as well as in the tank itself.

Table 4-2 provides examples of actual accidents that have occurred during the handling and transfer of petroleum products.

Table 4-2
ACCIDENTS INVOLVING HANDLING AND TRANSFER OF PETROLEUM PRODUCTS

Some reported accidents involving the handling and transfer of petroleum products are presented below. Notice that a large number of accidents occur during closure:

Explosion in Tank "Deemed Safe" Kills One

Georgia, 1990 — A Snellville, GA, man died April 17 when a 10,000 gallon underground gasoline storage tank exploded at Dry Storage of Georgia. The tank was deemed safe ½ hour before the explosion occurred. The worker was a five-year employee of Westinghouse Environmental and Geotechnical Services, a company that specializes in removing underground tanks. This is the third death in Georgia in less than a year involving a tank closure.

Worker Dies in "Preventable" Accident

Tulsa, 1990 — An underground storage tank explosion killed a worker and blew out the windows in nearby stores. The explosion occurred when two workers were attempting to cut a fill pipe from an UST created a spark that ignited the gasoline vapors. The ensuing blast blew the 5-ft end off the tank. The flying metal disk traveled 20 ft and decapitated a co-worker who was returning to the job site from a convenience store located across the street. A Tulsa Fire Department spokesman characterized the incident as "a highly preventable accident."

Worker Dies from Trauma Following Explosion

Tulsa, 1990 — An explosion in an empty gasoline storage tank killed a worker as he was dismantling it with an acetylene torch. According to authorities, the steel tank had been removed from ground the week prior to the explosion and a substance was placed in it to help ventilate fumes. The plumbing company returned to begin dismantling the tank, assuming it to be free of fumes. The 2,000-gallon steel tank exploded when the worker, employed by the plumbing contractor, applied an acetylene torch to it. The end of the tank blew out and propelled the worker backwards about 25 ft, where he hit a building. The man died, apparently from trauma suffered when thrown by the explosion. In addition, a building on the property and a truck owned by the plumbing contractor were damaged.

Explosion Crushes Worker

Indianapolis, 1990 — Employees of a company which collects empty tanks and cuts them up into scrap metal, were in the midst of purging vapors and cutting tanks when the accident occurred. A worker was using an acetylene torch to cut a tank when an adjacent tank exploded, pushing it 6 ft forward into the one he was working on. The worker was crushed between the tank he was working on and a wrecker parked nearby. Investigators suspect that the tank that exploded either had not yet been cleaned or had been cleaned improperly.

Table 4-2 (cont.)

Self-Employed Scrap Iron and Metal Dealer Killed While "Scrapping" an Abandoned Underground Storage Tank **The man was working along and using an acetylene torch to cut the tank into scrap when the flame from the torch ignited fumes inside the tank and touched off an explosion. The force of the blast lifted the 10,000-gallon tank into the air, sending it about 50 ft from its initial spot. A tank was blown about 450 ft into a nearby field.** **The tank measuring 20 ft by 10 ft, was reportedly used for underground storage of residential heating oil. However, individuals at the accident scene speculated the tank actually contained gasoline or gasoline residue, and that fumes from the gasoline ignited. The victim's brother said the worker was experienced in cutting scrap metal and "knew better than to cut up a gas tank."**
A Man Working for a Firm in Ohio that was Retained to Sandblast an Underground Storage Tank Dies **He turned on an electric vacuum cleaner as he prepared to clean sand from the tank bottom. A spark from the vacuum cleaner ignited the vapors inside the tank, causing it to explode. He died later as a result of the burns suffered in the blast.**
Four-Man Crew Cutting the Top Off an Empty Tank at Kerr-McGee's Cotton Valley Refinery **A piece of equipment apparently ignited vapors inside the tank. The blast killed three men inside the tank; the fourth man had left the tank to get some tools and escaped unharmed.**
Two Employees Remove Suction Pump from a Pump Island **They proceeded to break out the concrete inside the island in order to relocate the product line. Instead of capping the exposed line, they stuffed a rag in it to keep the dirt and broken concrete out. While cleaning the island with shovels, a spark was created which ignited the fumes coming through the rag. The rag immediately caught fire and burned until the employees smothered it with dirt. They were fortunate not to have had an explosion and in the future, will cap or plug all exposed lines.**
Oregon Tank Workers Places Lighted Rag Down a Fill Pipe to Determine if the Tank Contained Vapors **The tank did contain vapors and an explosion resulted.**

FIRE EXTINGUISHERS

Class "A" Extinguishers

- **For common combustibles (paper, wood, plastic, fibers, etc.).**
- **Rated by comparison to 1 gallon of water; thus, a 4A extinguisher is as effective as 4 gallons of water.**

Class "B" Extinguishers

- **Are for burning liquids and gases (LPG, paint, acetylene, gasoline).**
- **Are rated by the size of fire that a novice can extinguish. A 10B rating means a novice can extinguish 10 ft^2 of burning liquid.**

Class "C" Extinguishers

- **Are for fires involving energized electrical equipment.**
- **Are typically classed "AC" or "BC" depending on what kinds of materials (paper vs. liquid) are involved in the electrical fire.**

Class "D" Extinguishers

- **Are for fires involving combustible metals (magnesium, aluminum powder).**

Carbon Dioxide Extinguisher

This extinguisher has a smothering effect on fires. It is effective on Class B and Class C fires. It is a nonconductor of electricity. Due to its construction, the extinguisher should be used in an upright position as opposed to laying on its side. The 15-pound CO_2 extinguisher will last approximately 20-30 seconds with an effective range of 6-8 feet.

Operation of the Carbon Dioxide Extinguisher

a) **Remove the pin. (Place left hand on extinguisher neck, pull pin with right hand.)**
b) **Remove nozzle from clip or adjust nozzle on smaller units to desired angle.**
c) **Direct at base of fire, advance toward fire, press trigger.**
d) **Start at edge of fire, use sweeping motion.**
e) **Continue applying CO_2 to prevent flashback.**
f) **Do outside - keep wind to your back.**

The Dry Powder Extinguisher

This extinguisher has a smothering effect on fire. It is a good extinguisher on Class B and Class C fires. It is a nonconductor of electricity. The 20-pound extinguisher will last approximately 20 seconds. The dust cloud may extend up to 20-25 ft but best effective range is 10-15 ft or closer. Powder is made up predominately of sodium bicarbonate. It is propelled by a cartridge of inert gas, usually CO_2. If fire is in an area where machinery or product may be damaged by the dry powder, a CO_2 extinguisher may be a more desirable extinguisher if there is a choice.

Operation of a Dry Powder Extinguisher

a) Pull pin by holding extinguisher with left hand, pull with right.
b) Remove nozzle from clip.
c) Push lever down to break seal in cartridge.
d) Direct at base of fire.
e) Squeeze handles together and apply with a sweeping motion.
f) Continue application to prevent flashback.
g) If outside - keep wind to your back.

Pressurized Water Extinguishers

Operates under air pressure. This extinguisher carries approximately 125-190 pounds pressure on the gauge. Contains 2½ gallons of water. Effective range up to 30-40 ft. Used on Class A fires only. Can make a spray by using fingertip over nozzle to deflect water.

Operation of Pressurized Water Extinguisher

a) Pull pin, hold extinguisher with left hand, pull pin with right.
b) Remove nozzle from the clip.
c) Direct at base of fire.
d) Squeeze trigger.

FLAMMABLE AND COMBUSTIBLE LIQUID

When tanks of flammable liquid are leaking, fire may occur if the contained liquid has a flash point below 100°F(38°C).

The flash point of a liquid is the lowest temperature at which the vapor given off by the liquid will mix with air above the surface of the liquid to form an ignitable mixture. It is not the liquid that burns but the vapor. The possibility of ignition is the greatest for liquids having low flash points. The lower the flash point, the greater the probability that the temperature of the liquid or the atmospheric temperature will be materially higher than the flash point of the liquid. The higher the temperature, the greater the amount of vapor formed and the greater the hazard. Quite frequently, when leakage occurs in an accident ignition is caused instantly by friction sparks.

Combustible liquids have flash points between 100°Fand 200°F(38°C and 93°C). They are more difficult to ignite than flammable liquids, but once ignited, burn very well. On very hot days, low flash point combustible liquids may evolve enough vapor to require handling as a flammable liquid. For example, temperatures in confined spaces may be substantially higher than the ambient temperature, thereby causing vaporization of residual liquid.

If fire occurs, immediately:

1. **Rescue injured persons.**

2. **Pull away any other vehicles that are movable and not burning.**

3. **Dig holes or build earthen dikes in the path of burning liquid to limit the fire area and thus protect adjacent property against fire damage.**

4. **Control fire to protect property but do not extinguish it until all spilled material has burned. If exposures require fire be controlled, consider the use of foam to reduce intensity. An extinguished fire will create a flammable vapor hazard. Water streams are likely to float the liquid and spread the fire.**

5. **Watch all tanks in the fire for evidence of bulging or the appearance of red "hot spots" in the metal, which are an indication that the strength of the steel at such spots is being reduced by heat to a point where it cannot hold the pressure maintained in the tank. The hot spots are caused by a flame playing against the shell of a tank car. Keep all persons away because if the metal fails, a stream of burning liquid or vapor may be projected many feet. Water streams applied at point of flame impingement will prevent development of hot spots if sufficient water can be applied. If water streams are used to cool tanks while hazardous materials are in the area, runoff should be controlled to limit environmental damage.**

Do not puncture or rupture the shell of a tank involved in a fire. Puncture or rupture will increase the seriousness of the situation since any opening made in a tank will liberate more flammable liquid and extend the fire. The safety valves on tank vehicles are designed to limit internal pressure to much less than the designed bursting pressure of the tank, provided the valves are not buried or so obstructed that they cannot open. When a tank is in a position so that safety valves are buried, if it is safe to do so an effort should be made to roll it into a position where the valves are able to function properly.

When vapors are burning at the safety valves do not extinguish the flame, or else the leakage from the valves may spread over a large area and ignite, causing a sudden violent flash fire that may do great damage. It is safer to let the vapor burn at the valves or point of leakage.

If the fire does not occur immediately in an accident, the hazard of a leak of flammable liquid is greater than when fire occurs immediately. The vapor given off by flammable liquid will spread over a large area and will travel faster, especially with the wind, than the liquid will flow. Vapor cannot be confined, will ignite upon contact with any spark or flame, and will flash back to the surface from which the vapor originated. After such a flash of fire the vapor burns above the surface of the liquid.

Guard against the hazards that exist as long as leakage is not on fire:

1. **Extinguish all fires and smoking materials in the vicinity. When lights are necessary, use only permissible electric flashlights. Keep internal combustion engines out of the flammable vapor area. Use an explosimeter to determine the boundary of the LEL of the flammable vapors.**

2. **Keep all unauthorized persons out of the area.**

3. **Dig holes or trenches or build earthen dikes in the path of flowing liquid surface from which vapor can be given off.**

4. **Cover the liquid with sand, dirt, or appropriate foam to blanket the surface and reduce the rate of evaporation. The vapor of most flammable liquids is heavier than air and forms a layer along the ground which mixes slowly with the air. The mixing with air is increased by wind. The vapor flows along the ground following the slope of the ground and settles in low places sheltered from the wind. It will not drift or flow against the wind but may travel a considerable distance with the wind. Vapors can be dispersed by spraying with water as a fog.**

5. **Do not permit liquid to drain into sewers since vapor arising from it may become ignited at some point far distant from the leak, causing serious damage to life or property. Do not permit liquid to drain into water sources. Water thus contaminated may cause environmental harm.**

6. **Locate all leaks and stop them if possible. Nonmetallic plugs are useful for this purpose.**

7. **Wrecking operations or transfer of contents of tanks of flammable liquid should not be attempted until all vapors are dispersed. Cutting torches must not be used on tanks either empty or loaded. Many liquids regarded as safe under ordinary conditions and transported as combustible or nonregulated materials should be treated as dangerous in an accident. An empty or partially empty tank with or without placards is very likely to contain a vapor-air mixture that may ignite. Fumes in any empty tank should be considered as injurious to a person entering it. An empty tank should not be entered before it has been cleaned by steaming and checked for residual vapors. When using cutting torches care must be exercised to avoid contact with leakage or ground saturated with even such materials as lubricating oils, asphalts, other petroleum products, vegetable oils, and animal fats, for they can be ignited and will burn fiercely.**

8. **Move to safety the least-damaged vehicles. Avoid sudden shocks or jars that might produce sparks or friction. No unnecessary attempt should be made to move a damaged tank from which flammable liquid is leaking.**

9. **As a last resort, a tank may be moved by dragging, preferably on a bed of foam. All persons should be kept at a safe distance, determined by combustible gas detector measurements. When leaks are expected in handling, empty the tank first by transfer of contents and make inert with nitrogen or other noncombustible gas.**

MODULE 3

ELECTRICAL HAZARDS/SAFETY

POTENTIAL FOR ELECTROCUTION

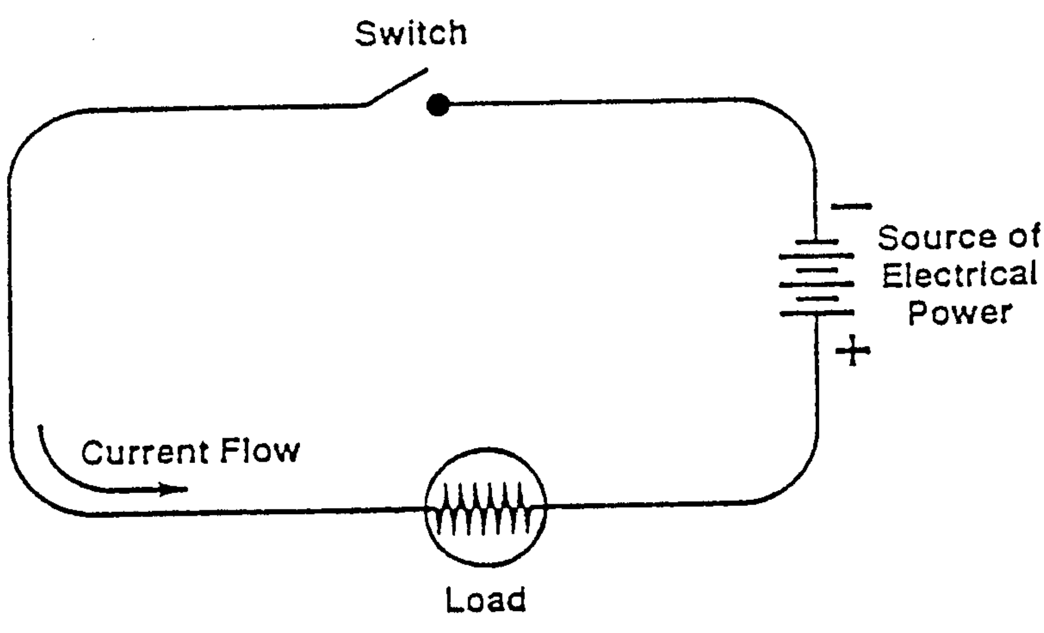
- **Tank/pipe installation and removal**

  - Contact with overhead electrical power lines
  - Striking underground utility lines

- **Petroleum release investigation**

- When drilling in the soil for sample collection, danger of hitting utility lines.

SIMPLE ELECTRIC CIRCUIT



DEFINITIONS

VOLTAGE is the electrical potential difference, or the electromotive force between two points in an electric circuit. If an analogy were drawn between electric current flow and water flow, the voltage would be the liquid pressure.

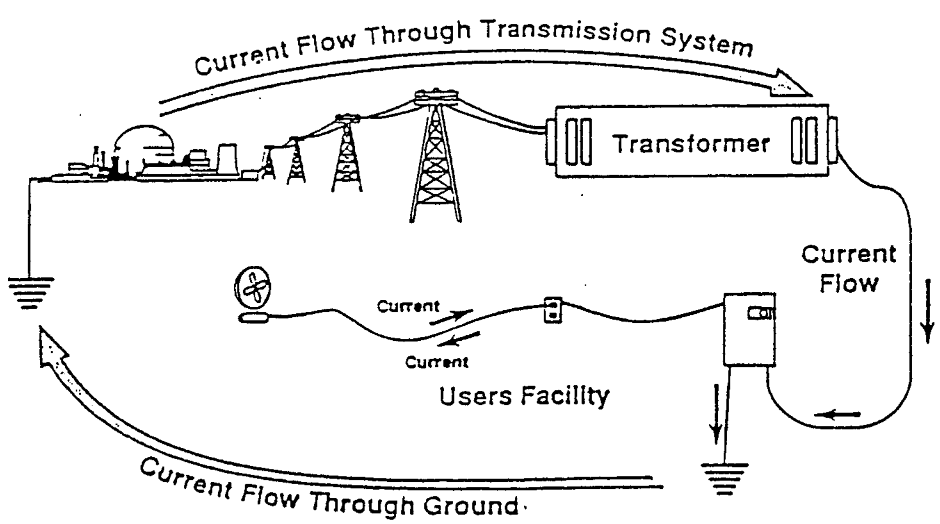
AMPERAGE is the rate of flow of electricity in a conductor.

ELECTROMAGNETIC FIELDS are the influence resulting from the flow of electric current in a conductor or the changing of magnetic influence on a conductor. These fields can be generated by both electric current flow in wires or by movement of a magnet in the vicinity of conductors as occurs in a generator.

CURRENT FLOW is the transmission of electrons through a conducting medium. The medium may transmit current with little resistance and be a "conductor" or it may offer resistance to flow and be an "insulator."

INSULATOR is a material which offers great resistance to the flow of electric current flow. Normally when a material is an insulator it is considered not to allow current to flow. This naturally has its limits.

ELECTRIC DISTRIBUTION SYSTEM

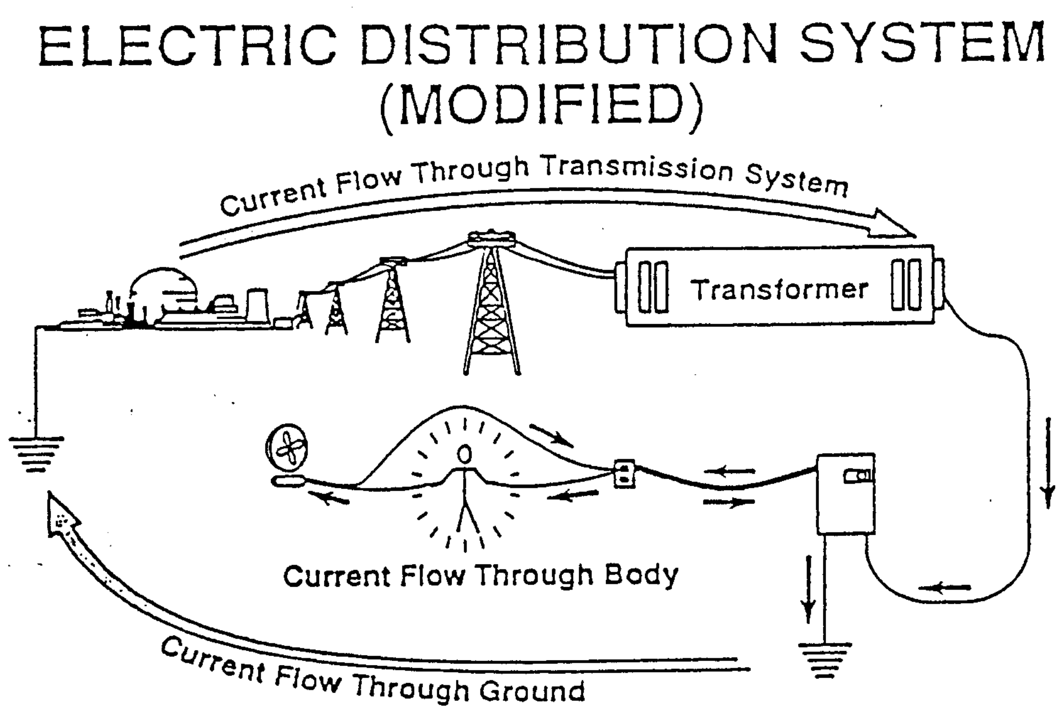


MOST COMMON WAYS TO RECEIVE ELECTRIC SHOCK

1. **Body contact with two energized wires, forming a complete electrical circuit.**

2. **Body contact with one energized wire and with ground, forming a complete electrical circuit.**

3. **Body contact with a metallic object which has become energized by contact with an energized wire, and body contact with ground, forming a complete electrical circuit.**



PHYSIOLOGICAL RESPONSE TO ELECTRIC SHOCK

DEATH

BURNS (Electric and thermal)

PARALYSIS of arm muscles on a conductor, "LOCKED ON"

RESPIRATORY BLOCK - Asphyxiation by interruption of nerve control of respiratory muscles

SHOCK

FIBRILLATION OF HEART

DISRUPTION OF NERVOUS SYSTEM. This can be throughout the system.

CARDIAC BLOCK - Interruption of nerve control of heart muscles

FACTORS AFFECTING PHYSIOLOGICAL RESPONSE TO ELECTRIC SHOCK

1. **Amount of electric current passing through the body (amperage).**
2. **Duration of the electric shock.**
3. **Path of the current through the body.**
4. **Type of electric current.**
5. **Physical condition of the individual.**
6. **First aid administered to the victim.**

FIRST AID FOR ELECTRIC SHOCK

1. **REMOVE VICTIM FROM ELECTRIC CIRCUIT.**

    a. **Determine if pulse is regular or fibrillating.**

    b. **Determine if victim is breathing.**

2. **IF VICTIM IS NOT BREATHING.**

    a. **Start mouth-to-mouth resuscitation.**

    b. **Continue resuscitation UNTIL the victim resumes regular breathing or is pronounced dead by a physician.**

3. **IF VICTIM'S HEART BEAT IS NOT REGULAR.**

    a. **Start cardiac compression of the chest to force the blood out of the heart.**

    b. **Cardiac compression should continue alternately along with mouth-to-mouth resuscitation.**

4. **CALL FOR HELP — DIAL 911.**

THRESHOLD RESPONSES TO ELECTRIC SHOCK

CURRENT	PHYSIOLOGICAL RESPONSE	CURRENT USES
1 mA	Perception threshold	
1-3 mA	Mild sensation	
10 mA	Paralysis threshold of arms	
30 mA	Respiratory paralysis	
75 mA	Fibrillation threshold 5%	
250 mA	Fibrillation threshold 95%	25w light bulb, 120v
4 A	Heart paralysis threshold	
5 A	Tissue burning	Current use of hand drill
12.5 A		Current use of toaster
25-200 A		Electric arc welder
200 A		Household service entrance current

PHYSIOLOGICAL RESPONSE TO ELECTRIC SHOCK

Physiological Effect	Direct Current (mA)	Alternating Current (mA) 60 cycles	10,000 cycles
Slight tingle	5.2	1.1	12
Shock - felt	9	1.8	17
Shock - painful	62	9	55
Let-go threshold	76	16	75
Muscular contraction	90	23	94
Ventricular fibrillation (3.0 sec duration)	500	100	500
Ventricular fibrillation (0.3 sec duration)	1300	1000	1100
Ventricular fibrillation Death (sustained)	1400	280	1400

HAZARDS RESULTING FROM ELECTRIC USE

SHOCK

FIRE

BURNS (electric and thermal)

IGNITION of hazardous atmospheres

CUTS from equipment fragmentation

FALLS from fear or involuntary muscle contraction

BLINDNESS from electric arc

INDUCTIVE CURRENT EFFECTS

ELECTRIC HAZARD DIFFERENCES FROM CURRENT TYPES

VOLTAGE

Voltage generally makes little difference in shock-type injuries. Amperage of the current is the dominant issue. When voltage is low the bodily resistance of the tissues will limit the current flow. Once the voltage exceeds the body's resistance and allows significant current flow, increased voltage has little affect.

AC vs. DC CURRENT

AC or alternating current has a much greater physiological impact on the muscle tissues. The rapid changing of polarity results in rapidly changing electromagnetic fields which disrupt the nervous electrical signals. These field changes also cause pain in the muscles. DC or direct current does not normally cause these changes in electric fields and therefore normally requires higher current to cause the same response.

FREQUENCY

Lower frequencies (60 cycles) have greater physiological responses in low amperage currents. As frequency increases to 10,000 cycles the response levels approach those of DC current.

CAUSES OF ELECTRIC ACCIDENTS AND INJURY

1. Unsafe electric equipment and installation.

2. Improper application of electric equipment.

3. Improper use of electrical equipment in hazardous atmospheres.

4. Use of normal equipment when hazardous atmospheres have been created around the equipment.

5. Unsafe work practices.

METHODS OF ELECTRICAL PROTECTION

INSULATION

Insulation of conductors, physical separation, insulation of tools.

GUARDING

Isolation of electrical equipment and switch gear from work areas, enclosing electrical connections in metal boxes, installation of electrical conductors in conduit or cable trays.

MECHANICAL DEVICES

Circuit breakers, ground-fault circuit interrupter (GFCI), switches.

SAFE WORK PRACTICES

Lockout-tagout procedures, hazard signs, color coding of conductors, training.

SAFE DISTANCES FOR CRANES AND BOOMS FROM ELECTRIC LINES[1]

<50 Kv	**10 feet**
>50 Kv	**10 feet + 0.4 inches/Kv above 50 Kv, or twice the length of the insulator but never less than 10 feet**
12 Kv	**10 feet**
69 Kv	**10 feet 8 inches**
120 Kv	**12 feet 4 inches**
500 Kv	**25 feet**

[1]29 CFR 1910.180(j) and 1910.333(c).

PURPOSE OF LOCKOUT-TAGOUT PROCEDURE

This procedure establishes the minimum requirements for the lockout or tagout of energy-isolating devices. It shall be used to ensure that the machine or equipment is isolated from all potentially hazardous energy, and locked out or tagged out before employees perform any servicing or maintenance activities where the unexpected energization, start-up, or release of stored energy could cause injury.

OTHER PHYSICAL HAZARDS

In addition to the areas already discussed, evaluation of a UST work site should consider the following potential hazards:

1. TEMPERATURE

Extremely hot or cold temperatures can present problems for workers. For example, if a confined space has been steamed, it should be allowed to cool before entry is made.

2. ENGULFMENT HAZARDS

Loose, granular material stored in bins and hoppers, such as grain, sand, coal, or similar material, can engulf and suffocate a worker. The loose material can crust or bridge over in a bin and break loose under the weight of a worker.

3. NOISE

Noise within a confined space can be amplified because of the design and acoustic properties of the space. Excessive noise cannot only damage hearing, but can also affect communication, such as causing a shouted warning to go unheard.

4. SLICK/WET SURFACES

Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface will increase the likelihood for and effect of electric shock in areas where electrical circuits, equipment, and tools are used.

5. FALLING OBJECTS

Workers in confined spaces should be mindful of the possibility of falling objects, particularly in spaces which have topside openings for entry, and where work is being done above the worker.

6. RADIATION

UST workers may encounter sources of radiation on industrial or disposal sites. A check for radioactivity should always be made where complete site history is not known and site has not been characterized.

7. COMPRESSED GAS CYLINDERS

Consult Compressed Gas Association (CGA) requirements - those are referenced by Federal OSHA in 29 CFR 1910.101, the Compressed Gases (General Requirements) Standard

Requirements	**CGA Citation**
routine visual inspection by employer	**pamphlets c-6-1968 and c-8-1962 (also DOT regs.)**
in-plant handling, storage, proper restraints, etc.	**pamphlet p-1-1965**
safety relief devices	**pamphlet s-1.1-1963 and s-1.2-1963**

According to CGA code, the following items are specified for each type of compressed gas:

* **cylinders of specific size, general shape and pressure rating**
* **fittings (pipe threads) cut so that no other gas fitting can be connected, valves of different design, construction**
* **cylinders of specific color, markings and labeling.**

Also, gases are rated according to standards of purity

Gas cylinders must be properly stored and restrained - also for transport (see DOT regulations)

Some gases are compressed at high pressures ($\geq$2,000 psi) such as breathing air and oxygen. This poses two hazards:

1. **Explosion, and**
2. **The cylinder could very suddenly become a very high speed airborne projectile, i.e., a missile, if there is a sudden, rapid loss of pressure through a broken stem valve. (Gas cylinders such as SCUBA tanks have been known to fly several hundred feet through the air at high speeds, passing through the walls of buildings before they stop, and causing tremendous destruction.)**

Finally, gas cylinders should be stored in a cool, dry place out of direct sunlight.

A standard 330-ft^3 cylinder pressured to 2,640 psi can, after a cylinder valve is broken off, become a rocket attaining a speed of several miles per hour in a fraction of a second after venting from the broken cylinder connection.

The following precautions should be taken to help prevent accidents with cylinders.

1. **When storing cylinders, secure them to a wall or vertical support by means of restraining straps, chains, etc.**

2. **When moving cylinders, use a cylinder cart with a chain restraint in place. Do not drag cylinders.**

3. **Valve protection caps should be installed on cylinders at all times when not in use.**

4. **Cylinders should never be dropped or rolled in a horizontal position as the cylinder valve might be broken off.**

5. **Return leaking cylinders to personnel authorized to make repairs as soon as possible.**

6. **Segregate cylinders in storage as to type of gas, empty or full, and maintain oxygen cylinders a minimum distance of 20 ft from flammable gas cylinders, unless separated by a fire resistant wall.**

7. **Smoking is prohibited in the vicinity of cylinders containing flammable gases or oxidants.**

8. **If a cylinder protective cap is extremely difficult to remove, do not apply excessive force or pry the cap loose with a bar inserted into the ventilation openings. Attach a label or a tag to the cylinder identifying the problem and return the cylinder to the supplier.**

9. **Wrenches should not be used on valves equipped with a handwheel. If the valve is faulty, attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier.**

10. **Cylinders should be grounded properly when in use.**

NOTE: Items 1 and 2 do not apply to cylinder charging facilities.

HEAT STRESS

1. **The human body maintains a fairly constant internal temperature despite outside temperatures.**

2. **To keep the body within safe limits, the body gets rid of excess heat by:**

   - **sweating (through perspiration and evaporative cooling),**
   - **increasing blood circulation (by expanding the blood vessels and increasing heart rate),**
   - **increasing the blood flow to the skin, and**
   - **radiating heat off the body.**

3. **These automatic responses usually occur when the temperature of the body exceeds 98.6 degrees F. When the body temperature rises to the point where these responses are no longer effective in eliminating body heat, various forms of heat stress or heat illness may develop. Our individual response to hot environments depends on various factors, including:**

   (a) Individual susceptibility, which may be increased by:

   - **lack of physical fitness,**
   - **lack of acclimatization,**
   - **age,**
   - **dehydration,**
   - **obesity,**
   - **alcohol or drug use,**
   - **infection,**
   - **sunburn,**
   - **diarrhea,**
   - **chronic disease;**

   (b) Environmental factors, especially humidity and direct sunlight exposure; and

   (c) Working conditions, such as:

   - **the duration of the work day,**
   - **the use of personal protective equipment, and**
   - **the amount of break time to rest and replenish body fluids.**

All of these factors exert a strong influence on our response to hot work environments.

HEAT ILLNESSES

1. **HEAT CRAMPS**

- Problem:

- **Cramping of legs and abdominal muscles**
- **Heavy sweating and water loss**
- **Strenuous activity in warm environment**

- Treatment:

- **Rest in cool shady place**
- **Light stretching and massage**
- **Fluids to replace water loss**

2. **HEAT RASH**

- Problem:

- **Skin remains wet (i.e., hot, humid environments)**
- **Sweat ducts become plugged**
- **Rash develops**

- Treatment:

- **Rest in cool area**
- **Regularly dry skin**

3. **HEAT EXHAUSTION (RARELY FATAL)**

- Problem:

- **Pale clammy skin**
- **Profuse perspiring**
- **Rapid shallow breathing**
- **Weakness, dizziness, and headache**

- Treatment:

- **Treat for shock**
- **Place in cool shady place**
- **Give fluids if conscious**
- **Restrict activity**

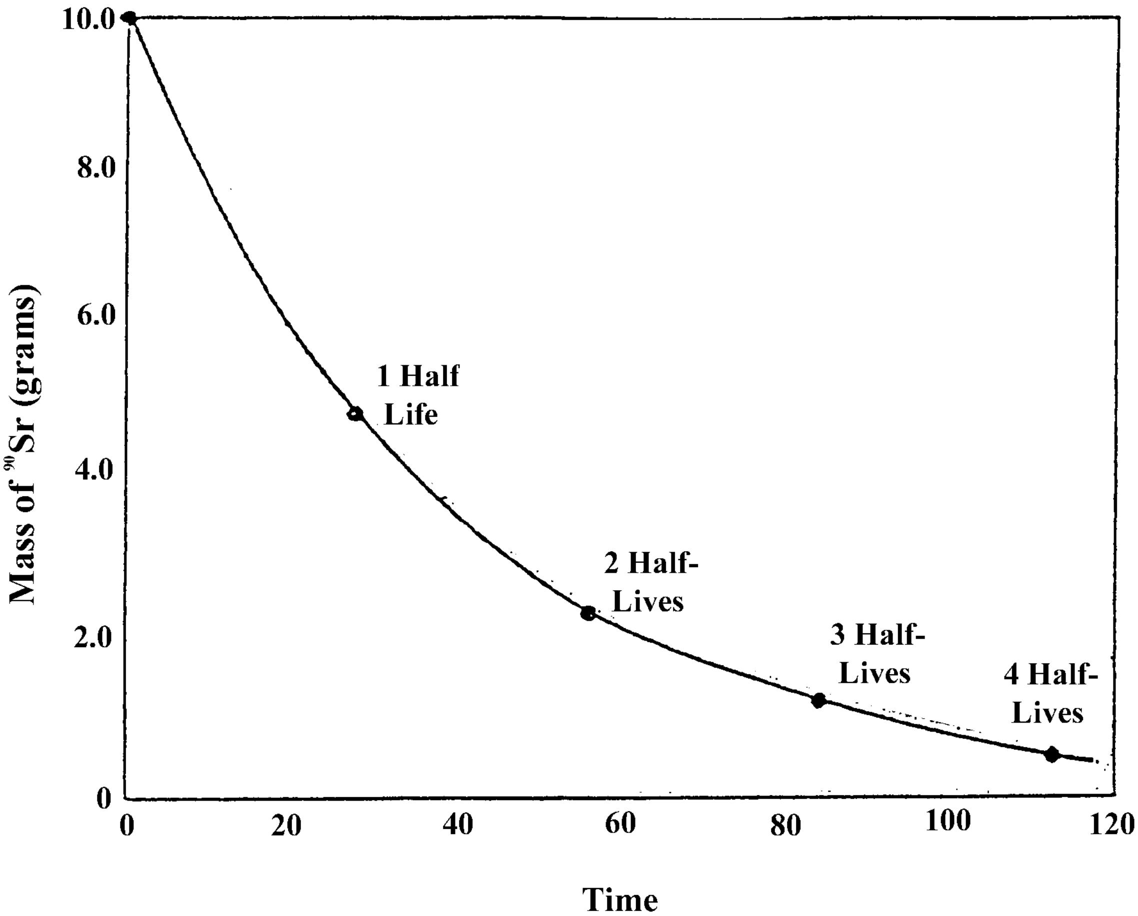
4. HEAT STROKE (CAN BE FATAL)

- Problem:

- **Face red and flushed**
- **Patient becomes rapidly unconscious**
- **Skin is hot and dry/no perspiration**
- **Body temperature is 105 degrees or higher**

- Treatment:

- **Treat for shock**
- **Get medical help ASAP**
- **Use ice, cold water and fan if available**
- **Remove to a cool place**

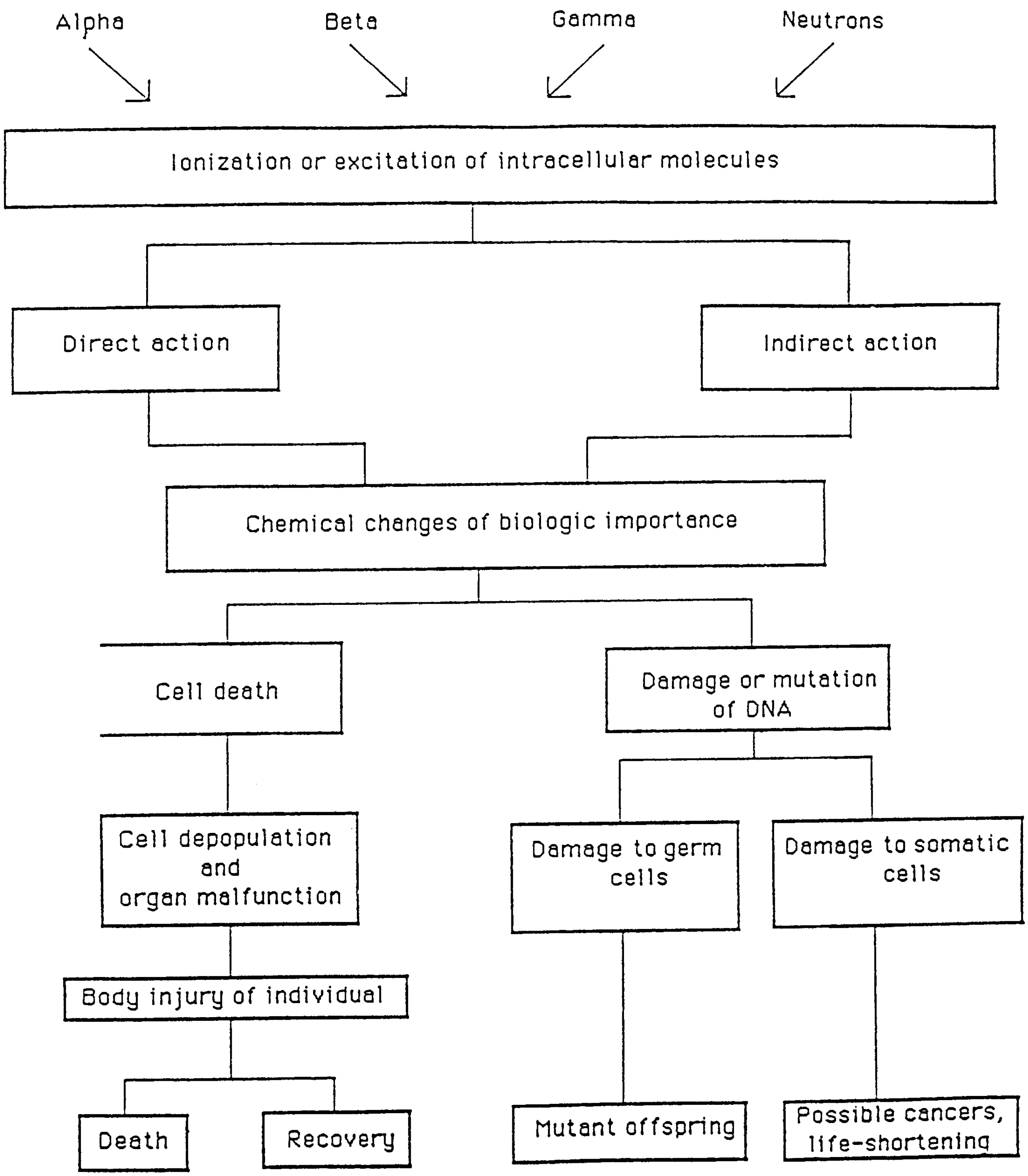


The decay of 10.0 grams of ^{90}Sr ($t_{1/2}$ =28yrs)

The following table lists just a few substances and the kind of radiation.

Type of Radioactive Sources	Alpha	Beta	Gamma	Neutron
Cesium			■	
Cobalt			■	
Europium			■	
Plutonium	■			
Plutonium-239				■
Polonium	■		■	
Radium	■		■	
Radon	■			
Reactors				■
Selenium		■		
Silver			■	
Strontium		■		
Technetium		■		
Thorium	■	■		
Tritium		■		
Uranium	■			
Uranium-235 (Fission)				■

Source: **Oil Chemical & Atomic Workers International Union, *Chemical and Radioactive Hazardous Waste Workbook*, 1990, p. 96.**


Alpha
Beta
Gamma
Neutrons
Ionization or excitation of intracellular molecules
Direct action
Indirect action
Chemical changes of biologic importance
Cell death
Damage or mutation of DNA
Cell depopulation and organ malfunction
Damage to germ cells
Damage to somatic cells
Body injury of individual
Death
Recovery
Mutant offspring
Possible cancers, life-shortening

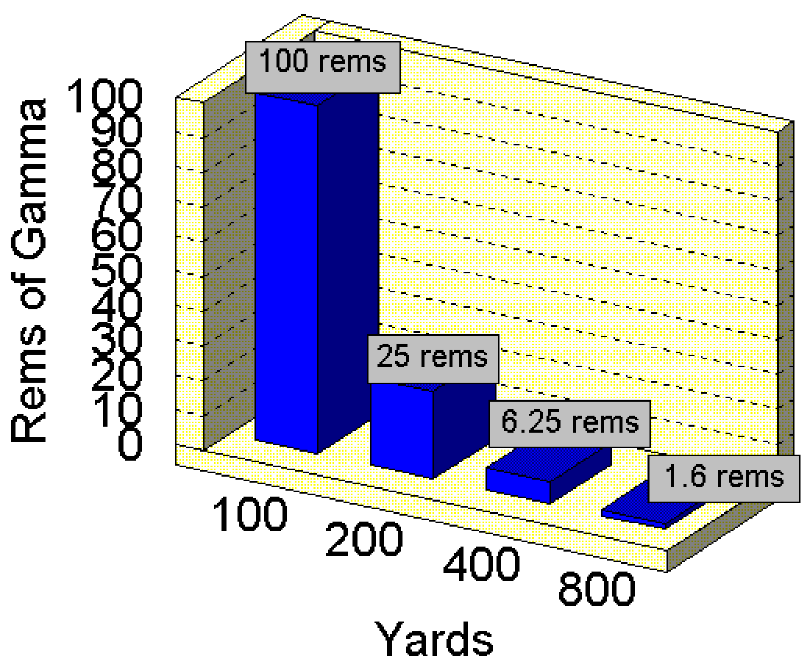
Protection from Radiation		
Radiation	**Protection**	**Biological Hazard**
Alpha	**Respirators*, Eye Protection, Coveralls, Gloves, Shoe Covers, Hoods, Etc.**	**Inhalation, Absorption, Ingestion**
Beta	**Respirators*, Shielding (Plexiglass or aluminum), Eye Protection, Time, Distance**	**Inhalation, Absorption, Ingestion**
Gamma and X-rays	**Respirators*, Shielding (heavy metals such as lead), Time, Distance**	**Penetration**

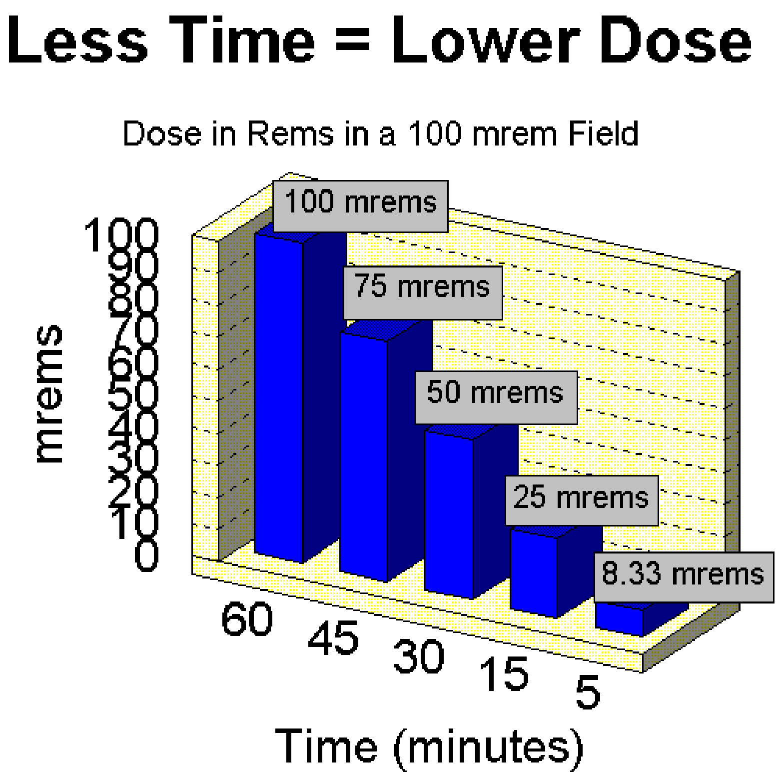
***The appropriate canister must be used with Air Purifying Respirators (APRs) and Powered Air Purifying Respirators (PAPRs). The canister should be colored magenta (purple) or have a magenta stripe on it.**

SOURCE: Oil Chemical & Atomic Workers International Union, *Chemical and Radioactive Hazardous Waste Workbook*, 1990, p. 189.

SOURCE: Oil Chemical & Atomic Workers International Union, *Chemical and Radioactive Hazardous Waste Workbook*, 1990, p. 193.

Greater Distance = Lower Dose





SOURCE: Oil Chemical & Atomic Workers International Union, *Chemical and Radioactive Hazardous Waste Workbook*, 1990, p. 193.

DOSE LIMITATIONS AND RECOMMENDATIONS

In Title: 10 CFR Part 20.101 (1993) of the NRC standards the maximum permissible dose equivalent (MPD) for occupational exposures are (above natural background and medical exposures):

OCCUPATIONAL EXPOSURE

Whole body, sum of internal and external exposure	**5 rems/yrTEDE[2]**
Any organ, sum of internal and external exposure	**50 rem/yr**
Hands and forearms, feet and ankles	**50 rem/yr**
Lenses of eyes	**15 rem/yr**
Planned special exposure (lifetime maximum of 25 rem)	**25 rem/event**
Dose to fetus during a declared pregnancy	**0.5 rem total**

Employees under 18 years of age should receive a maximum of 10% of the limits listed above.

GENERAL PUBLIC

Total effective dose to the body	**0.1 rem/yr**

In addition, the National Council on Radiation Protection (1993) recommends the following dose-limiting guidelines:

OCCUPATIONAL LIMITS

Persons under 18 years old	**1.0 rem/yr**
Dose to fetus during pregnancy	**0.05 rem/mo**

Maximum lifetime dose in rems equals the person's age in years.

EMERGENCY DOSE LIMITS: LIFE SAVING

Total effective dose to the body	**50 rem**
Skin	**500 rem**

The use of older volunteers with low lifetime accumulated dose is suggested.

DOSE LIMITS FOR MEMBERS OF THE PUBLIC

Continuous	**0.1 rem/yr**
Single individual or occasional occurrence	**0.5 rem/year**

---

[2]TEDE is the sum of DDE (whole body exposure from external sources) and CEDE (whole body exposure from internal sources). This is the total amount of radiation you receive from all sources, internal and external.

POSTING OF AREA SIGNS

EXPOSURE	CAUTION SIGNS
<2 mrems/hr and <100 mrems in any 7 consecutive days	Unrestricted area. No sign required.
>2 mrems/hr or >100 mrems in any 7 consecutive days	Control of area required.
>5 mrems/hr or >100 mrems in 5 days, to a major portion of the body	"Caution Radiation Area" sign.
>100 mrems/hr in a major portion of the body	"Caution High Radiation Area" sign.
Airborne radioactive materials exceed in average concentration 25% of the amounts specified in column 1 of Table 1 of Appendix B of 10 CFR Part 20	"Caution Airborne Radioactivity Area" sign.
In areas or rooms in which radioactive material is used or stored in an amount exceeding 10 times the quantities specified in Appendix C of 10 CFR Part 20	"Caution Radioactive Material" sign.
Each container in which transported, used, or stored a radioactive material (other than natural U or Th) in amounts greater than those specified in Appendix C of 10 CFR Part 20	"Caution Radioactive Material" sign.
Each container in which natural U or Th is transported, used or stored in quantities greater than 10 times the amounts specified in Appendix C of 10 CFR Part 20	"Caution Radioactive Material" sign.

NOISE HAZARDS

1. **TEMPORARY HEARING LOSS - Hearing is recoverable within several hours of exposure to continuous or intermittent noise (>80 dBA approx.).**

2. **PERMANENT HEARING LOSS - Some permanent, irreversible loss is experienced after chronic exposure. High frequency noise is more harmful to hearing than low frequency. Continuous noise is more harmful than intermittent.**

3. **INTERFERENCE WITH COMMUNICATIONS - Safety problems, stress and annoyance can result - these are serious and reversible problems.**

4. **MIDDLE EAR DAMAGE - May happen upon exposure to extremely loud impulse noise - sudden impulses at high volume sound in the 160 to 180 dBA range (or greater) from explosion or other impact. Physical injury (e.g., concussion or head injury) can cause the same problems.**

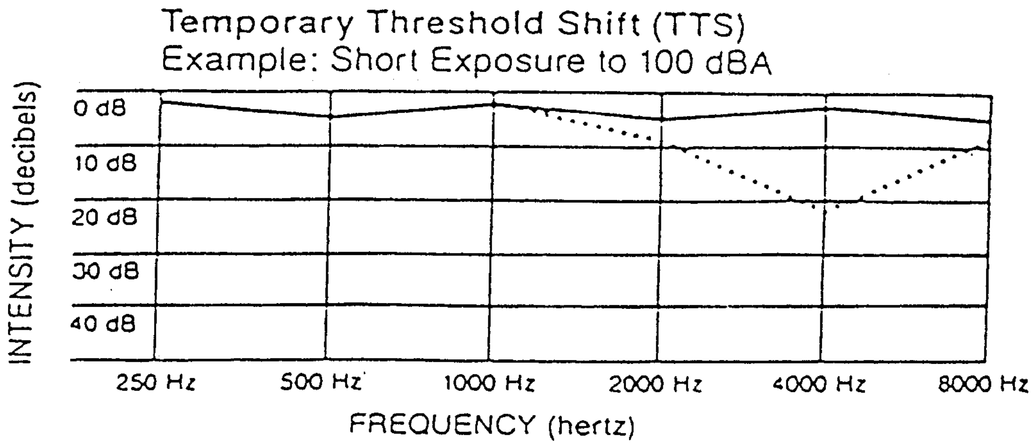
NOISE SOURCES AT THE WORK SITE

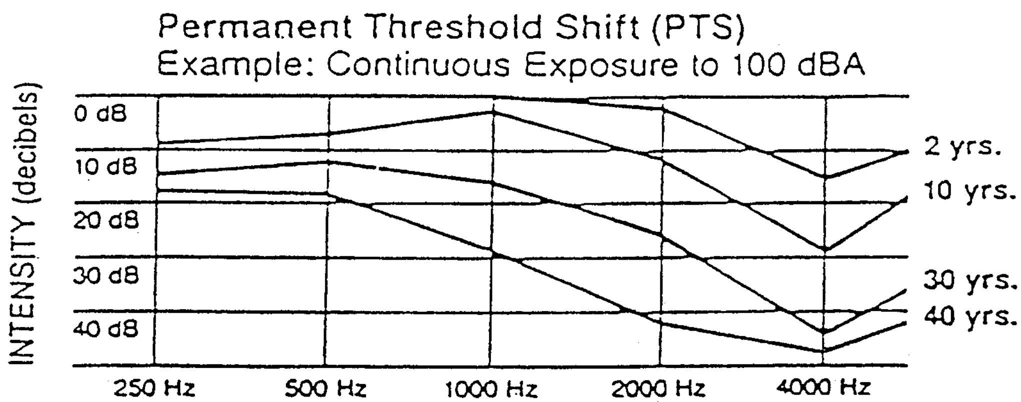
1. **DIESEL ENGINES, CONSTRUCTION & EXCAVATION EQUIPMENT**

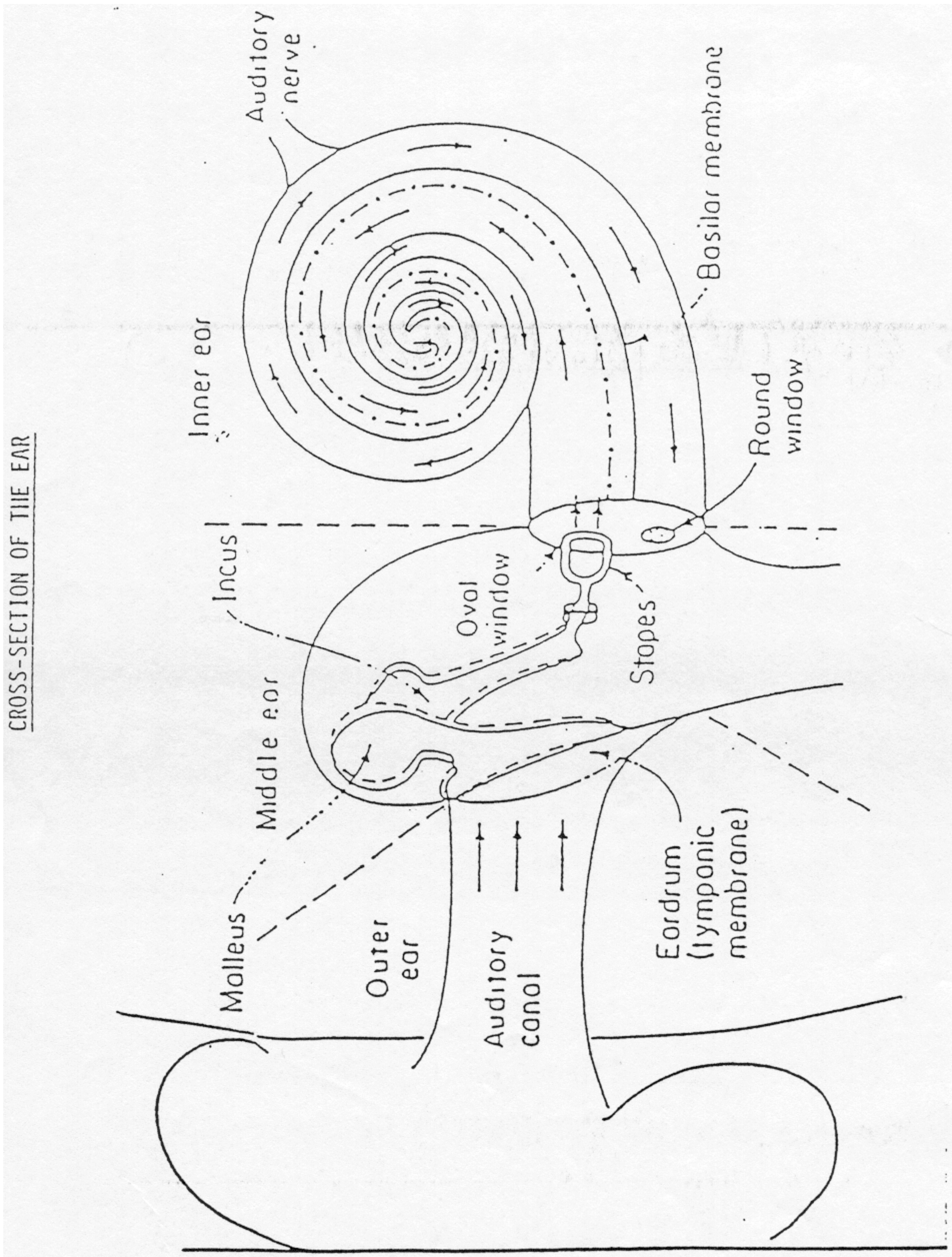
2. **ELECTRICAL MOTORS, GENERATORS, FANS, BLOWERS**

3. **DRILLING RIGS, AIR ROTARY/PERCUSSION**

4. **VACUUM TRUCKS**


Temporary Threshold Shift (TTS)
Example: Short Exposure to 100 dBA
INTENSITY (decibels)
0 dB
10 dB
20 dB
30 dB
40 dB
250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
8000 Hz
FREQUENCY (hertz)


Permanent Threshold Shift (PTS)
Example: Continuous Exposure to 100 dBA
INTENSITY (decibels)
0 dB
10 dB
20 dB
30 dB
40 dB
250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
2 yrs.
10 yrs.
30 yrs.
40 yrs.


CROSS-SECTION OF THE EAR
Auditory nerve
Basilar membrane
Inner ear
Round window
Incus
Oval window
Stapes
Middle ear
Malleus
Outer ear
Auditory canal
Eardrum (tympanic membrane)

EXAMPLES OF NOISE LEVELS

30 dBaquiet sound studio

40 dBalowest levels in city at night

50 dBaaverage residence; business office

60 dBalarge store; accounting office

70 dBaspeech; vacuum cleaner at 10 feet

80 dBainside sports car (50 mph)

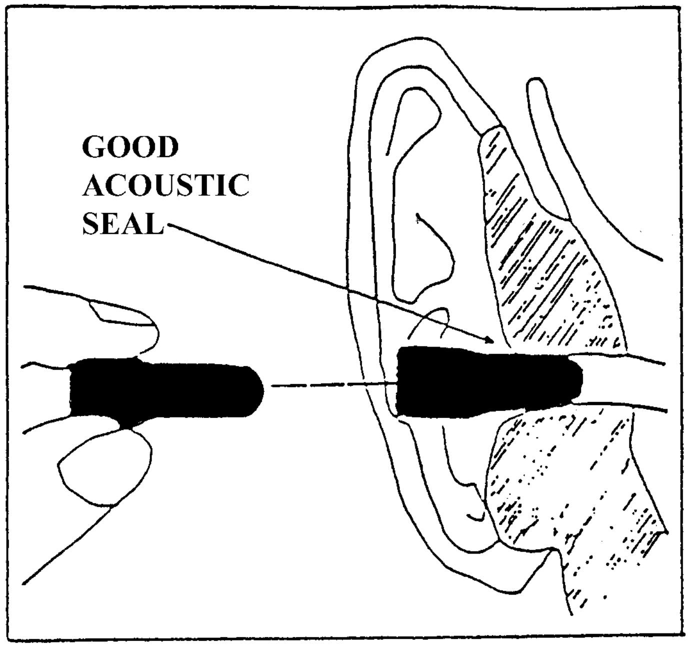
90 dBasubway train at 20 feet; printing press

100 dBa pneumatic hammer; cut off saw

110 dBa riveting machine

120 dBa jet takeoff at 200 feet

LIMITING YOUR EXPOSURE



NRR = NOISE REDUCTION RATING

PROTECTIVE EQUIPMENT	NRR
E.A.R. (FOAM) PLUGS	29 DECIBELS
EAR MUFFS (HEAD BAND WORN OVER THE HEAD)	25 DECIBELS
EAR MUFFS (HEAD BAND WORN BEHIND THE HEAD)	23 DECIBELS
EAR MUFFS (HEAD BAND WORN UNDER THE CHIN)	21 DECIBELS
KLEENEX OR TOILET TISSUE	5 DECIBELS

COMPONENTS OF A NOISE PROBLEM

1. **Engineering Controls, Work Practices and Personal Protective Equipment can be used to protect workers against noise. If a noise problem can be broken down into the 3 components below, <u>how</u> and <u>where</u> can these controls be implemented?**

<u>**SOURCE**</u>	<u>**PATHWAY**</u>	<u>**RECEIVER**</u>

I. DRILLING ON HAZARDOUS WASTE SITES

In order to characterize the nature and magnitude of soil and groundwater contamination at hazardous waste sites, it may be necessary to perform GEOTECHNICAL INVESTIGATIONS, i.e., drilling gas and groundwater monitoring wells to obtain samples of contaminated soil, groundwater, gas or landfill leachate. Samples provide information about the type and concentration of contaminants and the spread of contaminants from their original source.

Drill rigs and various kinds of supporting equipment, such as:

- **forklifts, for removing drummed cuttings**
- **trucks (vacuum trucks, fuel trucks)**
- **steam cleaning equipment - decontamination**
- **welding equipment - rig repair**
- **compressors - drive rigs or blowers**
- **air blowers - ventilate boreholes**

are complicated and powerful tools. Each presents its own set of hazards. The routine hazards are multiplied by the use of PPE by drillers, their helpers and equipment operators.

II. DRILLING OPERATIONS AND TECHNOLOGIES

Drilling groundwater and gas monitoring wells proceeds in two phases:

1. **Drilling, and**
2. **Well construction and development**

1. **Drilling - gas and groundwater monitoring wells are drilled using two common techniques:**

   a. **Direct Rotary drilling, and**
   b. **Hollow-stem augur.**

   Personnel involved:

   a. **Driller - operates drill rig controls**
   b. **Drillers helpers - assist in handling drill pipe, equipment (2 per rig)**
   c. **geologist - "logs" borehole - observes drill cuttings and borehole samples, records number of feet drilled per given time.**

<u>Direct Rotary Drilling</u>

- the borehole is drilled by a rotating bit
- cuttings removed by circulating fluid (mud slurry or compressed air) i.e., "mud rotary, air-rotary" drilling
- fluid is pumped into borehole, through parts in the drill bit and pumped up with cuttings through the annular space between drill pipe and the borehole
- fluid and cuttings exit into the "blooey tube" - 6" dia. flexible discharge hose and are deposited into a mud tank or through a cyclone into 55 gal. drums
- in soft geologic formations, steel well casing is driven into the well to prevent it from collapsing; this is also done in hard formations to prevent cross-contamination between different strata in the well - casing is driven into the ground by a large, heavy compressed-air driven hammer (on top-head drive rigs)

<u>Making a Connection</u> - connecting new pipe section

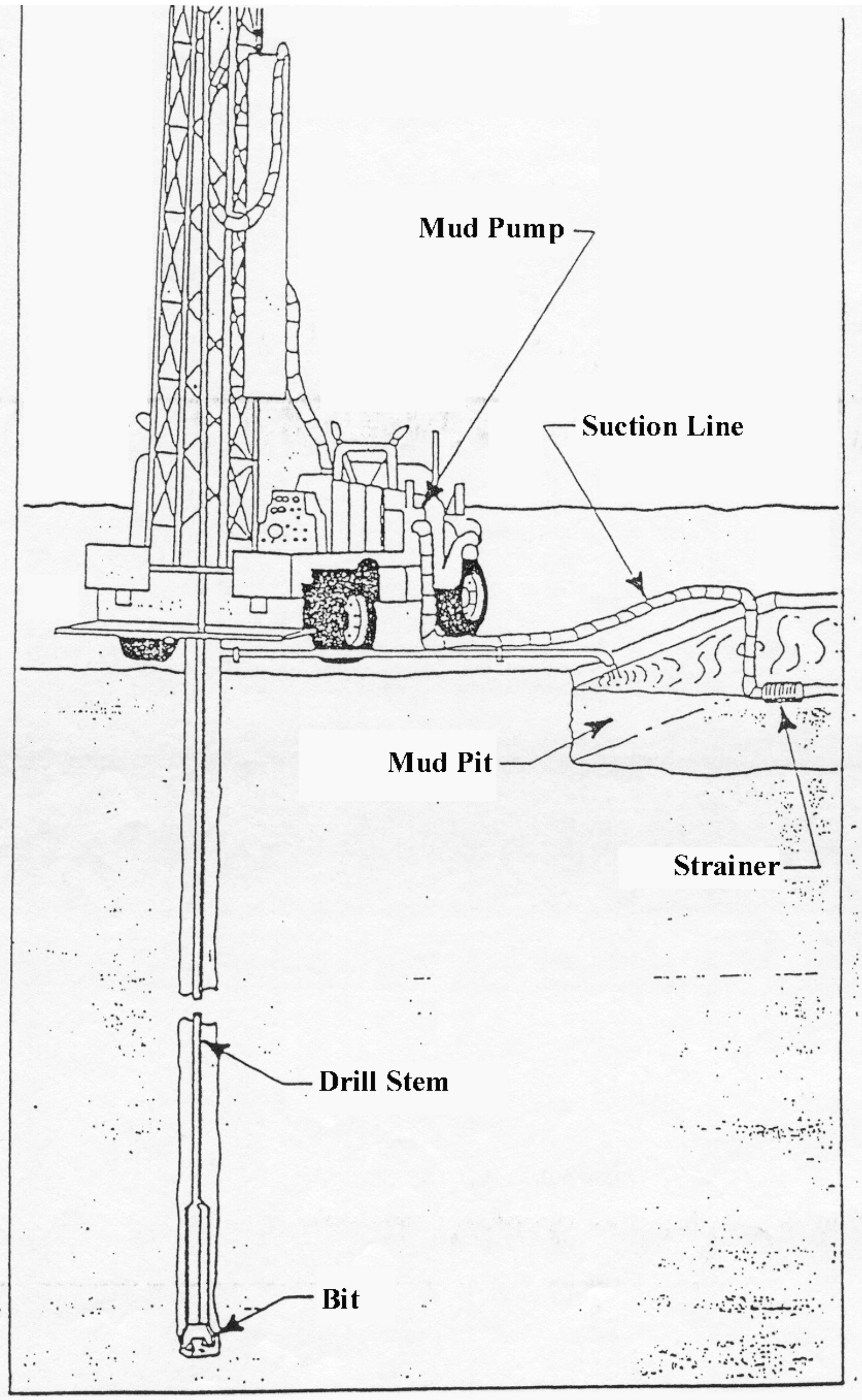
- can be very hazardous, requires drillers helper(s) to climb mast to guide new section of pipe onto top of drilling string
- borehole is open when connecting new pipe sections - potentially higher chemical exposures

<u>Hollow-Stem Augur Drilling</u>

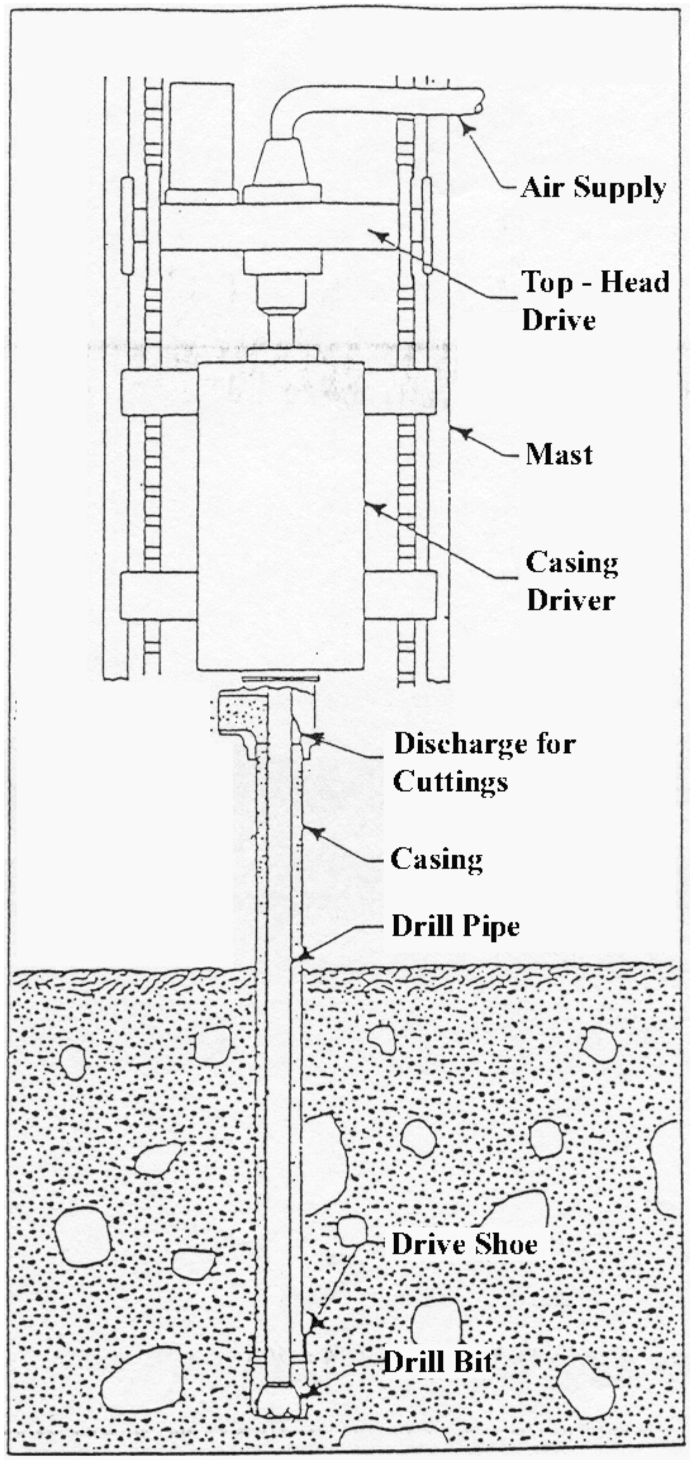
- Stem includes 5' sections of drill rods (bit attached to end of rod) around which fit 5' sections of hollow-stem augur
- Cuttings circulate continuously to the top of the borehole where they are deposited on the ground. They must be shoveled into 55 gal. drums by driller's helpers.
- sampling tools such as:

a. split-spoon sampler, or
b. core-barrel sampler

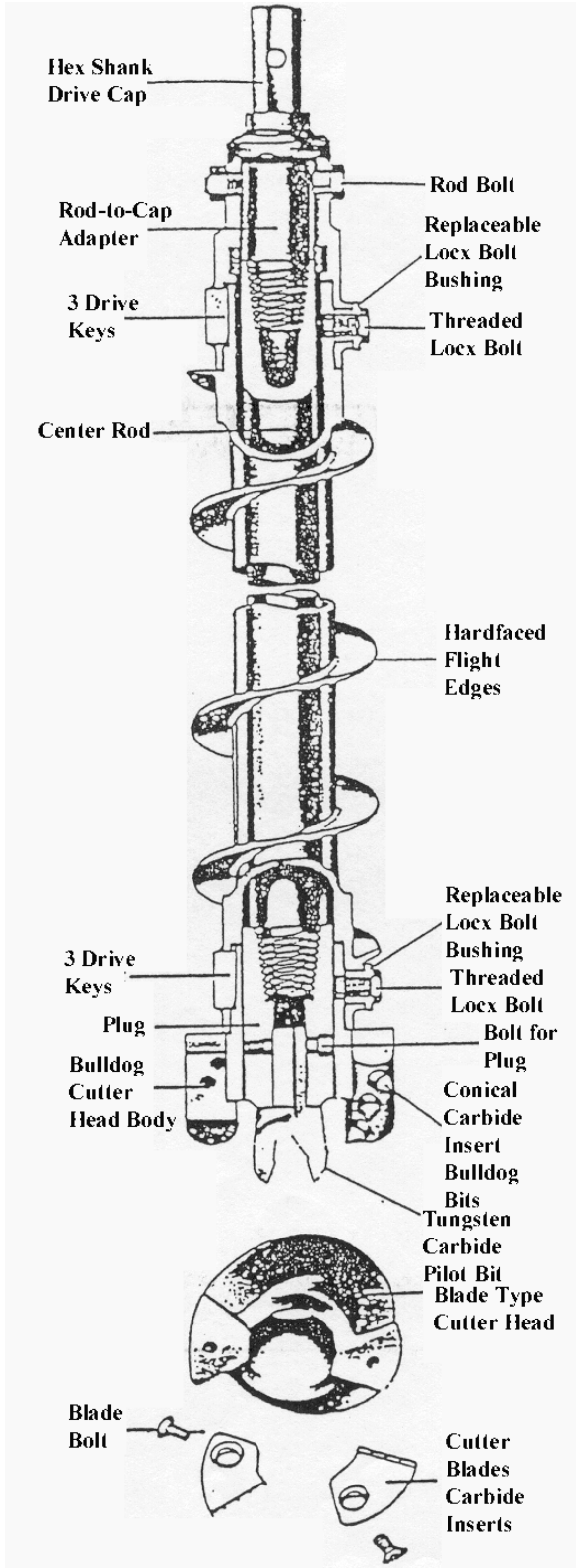
can be used at each 5' or 10' foot interval - before making a connection between the drill string and a new 5' section of augur. These samplers are driven into the ground via a hammer mounted on the mast.



Components of a complete drilling fluid circulating system for a direct rotary rig.



Casing drivers can be fitted to top-head drive rotary rigs to simultaneously drill and drive casting.
(Wellen Drill Tools, Inc.)


Hex Shank
Drive Cap
Rod Bolt
Rod-to-Cap
Adapter
Replaceable
Locx Bolt
Bushing
3 Drive
Keys
Threaded
Locx Bolt
Center Rod
Hardfaced
Flight
Edges
Replaceable
Locx Bolt
Bushing
3 Drive
Keys
Threaded
Locx Bolt
Plug
Bolt for
Plug
Bulldog
Cutter
Head Body
Conical
Carbide
Insert
Bulldog
Bits
Tungsten
Carbide
Pilot Bit
Blade Type
Cutter Head
Blade
Bolt
Cutter
Blades
Carbide
Inserts

IV. WELL CONSTRUCTION

1. Groundwater wells -

- **use PVC pipe as casing with bottom section perforated ("screen") groundwater seeps into the screen and can then be pumped out (or bailed)**
- **gravel is poured around the screen, sand above that and bentonite grout above that to finish sealing the casing and the borehole**

2. Gas monitoring wells

- **similar construction - may have more than one PVC probe per borehole**

3. Wells must be "sounded," their depth measured by tape measure before and during installation.

PHYSICAL HAZARDS TO HEALTH

HAZARD	SOURCE AT THE WORKPLACE	HEALTH EFFECTS
NOISE		
RADIATION		
THERMAL STRESS		
VIBRATION		

DRILLING HAZARDS, PREVENTION AND MITIGATION

Hazards		Mitigation
1.	EXAMPLE: combustible gases present	monitor borehole, eliminate ignition sources, ventilation borehole

AVOIDING BACK STRAIN AND PAIN

Understand the back. The backbone:

- **Allows us to stand up**
- **Allows us to bend and twist**
- **Is composed of alternating vertebrae (bone) & discs (tough fibers wrapped around a soft fluid center)**

DISCS

- **Can be damaged or ruptured by pressure**
- **Do not heal readily**
- **If damaged can result in severe pain**

Lifting improperly creates pressure on the discs. Excess pressure will scar or rupture a disc.

"BACK" MAINTENANCE GUIDE

1. **Maintain your back's three natural curves by being constantly aware of your posture and correcting it.**

2. **Avoid excessive swayback at all times.**

3. **Help relieve unnecessary back strain by keeping your weight down and exercising regularly to build strong supporting muscles.**

4. **Lift with your legs - not your back - by squatting and bending your knees. Hold the objects as close to your body as possible. Do not twist.**

5. **Sleep on a firm mattress, either on your back or your side.**

6. **Do not bend straight over, turn or twist to pick up something, even if it is a light object - don't lift or carry anything heavier than you can manage with ease.**

7. **Don't slouch or bend forward when sitting or driving.**

MODULE 4

AIR MONITORING INSTRUMENTATION

Objectives - Participants will be able to:

- Identify chemical hazards requiring monitoring.
- List the two main categories of monitoring instruments.
- Name types of direct reading instruments (DRIs).
- Discuss how DRIs work.
- Identify at least one condition in which you would use each DRI.
- List the main limitations of each type of DRI.

NOTES

Video MOD 5 - 39 min. "Monitoring Instruments, Permissible Exposure Limits."

PURPOSES

- Identify and quantify airborne contaminants
- Determine level of worker protection
- Determine further monitoring, sampling needs or strategies
- Monitor compliance with standards

SAMPLING STRATEGIES

Instantaneous or "grab"

- Collection of air sample over short period - 1 to 5 minutes approximately.
- Is only representative of the momentary contaminant concentration.
- Examples: Dräger pump/tubs; teflon air sample bag; direct reading instruments

Integrated sampling

- Collection of a known volume of air over a longer recorded time.
- Sampling period is determined either by lab analytical sensitivity or by need to comply with standards set on the basis of a time-weighted average.
- Is representative of the total accumulated dose over the entire period of sampling and is also used to determine the average exposure over the sampling time.

Area sampling

- To determine ambient air contaminant concentrations in entire work area and perimeter.
- To determine dispersion of contaminants from source, dilution of contaminants, boundaries of site zones, levels of protection in all site zones.

Personal sampling

- Sample worker's breathing zone if possible.
- To determine air contaminant concentration in individual's immediate work area.
- To assess actual inhalation exposure more accurately.
- To determine workers or jobs with higher routine exposures.

GENERAL CONSIDERATIONS

- Calibrate or check calibration daily before use.
- Use more than one detection system and take more than one measurement.
- Do periodic breathing zone and area monitoring.
- Record readings in detail.
- Use conservative judgment in interpreting readings.
- Inherent safety.

WHAT CONDITIONS MUST BE MONITORED ON UST SITES?

- Oxygen deficiency
- IDLH concentrations of airborne contaminants
- Confined spaces, excavations, trenches
- Drums and other containers
- New work locations
- New work operations
  - Before initial entry into the work zone or excavations (start of each day)
  - Other examples: drilling, soil sampling, liquid sampling, tank opening (if contents or other states are unknown)

CHEMICAL HAZARDS REQUIRING MONITORING

- Airborne toxic substances — product handling, transfer, product release;
- Oxygen deficient atmospheres — confined spaces;
- Combustible gases/vapors — confined spaces, product handling, product release;
- Hydrogen sulfide/methane — entering sewers.

Toxic substances enter the body via the skin, ingestion, or inhalation. Of these three routes, inhalation is the quickest and most efficient route into the body. The adverse effects produced by inhalation of a toxic substance can be almost instantaneous because the lungs efficiently and rapidly transfer the inhaled substances to the bloodstream, which distributes it to all parts of the body. The toxic effect will be proportional to the concentration of the toxin in the area, its toxicity, and an individual's sensitivity to the toxin.

The objective of this module is to introduce various monitoring instruments which could warn workers of some of the major chemical hazards they might face such as airborne toxic substances, oxygen deficient atmospheres, combustible gas/vapors, and hydrogen sulfide. These can appear during product handling, transfer or release, or while working in confined spaces.

MONITORING INSTRUMENTS

- These hazards can be measured in several ways including:

  Direct reading instrument
  Compound-specific detectors

- Direct reading instruments (DRIs) can effectively detect:

  Organic and inorganic vapors;
  Oxygen-deficient atmospheres;
  Explosive atmospheres; and
  Specific compounds (e.g., hydrogen sulfide).

The major chemical hazards faced by UST workers can be measured in several ways including direct reading instruments (DRIs) or compound-specific detectors. The most commonly used instruments are direct reading instruments which can effectively detect both inorganic and organic vapors, oxygen-deficient atmospheres, explosive atmospheres, and specific compounds such as hydrogen sulfides.

Most DRIs respond to many different substances, and while this characteristic is desirable because it allows for fast identification of dangerous situations, information about specific substances often cannot be determined directly. All DRIs have inherent constraints in their ability to detect hazards:

- They usually detect and/or measure only specific classes of chemicals;

- They are generally not designed to measure and/or detect airborne concentrations below the 1 ppm level; and

- Many of the DRIs that have been designed to detect one particular substance also detect other substances (i.e., they are prone to interferences) and may give false readings.

INSTRUMENT CERTIFICATION

- All monitoring instruments should be certified safe in explosive atmospheres.
- Certified monitoring instruments carry a permanently fixed plate showing that they were tested by:

  Underwriters Laboratories;
  Factory Mutual; or
  Mine Health and Safety Administration.

- Instruments are certified by Class, Division, and Group.

  Class I Potentially flammable gas/vapor
  Class IIPotentially explosive dust

Division 1	Explosive conditions exist routinely
Division 2	Explosive conditions exist only after an unintentional release

Group A	Acetylene
Group B	Hydrogen and similar gases
Group C	Ethyl ether, cyclopropane, carbon disulfide
Group D	Methane, butane, and most solvents
Group E	Explosive dusts

Explosion hazards are a major concern at UST sites; instruments used by UST workers must not contribute to the hazard by being potential sources of ignition.

A number of engineering, insurance, and safety organizations have established definitions and developed codes for testing electrical devices used in hazardous situations. The National Fire Protection Association publishes the National Electrical Code (NEC) every three years. Underwriters Laboratories, Factory Mutual, and the Mine Health and Safety Administration conduct tests to certify that monitoring instruments meet the minimum standards of acceptance set by the NEC.

An electrical instrument certified for use in hazardous locations under one of these test methods, will carry a permanently affixed plate. This plate will show the logo of the laboratory that granted the certification and the Class(es), Division(s), and Group(s) the instrument was tested against. If an instrument does not have an approved rating, it should not be used in a hazardous or potentially hazardous situation.

The instrument certification categories included are divided into classes, divisions, and groups. There are two classes covering "potentially flammable gas/vapor" and "potentially explosive dust." There are two divisions including "explosive conditions exist routinely" and "explosive conditions exist only after an unintentional release." Finally, there are six groups divided according to specific compounds such as acetylene, hydrogen and similar gases, and others. The categories of instruments most likely to be used in investigations at UST sites are approved for Class I, Division 1, Groups A, B, C, and D.

Because of the wide variability of compounds that can be encountered at an UST site, instruments are more typically certified for multigroups of substances. This affords the widest applicability possible.

HAZARDOUS ATMOSPHERES

Depending upon the response worker's background, the term "hazardous atmosphere" conjures up situations ranging from toxic air contaminants to flammable atmospheres. For our purposes, an atmosphere is hazardous if it meets the following criteria:

- It is a mixture of any flammable material in air (see Class and Group below) whose composition is within this material's flammable range (LEL-LFL).

- A critical volume of the mixture is sufficiently heated by an outside ignition source.

- The resulting exothermic reaction propagates the flame beyond where it started.

Hazardous atmospheres can be produced by one of three general types of materials:

- Flammable gases/vapors

- Combustible dusts

- Ignitable fibers

Whereas the flammable material may define the hazard associated with a given product, the occurrence of release (how often the material generates a hazardous atmosphere) dictates the risk. Two types of releases are associated with hazardous atmospheres:

- Continuous — those existing continuously in an open unconfined area during normal operating conditions.

- Confined — those existing in closed containers, systems, or piping, where only ruptures, leaks, or other failures result in a hazardous atmosphere outside the closed system.

There are six possible environments in which a hazardous atmosphere can be generated. However not every type of control will prevent an ignition in every environment. To adequately describe the characteristics of those environments and what controls can be used, the National Electrical Code defines each characteristic:

- Class is a category describing the type of flammable material that produces the hazardous atmosphere:

    - Class I is flammable vapors and gases, such as gasoline, hydrogen. Class I is further subdivided into groups A, B, C, and D on the basis of similar flammability characteristics (Table 18-1).

    - Class II consists of combustible dusts like coal or grain and is divided into groups E, F, and G.

    - Class III is ignitable fibers such as produced by cotton milling.

TABLE 18-1
CLASS I CHEMICALS BY GROUP

GROUP A ATMOSPHERES	GROUP D ATMOSPHERES
Acetylene	Acetone
	Acrylonitrile
GROUP B ATMOSPHERES	Ammonia
Butadiene	Benzene
Ethylene oxide	Butane
Hydrogen	1-Butanol (butyl alcohol)
Manufactured gases contain-	2-Butanol (secondary butyl alcohol)
ing than 30% H (by vol)	n-Butyl acetate
Propylene oxide	Isobutyl acetate
	Ethane
GROUP C ATMOSPHERES	Ethanol (ethyl alcohol)
	Ethyl acetate
Acetaldehyde	Ethylene dichloride
Crotonaldehyde	Gasoline
Cyclopropane	Heptanes
Diethyl ether	Hexanes
Ethylene	Isoprene
Unsymmetrical dimethyl	Methane (natural gas)
hydrazine (UDMH, 1-,	Methanol (methyl alcohol)

TABLE 18-1 (Cont.)

1-dimethyl hydrazine)	3-Methyl-1-butanol

Methyl ethyl ketone

GROUP D ATMOSPHERES (Cont.)
Methyl isobutyl ketone
2-Methyl-1-propanol (isobutyl alcohol)
2-Methyl-2-propanol (tertiary butyl alcohol)
Octanes
Petroleum naphtha*
Pentanes
1-Pentanol (amyl alcohol)
Propane
1-Propanol (propyl alcohol)
2-Propanol (isopropyl alcohol)
Propylene
Styrene
Toluene
Vinyl acetate
Vinyl chloride
Xylenes

*A saturated hydrocarbon mixture boiling in the range 20°-135°C (60°-135°F). Also known by the synonyms benzine, ligroin, petroleum ether, or naphtha.

Source: *National Electrical Code*, National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210 (1977).

- Division is the term describing the "location" of generation and release of the flammable material.

  - Division 1 is a location where the generation and release are continuous, intermittent, or periodic into an open, unconfined area under normal conditions.

  - Division 2 is a location where the generation and release are in closed systems or containers and only from ruptures, leaks, or other failures.

Using this system, a hazardous atmosphere can be routinely and adequately defined. As an example, a spray-painting operation using acetone carrier would be classified as a Class I, Division 1, Group D environment. Additionally, an abandoned waste site containing intact closed drums of methyl ethyl ketone, toluene, and xylene would be considered a Class I, Division 2, Group D environment. Once the containers begin to leak and produce a hazardous atmosphere, the environment changes to Class I, Division 1, Group D.

CONTROLS

Three methods exist to prevent a potential ignition source from igniting a flammable atmosphere:

- **Explosion-Proof**: Encase the ignition source in a rigidly built container. "Explosion-proof" instruments allow the flammable atmosphere to enter. If and when an arc is generated, the ensuing explosion is contained within the specially designed and built enclosure. Within it, any flames or hot gases are cooled prior to exiting into the ambient flammable atmosphere so that the explosion does not spread into the environment.

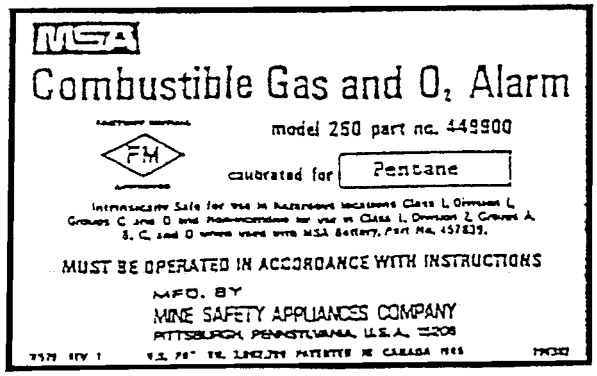
- **Intrinsically Safe**: Reduce the potential for arcing among components by encasing them in a solid insulating material. Also, reducing the instrument's operational current and voltage below the energy level necessary for ignition of the flammable atmosphere provides equal protection. An "intrinsically safe" device, as defined by the National Electrical Code, is incapable "of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture in its most easily ignited concentration. Abnormal conditions shall include accidental damage to any...wiring, failure of electrical components, application of over-voltage, adjustment and maintenance operations and other similar conditions."

- **Purged**: Buffer the arcing or flame-producing device from the flammable atmosphere with an inert gas. In a pressurized or "purged" system, a steady stream of, for example, nitrogen or helium is passed by the potential arcing device, keeping the flammable atmosphere from the ignition source. This type of control, however, does not satisfactorily control analytical devices that use a flame or heat for analysis such as a combustible gas indicator (CGI) or gas chromatograph (GC).

National groups such as Underwriters Laboratories (UL), Mutual (FM), and the American National Standards Institute (ANSI), together with NFPA, developed test protocols for certifying explosion-proof, intrinsically safe, or purged devices to meet minimum standards of acceptance.

An electrical device certified under one of these test methods carries a permanently affixed plate showing the logo of the laboratory granting certification and the Class(es), Division(s), and Group(s) it was tested against. See Figure 18-1.

FIGURE 18-1



Certification means that if a device is certified as explosion-proof, intrinsically safe, or purged for a given Class, Division, and Group, and is used, maintained, and serviced according to the manufacturer's instructions, it will not contribute to ignition. The device is not, however, certified for use in atmospheres other than those indicated.

Any manufacturer wishing to have an electrical device certified by FM or UL must submit a prototype for testing. If the unit passes, it is certified as submitted. However the manufacturer agrees to allow the testing laboratory to randomly check the manufacturing plant at any time, as well as any marketed units. Furthermore, any change in the unit requires the manufacturer to notify the test laboratory, which can continue the certification or withdraw it until the modified unit can be retested.

A unit may be certified either by UL, FM, or both. Both laboratories follow test protocols established by NFPA and ANSI. Therefore one certification is no better or worse than the other. The important consideration is that the device is approved for the Class(es), Division(s), and Group(s) it will be used in.

The mention of FM or UL in the manufacturer's equipment literature does not guarantee certification. All certified devices that are used in hazardous (flammable) locations must be marked to show Class, Division, and Group, per NEC Table 500-2(b).

Other organizations such as the Mine Safety and Health Administration (MSHA), Canadian Standards Association (CSA), National Electrical Manufacturers Association (NEMA), and the U.S. Coast Guard (UCCG) have developed their own testing and certification schemes for electrical devices in hazardous locations common to their jurisdiction.

MSHA tests and certifies electrical equipment to be used in hazardous atmospheres associated with underground mining. These atmospheres usually contain methane gas and coal dust; hence the tests and certification are specific to those two contaminants.

Often the same monitoring equipment is used in mines as well as above ground and therefore carry more than one certification, such as FM and MSHA.

To ensure personnel safety, it is recommended that only approved (FM or UL) instruments be used on-site and only in atmospheres for which they have been certified. When investigating incidents involving unknown hazards, the monitoring instruments should be rated for use in the most hazardous locations. The following points will assist in selection of equipment that will not contribute to ignition of a hazardous atmosphere:

- In an area designated Division 1, there is a greater probability of generating a hazardous atmosphere than in Division 2. Therefore, the test protocols for Division 1 certification are more stringent than those for Division 2. Thus a device approved for Division 1 is also permitted for use in Division 2, but not vice versa. For most response work this means that devices approved for Class I (vapors, gases), Division 1 (areas of ignitable concentrations), Groups A, B, C, D should be chosen whenever possible. At a minimum, an instrument should be approved for use in Division 2 locations.

- An additional consideration is that all instruments used in a methane environment should be approved by the Mine Safety and Health Administration (MSHA) as being safe in such atmospheres.

- There are so many Groups, Classes, and Divisions that it is impossible to certify an all-inclusive instrument. Therefore, select a certified device based on the chemicals and conditions most likely to be encountered. For example, a device certified for a Class II, Division 1, Group E (combustible metal dust) would offer little protection around a flammable vapor or gas.

OXYGEN METER

- Function is to detect the percentage of oxygen in the air

  Most models detect 0-25% range.
  A few models detect 0-10%, 1-100%.

- It works using an electrochemical sensor

  Air is pumped into the meter; diffuses onto a semipermeable membrane.
  Reaction between oxygen and electrodes produces a minute current.
  Current moves the needle indicator.

The oxygen detector has three principal components: the air flow system, the oxygen sensing element, and the microamp meter. Air is drawn into the detector with an aspirator bulb or pump. The detector uses an electrochemical sensor to determine the oxygen concentration. The sensor consists of two electrodes (a sensing and counting electrode), a housing containing the basic electrolytic solution, and a semipermeable teflon membrane.

Oxygen molecules diffuse through the membrane into the solution. Reactions between the oxygen and the electrodes produce a minute electric current which is directly proportional to the sensor's oxygen content. The current passes through the electronic circuit and the resulting signal is shown as a needle deflection on a meter.

<u>Oxygen measurements are most informative when paired with combustible gas measurements.</u> Together they provide quick and reliable hazard data. A lower oxygen reading will show a lower combustible gas reading; while a higher oxygen reading will show a higher combustible gas reading. In general, oxygen measurements should be taken before combustible gas indicator readings.

OXYGEN METER LIMITATIONS

- Different altitudes skew calibrations.
- Measurements are best when paired with combustible gas measurements (take oxygen readings first).
- Oxidants (e.g., ozone) affect readings.
- Carbon dioxide interferes with the detector.

The use of an oxygen meter has limitations, since its operation depends on absolute atmospheric pressure. An oxygen meter calibrated at sea level and operated at an altitude of several thousand feet will falsely indicate and oxygen-deficient atmosphere. Furthermore, oxidants, such as ozone, interfere with detectors. Chlorine, Fl, Br, and acid gases are all potent oxidants (oxidizers). An oxygen measurement should be paired with a combustible gas measurement in order to ensure reliability.

NOTES

Most oxygen meters in use today are microfuel cells, and have a limited life, typically less than two years. They are also sensitive to sudden movement and rapid temperature changes.

Oxygen Meter

Hazard Monitored: Oxygen deficient atmospheres.

Applications: Determines atmospheric oxygen concentration. This information can be used to check for asphyxiants, flammable or toxic gases/vapors. This information is also considered important in choosing a respirator.

Components: Aspirator bulb or pump to draw sample, but also can be passive; meter readout with needle or LCD; audio and/or visual alarm or neither; nicad or regular batteries; calibration adjustment. May be combined with CGI.

Readout: The instrument reads out as percent oxygen. Most instruments read from 0-25% oxygen.

Calibration: The instrument is easily calibrated to ambient oxygen in a clean atmosphere by adjusting a screw or knob. It should be calibrated at the same temperature and pressure it will be used in.

Inherent Safety: Desired approval is Class I Division I Groups ABCD. Not all oxygen meters are approved. Approval should be on the instrument label. Make sure it is approved for the use you put it to.

Limitations: Instrument is affected by temperature and pressure. Oxidizers can cause increased readings. Carbon dioxide can reduce instrument sensitivity.

EPA ACTION LEVELS

<19.5%	**Supplied air (SCBA) required**
19.5-25%	**Continue with caution**
>25%	**LEAVE AREA, INCREASED FIRE HAZARD**

HYDROGEN SULFIDE METER

- Capabilities: Detect hydrogen sulfide levels in air.
- Function: Similar to oxygen meter.
- Limitations: Cross sensitivity (e.g., HCN).

Hydrogen sulfide indicators range from simple color change devices to sophisticated electronic meters. With the electronic versions, sample air is introduced to the sensor by passive diffusion or active pumps through a gas-porous semipermeable membrane. The cell electro-oxidizes the gas in proportion to the gas partial pressure in the sample. The resulting electrical signal is then amplified to run the meter.

Hydrogen sulfide gas can be fatal if inhaled in sufficiently high concentrations. UST workers are most likely to encounter H_2S in sewers. The gas has a strong "rotten egg" odor. The worker should never rely on the olfactory senses as a means of determining concentrations of H_2S, since the gas "deadens" the sense of smell (i.e., the olfactory nerves will adjust to and tolerate concentrations of H_2S).

NOTES

Some individuals are congenitally unable to smell H_2S.

Concerning limitations, no hydrogen sulfide meters are sensitive to less than 1 ppm. In addition, they are cross sensitive to hydrogen cyanide, therefore, they can, in certain instances, give misleading readings.

COMBUSTIBLE GAS INDICATOR (CGI)

- Function: Measures concentrations of flammable vapors/gases in air.
- Results shown as a percentage of lower flammable limit.
- Measure O_2 percentage before using CGI.
- Operates on "hot wire" principle:

  Combustion chamber with platinum filament.
  Gas combustion raises filament temperature.
  Increased temperature causes "imbalance" in resistor circuit.

- Concentrations above LEL but below the UEL; meter needle stays beyond the 1.0 (100%) mark.
- **Concentrations above UEL: meter rises above the 1.0 mark and quickly returns to zero**.

The combustible gas indicator (CGI) is one of the first instruments that should be used when surveying a site. It measures the concentrations of flammable vapors or gases in air and indicates the results as a percentage of the lower explosive limit (LEL) of the calibration gas. Before using a CGI, however, the percentage of oxygen should be measured with an oxygen meter.

The LEL of a combustible gas is the lowest concentration by volume in air which will explode, ignite, or burn when there is an ignition source. The UEL is the maximum concentration of a gas or vapor which will ignite. Above the UEL, there is insufficient oxygen for the fuel level to support combustion. Below the LEL there is insufficient fuel to support ignition.

Most CGIs operate on the "hot wire principle." In the combustion chamber there is a platinum filament that is heated. This filament is an integral part of a balanced resistor circuit called the Wheatstone Bridge. The hot filament combusts the gas(es) on the immediate surface of the element, thus raising the temperature of the filament. Any single gas, or mixture of combustible gases, will cause the meter to react; the effect of this trait must be understood by the CGI operator.

As the temperature of the filament increases so does the resistance. This change in resistance causes an imbalance in the Wheatstone Bridge. This is measured as the ratio of combustible vapor present compared to the total required to reach the LEL of the combustible gas used to calibrate the CGI. If a concentration greater than the LEL and less than the UEL is present, the meter needle will stay beyond the 1.0 (100%) level of the meter. This indicates that the ambient atmosphere is readily combustible. When the atmosphere has a gas concentration above the UEL, the meter will rise above the 1.0 mark and then return to zero. This occurs because the gas mixture in the combustion cell is too rich to burn. This permits the filament to conduct a current as if the atmosphere contained no combustibles at all. For this reason, it is critical to always watch the meter, since this rapid deflection may go undetected.

NOTES

This is not a problem with most of the newer meters equipped with an audible alarm.

There is a relatively new detector system for flammables on the market now. Some detectors are using a tin oxide sensor. The tin oxide coating on the surface of the sensor has only a limited number of electrons available for conduction of electricity. Oxygen, which is highly electronegative, tends to gain electrons. Normal oxygen content will pull most of the electrons away from the tin oxide, reducing its ability to conduct electricity (high resistance). As concentrations of a flammable gas increase, oxygen "turns away" from the tin oxide to interact with the flammable compounds. The newly freed electrons can now flow, and resistance drops. The resistance changes area calibrated to be proportional to a specific flammable gas. This technology can also be used to detect nonflammable vapors as well.

Pros and cons of this technology are not yet fully field-tested, but it is reasonable to assume that varying oxygen concentrations can cause ambiguous readings, and that cross sensitivities exist. The sensor is reported to be poisoned by halogenated gases.

Combustible Gas Indicator (CGI)

Hazard Monitored: Flammable vapors and gases including alcohols, acids, aldehydes, ketones, esters, aromatics, amines, nitro compounds, high (lethal) concentartions of hydrogen sulfide, hydrogen cyanide, carbon monoxide, and ammonia.

Applications: Determines the concentration of flammable vapors and gases. This information can be used to assess explosive potential and the risk of working in that atmosphere. Quantitative only!

Components: Aspirator bulb or pump to draw sample; meter readout with needle or LCD; audio and/or visual alarm; NICAD or regular batteries; zero and/or voltage adjustment.

Detection Method: Combustion of vapor/gas on heated platinum filament.

Readout: Meter indicates 0-100% of LEL (lower explosive limit). When concentrations are above LEL the meter will indicate greater than 100%. With most CGIs the meter will return to 0 when concentrations are greater than the UEL (upper explosive limit). Instruments with audio or visual alarms can be set at whatever level desired by the operator.

Calibration: Calibration of CGIs should be checked before and after use. Common gases used for calibration are pentane and hexane. Actual calibration requires return to factory or trained technicians.

Inherent Safety: Desired approval is for Class I Division I Groups ABCD. Not all CGIs are approved. Check to make sure that the instrument is approved for the use you put it to.

Limitations: Instrument is affected by the following compounds: selenium compounds, silicon compounds, volatile heavy metals such as tetraethyl lead. High humidity may reduce sensitivity. Halogenated hydrocarbons corrode the detector. The sensitivity of the CGI varies with different vapors and gases so it is only truly accurate when measuring the calibration gas.

EPA ACTION GUIDES

0-10% LEL	**Continue investigation**
10-25% LEL	**Continue with caution**
>25% LEL	**LEAVE AREA IMMEDIATELY**

COMBUSTIBLE GAS INDICATOR LIMITATIONS

- Watch needle continuously (it rapidly pegs, the returns to zero at concentrations above UEL).
- Always use in conjunction with an oxygen meter.
- Should not be used in oxygen enriched, nor deficient area.
- Leaded gasoline may "poison" internal filament.
- Gives accurate readings for the "calibration gas" only.

There are limitations to the use of a combustible gas indicator. As mentioned previously, the needle of the indicator must be watched continuously because a reading above UEL will return to zero. For a more accurate measure of combustible gases, readings should be taken at ground, waist, and overhead positions to ensure detection of vapors whose densities are greater or less than air.

The following substances may "poison" the detection filaments: fuming acids, leaded gasolines, silicones, silicates, and other silicon-containing compounds. When it is suspected that these substances have been aspirated, the CGI should be checked with a calibration kit; if leaded gasolines are anticipated, additional filaments should be on hand. The instrument should not be switched On/Off unless it is known that you are in a combustion-free environment. The CGI reads only from 0 to 100% of the calibration gas, often either methane or propane. Therefore, when another combustible gas is detected, the exact meter reading is not correct and cannot be relied upon. To provide additional safety factors, field crews should discontinue operations where combustible gas is measured above 25% of the LEL for a methane- or propane-calibrated CGI.

NOTES

There are catalytic filters available for use with leaded gasolines.

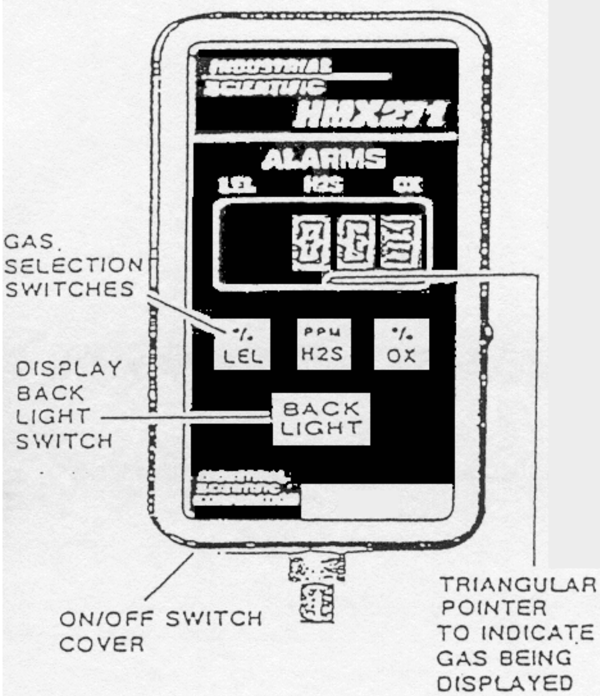


Figure 1.
HMX271 Controls

6

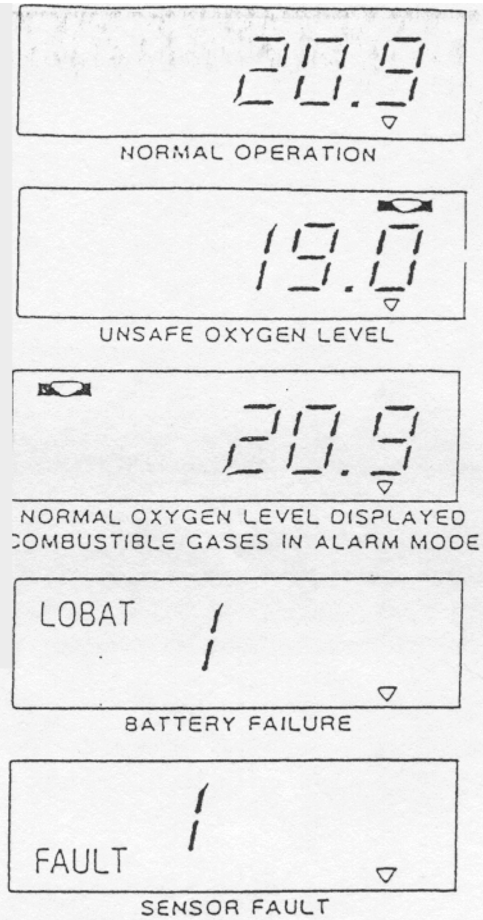


Figure 2.
Display and Alarms

7

CGI

CGI INSTRUMENT

Preparing for Operation

To switch on the instrument:

Back off the knurled nut that holds the calibration cover in place.

Rotate the cover so that the metal button is inserted in the oval-shaped hole.

Tighten the nut until the calibration cover is flush with the case. Do not over tighten.

To switch off the instrument:

Back off the knurled nut that holds the calibration cover in place.

Rotate the cover so that the metal button is inserted in the unmarked round hole.

Tighten the nut until the calibration cover is flush with the case. Do not over tighten.

Checking Alarm Settings

Before calibrating the instrument, it is good practice to check all of the alarm settings to verify that they are set correctly. The calibration cover must first be released and turned 90 degrees to expose the 5 calibration adjustments along the bottom end of the instrument. The function of the five control adjustments are: (1) LEL zero offset Z LEL, (2) LEL span sensitivity S LEL, (3) H_2S span sensitivity S PPM, (4) H_2S zero offset Z PPM, and (5) OX calibration S OX.

To Check LEL

To check the LEL alarm setting, switch the display to the LEL mode. Slowly turn the Z LEL (LEL zero offset) adjustment in the clockwise direction until the alarm is activated. When the alarm point is reached, slowly turn the adjustment back and forth through the point at which the alarm is activated. Observe the display. The display will show the percent of LEL at which the alarm is set to activate. Turn the adjustment back to the zero display reading. The factory setting for the LEL alarm is 20%.

To Check H_2S

Checking the H_2S alarm setting is similar to the procedure used for the LEL. Switch the display to the H_2S mode and slowly turn the Z PPM (H_2S zero offset) adjustment in the clockwise direction until the alarm is activated. Slowly turn the adjustment back and forth through the point of activation and observe the display for the ppm level at which the H_2S alarm activates. Turn the adjustment back to the zero display reading. The factory setting for the hydrogen sulfide alarm is 10 ppm.

To Check OX

Unlike the LEL and H_2S, the OX section does not require a Z adjustment. After switching to the OX mode, observe and note the display reading, which should be 20.9% in normal room air. Slowly turn the S OX (O; calibration) adjustment counterclockwise until the low oxygen alarm setting is reached. Slowly turn the adjustment back and forth through the alarm point to verify the setting. After the low alarm setting is located, slowly turn the adjustment in the clockwise direction until the high oxygen alarm setting is found. Slowly turn the adjustment back and forth through the alarm point to verify the setting. Return the display to the original setting. The oxygen alarms are factory set at 19.5% for the low alarm and 23.0% for the high alarm.

Span Adjustments

After the LEL and H_2S zeros have been properly set, the span sensitivity may be calibrated. Switch the display to the LEL mode and apply the LEL span gas to the monitor using the calibration cup. Allow the gas to flow for two (2) minutes. With the gas still flowing, adjust the S LEL (LEL span sensitivity) control, on the bottom of the instrument, to the nearest percent, that is printed on the LEL calibration gas cylinder. Remove the LEL calibration gas.

Repeat the above procedure for H_2S using hydrogen sulfide span calibration gas with the S PPM (H_2S span sensitivity) control to complete the span calibration.

In clean air, known to have 20.9% oxygen, the S OX (OX calibration) control should be adjusted so that the display reads 20.9% oxygen. Final calibration of the oxygen readout should only be done in free air if the user is sure that the air contains the normal 20.9% oxygen. The readout should then be adjusted to 20.9. If there is any doubt of the oxygen content of the air, calibration gas of a known percentage of oxygen in nitrogen should be used.

Zero Adjustments

Only the H_2S and LEL sections of the HMX271 require zero calibration. In clean air, switch the display to the H_2S mode and adjust the Z PPM (H_2S zero offset) by turning it counterclockwise until the minus sign (-) appears on the display. Very slowly turn the Z PPM control clockwise until the minus sign just goes off, leaving (000) in the display.

In clean air, switch the display to the LEL mode and adjust the Z LEL (LEL zero offset) control by turning it counterclockwise until the minus sign (-) appears on the display. Very slowly turn the Z LEL control clockwise until the minus sign just goes off, leaving (000) in the display.

DETECTOR TUBES

- Function: Measure levels of petroleum, other gases.
- How it works: "Detecting chemicals" change color

  Air is drawn through tube.
  Intensity of color change shows concentration of gases.

Detector tubes (also known as calorimetric and indicator tubes) measure levels of petroleum and other gases. They are small glass tubes filled with a solid absorbent and impregnated with detecting chemicals. Air is drawn through the tube at a controlled rate, and airborne contaminants will change the color of the detecting chemicals. The intensity of the color change is taken as an index of the contaminant concentration. Because specific tubes exist for the detection of hydrocarbons and other petroleum product constituents, they can be effectively used at UST sites as a screening tool, but they are not very accurate.

NOTES

There are two basic types of detector tubes: (1) stain length and (2) color density. Stain length tubes are graduated, and the <u>length</u> of the color change is proportional to concentration. Stain length tubes are more convenient.

DESCRIPTION OF THE DRÄGER GAS DETECTOR

The Dräger Gas Detector (Fig. 1) consists of the combination Dräger Tube + Dräger bellows pump. The Dräger Tube + Dräger pump must be used together.

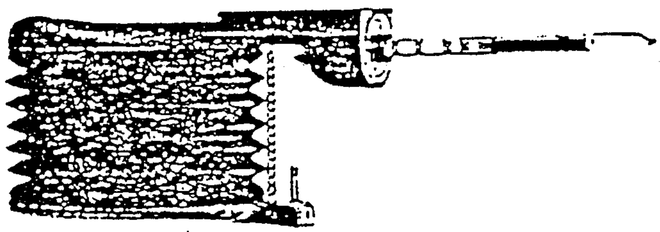


Fig. 1. Dräger gas detector, consisting of the gas detector pump and Dräger tube.

Brief description of the basic detector pump:
The gas detector pump is a hand-operated bellow pump (Fig. 2). This pump supplies 100 cm^3 with each stroke. Thus, not only does the gas detector pump suck in the gas sample, but it also simultaneously carries out a volume measurement with each stroke. Its mode of operation is, therefore, that of a dosage pump.

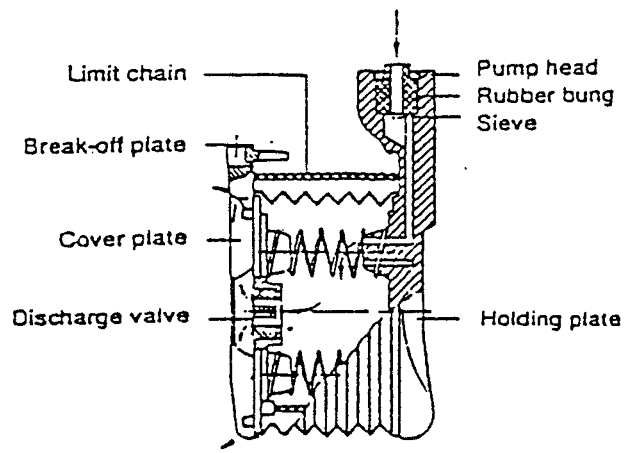


Fig. 2. Cross-section through the gas detector pump.

The gas detector pump is made from neoprene and opens automatically after compressing and releasing the bellows. This opening process is effected by two steel springs built into the pump. The end of the suction process is reached when the limit chain is taut.

The gas detector pump has only one valve, which is closed when the gas sample is sucked in and opens again on squeezing the bellows. The pump head has an aperture into which the Dräger tube to be used is inserted.

The time from releasing the bellows (after squeezing) until the limit chain is taut is termed the opening time of the gas detector pump; hence the opening time is the duration of one pump stroke.

The opening time depends on the flow resistance of the Dräger tube inserted, which is a function of the filling preparation used. On the basis of the reaction kinetics, the flow resistance of the tube, and thus the opening time of the gas detector pump, differs depending upon the type of tube used. There are types of tube in which the pump opens in 3 seconds, but there are also tubes in which this process takes 40 seconds. However, the flow resistance for an individual type of tube varies only slightly, so that a range for the opening time of the gas detector pump can be kept with each type of tube. These opening times are indicated in the instructions for use of the tubes concerned.

Unused

After determination of 30 ppm H_2S

Fig. 3 and 4. Dräger Hydrogen Sulfide 5/b Tube

NOTES

Other manufacturers offer detector tube equipment with improved features such as pump stroke counters, etc. The prospective buyer should carefully examine all of the various offerings, including prices of tubes.

DETECTOR TUBES

Hazard Monitored: Specific vapors and gases.

Application: Determine concentration of specific vapor or gas in atmosphere. Information can be used to assess hazard and establish control measures.

Components: Bellows or piston pump; detector tube.

Detection Method: Chemical reaction with color change.

Readout: The tubes normally read directly in ppm or % from a scale on the tube. Some tubes have scales in millimeters. With that type the length is read in mm and referenced on the instructions for the appropriate conversion factor.

Calibration: The tubes come calibrated. The pump must be checked regularly to verify flow rate and sample volume per pump strike.

Inherent Safety: None required.

Limitations: The problems that contribute to poor accuracy are: leak in pump; insufficient contact (analysis) time; high humidity; high temperature; difficulty reading scale; interferences from other compounds; improperly stored tubes; out of date tubes; operator error.

EPA ACTION LEVELS

None established. Depends on the toxicity of the specific chemical being monitored.

DETECTOR TUBE LIMITATIONS

- Accuracy is only within 25% concentration.
- Interfering gases can affect readings.
- Slow and tedious.
- Subjective determination of results.

One limitation of detector tubes is that their accuracy is limited to within 25% of the true concentration of the contaminant. Furthermore, some gases can interfere with the reading. It is a relatively slower and more tedious approach to measuring contaminants than some other instruments. The color or stain must be evaluated immediately, as many colors fade rapidly. Finally, with some tubes, the air flow must be in one direction only; this is typically indicated by an arrow or dot. This type of tube usually contains a drying agent or a precleaning layer ahead of the indicating chemical, to remove interfering gases or vapors, or an oxidizing layer which releases a certain part of the vapor test molecule which reacts with the indicating chemical.

FLAME IONIZATION DETECTOR (OVA 128)

- Function: Has two modes.
  - Survey. Detects concentrations of volatile organic chemicals.
  - Gas Chromatograph. Separates and measures individual components.
- How it works:
  - Samples drawn into hydrogen flame.
  - Sample burns; ions produced; resulting current read by meter.

The OVA is used to detect concentrations of volatile organics. It consists of two major parts: (1) a nine pound package containing the sampling pump, battery pack, support electronics, flame ionization detector, and hydrogen gas cylinder; and (2) a hand-held meter/sampling probe assembly. When the sample reaches the hydrogen flame it burns and the resulting ions carry an electric current. The current is then amplified and displayed on the probe's meter. The measurement equals the total concentration of organic compounds relative to the calibration standard.

The OVA can operate in two different modes. In the **survey** mode, it can determine the approximate concentration of all detectable volatile organic chemicals in the air. The **gas chromatograph** (GC) **mode** separates and measures individual components. This is done by drawing a sample into the OVA's probe which is then carried to the detector by an internal pump.

In the GC mode, a small sample of ambient air is injected into a chromatographic column and carried through the column by a stream of hydrogen gas. Contaminants with different chemical structures are retained on the column for different lengths of time (known as retention times) and, hence, are detected separately by the flame ionization detector. A strip chart recorder can be used to record the retention times and peaks (concentrations), which are then compared to the retention times of a standard with known chemical constituents.

FLAME IONIZATION DETECTOR (OVA 128) LIMITATIONS

- Internally calibrated to methane by manufacturer; for other compounds, adjustments and/or calibration charts needed.
- Can only detect organic compounds.
- Detector needs high-quality hydrogen, whose transport is regulated by the U.S. Department of Transportation.

Limitations of the OVA include that fact that it is internally calibrated by the manufacturer (usually to methane), and therefore, does not give an exact reading for other compounds. The OVA can only detect organic compounds, however, since petroleum products are organic compounds, this poses no major problem.

The OVA needs high-quality hydrogen to operate. Hydrogen transport is regulated by the U.S. Department of Transportation. If the OVA's hydrogen tank is empty, it can be shipped without restriction. Once onsite, however, plans have to made for the acquisition of high-quality hydrogen.

Lead-acid batteries are used by the OVA and they tend to lose power in cold weather which could cause problems with onsite usage. Finally, OVA's do not detect compounds less than 1 ppm in concentration.

SUMMARY OF OVA OPERATING PROCEDURES

Startup

A. Check battery condition by moving the INSTR Switch to the BATT position.

B. Move INTR Switch to ON and allow five (5) minutes to warmup.

C. Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.

D. Turn the Volume knob fully clockwise.

E. Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.

F. Set CALIBRATE Switch to X1 position, use CALIBRATE knob and set meter to read 0.

G. Move PUMP Switch to ON position, then place instrument panel in vertical position and check SAMPLE FLOW RATE indication. The normal range is 1.5 to 2.5 units. If less, check filters.

H. Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE. Wait one minute for hydrogen to purge the system.

I. Depress Igniter Button until burner lights. Do not depress Igniter Button for more than six seconds. (If burner does not ignite, let hydrogen flow for one minute and again attempt ignition.)

J. Use CALIBRATE Knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE Knob and make differential readings from there.

Shut Down

A. Close the HYDROGEN SUPPLY VALVE.

B. Close the HYDROGEN TANK VALVE.

C. Move the INSTR Switch and PUMP Switch to OFF

D. Instrument is now in shut down configuration.

PHOTOIONIZATION DETECTOR (HNu)

- Function: Detects total organic and some inorganic gases.

- How it works:

  Sample subjected to ultraviolet radiation which ionizes many gases.
  Ions produced; resulting current read by meter.
  Easier to use than OVA.
  Calibrated to a benzene equivalent (isobutylene).

The HNu system portable photoionizer detects concentrations of organic gases and a few inorganic gases. The basis for detection is the photoionization of gaseous species. The incoming gas molecules are subjected to ultraviolet radiation, which ionizes a number of gaseous compounds. Each particle is changed into charged-ion pairs creating a current between two electrodes, which can be read by a meter. The HNu measures the total concentration of those organic (and some inorganic) vapors in air that have an ionization potential less than or equal to the energy of the probe.

The HNu consists of two modules connected via a signal-power cord; a readout unit consisting of a meter, battery, and electronics; and a sensor unit consisting of a light source, a pump, and an ionization chamber.

The photoionization detector is easier to use than the OVA and it has a lower detection limit. The system is usually calibrated to a benzene substitute such as isobutylene and reads benzene directly.

Two other models of photoionization detectors that are recommended include the TIP manufactured by Photovac and the OVM manufactured by Envirotherm. These two models, unlike the HNu, have the ability to retain readings in memory, which can then be downloaded into the computer at a later date.

HNu CALIBRATION/CHECKOUT PROCEDURE

1. Take HNu off charger and unplug charger.

2. Test battery by turning the function switch from OFF to BATT - note deflection of needle to BATT CHK zone on far right - this indicates that the battery is charged.

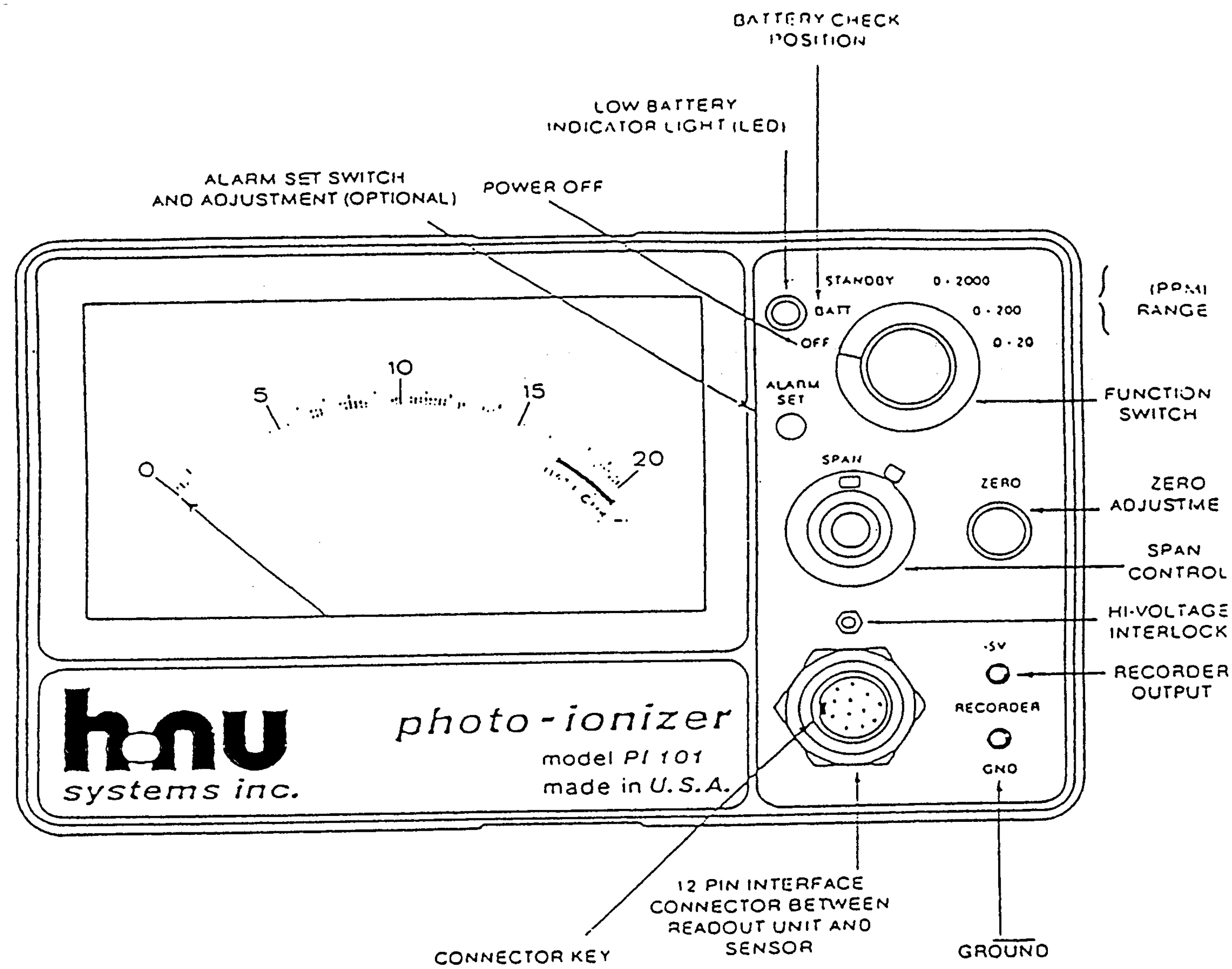
3. Zero the instrument by turning the function switch from BATT to STANDBY - turn ZERO ADJUSTMENT POT right or left until needle in readout module reads 0.

4. Calibration. Using 100 ppm ISOBUTYLENE calibration gas (tedlar bag or calibration gas bottle), calibrate HNu. Set the function switch to 0-200 ppm range. Attach tygon hose to the HNu probe extension. Check the gas pressure in the calibration bottle. This can be read from the pressure regulator attached to the bottle. If the pressure is less than 50 psi, then the bottle is no longer useful. Attach the tygon hose from the probe extension to the calibration gas bottle at the pressure regulator. Check the span control. Make sure the dial is et at 9.8 and the lock is set all the way down to the right. Turn the valve on the regulator all the way to the open position. The needle should climb to about 70 ppm and stabilize. If it does not, consult the instructor.

5. Field function tests.

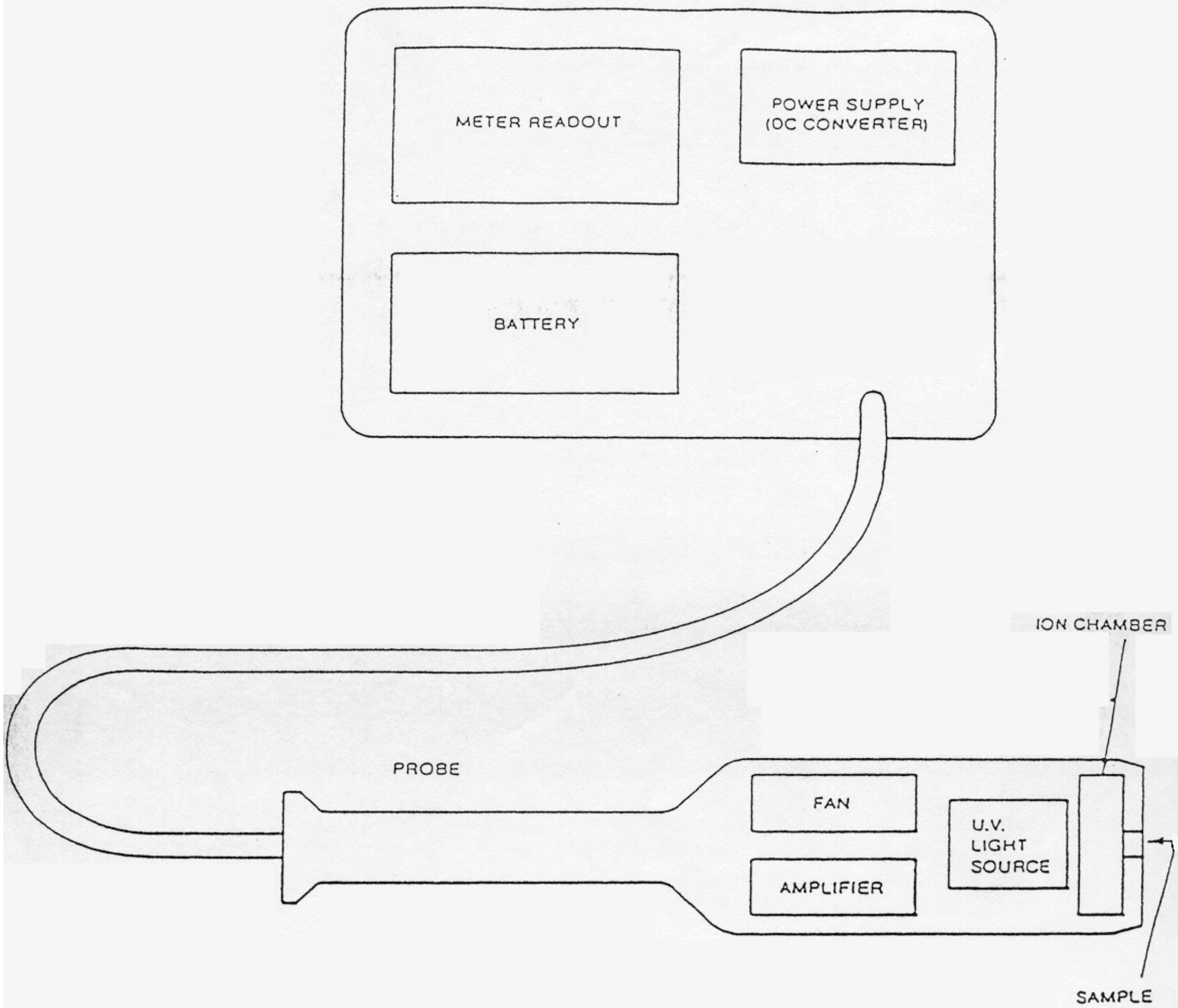
   a. Turn the function switch to Standby - hold probe up to ear to hear pump motor sound.

   b. Hold marking pen point up to probe with function switch in the 0-200 ppm position.



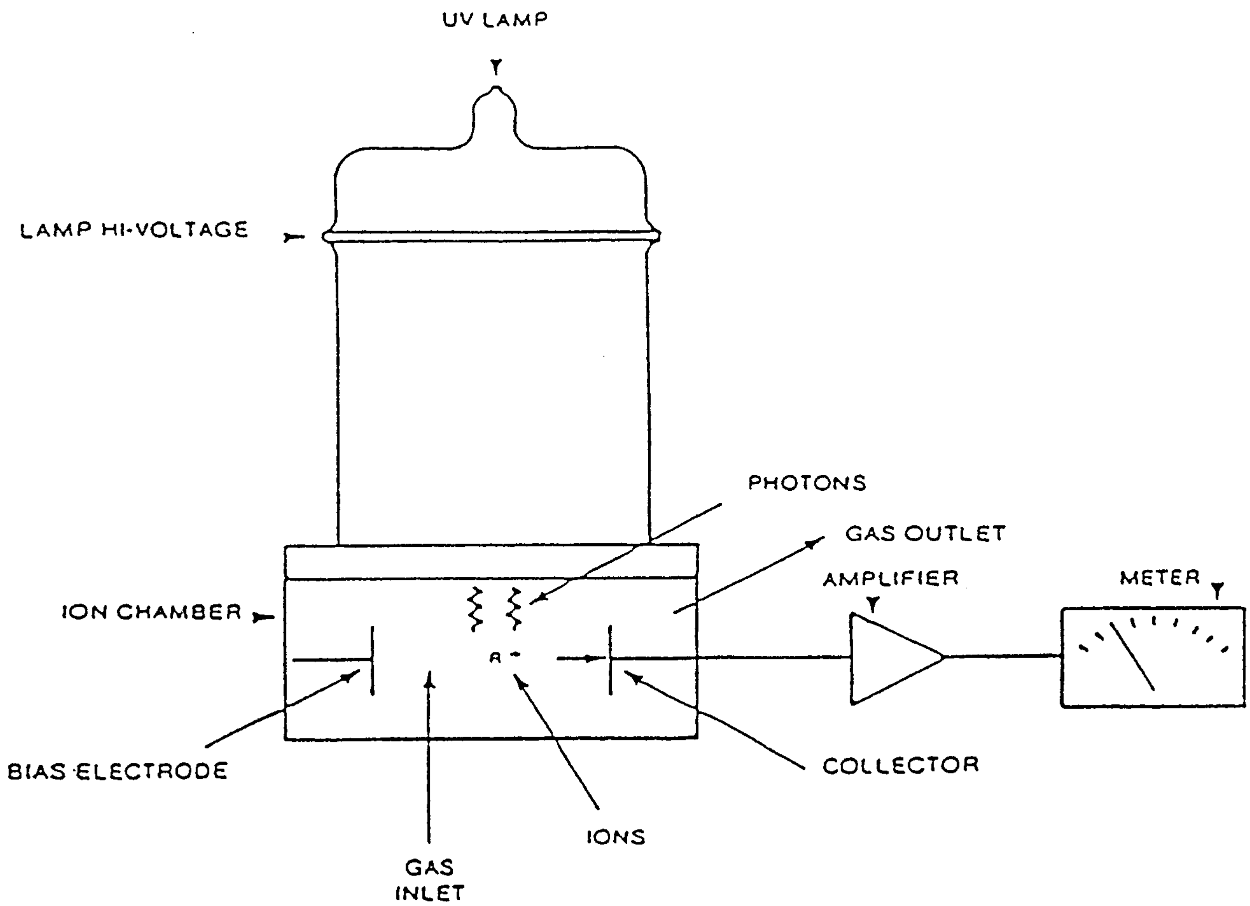
Hnu Photoionizer

CONTROLS AND INDICATORS



Hnu Photoionizer

BLOCK DIAGRAM
COMPONENT LOCATION


UV LAMP
LAMP HI-VOLTAGE
PHOTONS
GAS OUTLET
AMPLIFIER
METER
ION CHAMBER
BIAS ELECTRODE
COLLECTOR
IONS
GAS
INLET

Photoionizing Detector (NHu)

Hazard Monitored: Organic and inorganic vapors and gases.

Application: To determine relative concentrations of air contaminants. Information used to establish level of protection and other control measures such as action levels. It will not detect methane.

Components: Survey probe with ultraviolet lamp (9.5, 10.2, 11.7 eV); needle meter readout; lead-acid gel battery; span potentiometer; range selector; and zero control.

Detection Method: Photoionization.

Readout: The meter usually can be read on the following ranges depending on the make of the instrument: 0-20, 0-200, and 0-2000 (span = 9.8 - benzene equivalent).

Calibration: The instrument is factory calibrated to benzene. The calibration should be checked before and after use with a calibration check gas. Once calibrated the span setting can be changed. HNu Systems supplies isobutylene as a check gas for the instrument.

Inherent Safety: The HNu photoionizer can be purchased with the following approvals: Class I Division I Groups ABCD; Class I Division 2 Groups ABCD; and nonapproved. Be sure to examine the instrument to determine its approval. Check to make sure the instrument is approved for the use you put it to.

Limitations: Because the instrument is sensitive to many organic and inorganic vapors/gases it cannot be used as a qualitative instrument in unknown situations. It is strictly quantitative, except when the nature of the contaminant is known and the instrument has been calibrated for it. High humidity reduces sensitivity. Atmospheres with concentrations of vapors and gases above the detection limits of the instrument will cause inconsistent instrument behavior.

EPA ACTION GUIDES

UNKNOWN ATMOSPHERE

0-5 ppm	**level C**
5-500 ppm	**level B**
500-2000	**level A**

PHOTOIONIZATION DETECTION (HNu) LIMITATIONS

- Radio frequency interference may skew readings.
- High humidity, temperature differentials "cloud" the UV lamp window, depressing readings.
- Uses lead-acid battery which loses power in cold weather, affects readings.

The HNu system does have a number of limitations. It can be susceptible to radio frequency interference from power lines, transformers, high-voltage equipment, and radio transmissions. Also, the window of the UV lamp must be cleaned on a regular basis to ensure that airborne contaminants are ionized. Finally, the HNu system also uses a lead-acid battery. These batteries lose power in cold weather and can be unreliable. Once the batteries have been severely discharged, they may no longer accept a charge and will need to be replaced. For these reasons, the unit should be placed on the battery charger after every use. The HNu charge circuit has a protector that prevents overcharging.

NOTES

Lamp strength is also an important consideration with any photoionization detector. The UV lamp may not have enough energy to ionize certain compounds, and they will therefore not be detected. UV lamp strengths are given in electron volts (eV). Compare the lamp strength to the compound's ionization potential, also expressed in electron volts. Common lamp strengths are 9.6 eV, 10.2 eV, and 11.7 eV.

Ionization potentials may be found in chemical reference works, such as the CRC Handbook of Chemistry and Physics. Most owner's manuals will also specify common ionization potentials.

Lamp strengths of 10.2 eV are suitable for general UST work.

RADIATION SURVEY METER

Hazard Monitored: Alpha, beta, and gamma radiation.

Application: Determine the presence and level of radiation. This information will be used to establish control measures to reduce or prevent exposure.

Readout: The readout normally is in mR/hr. Instruments used to detect alpha may read in counts per minute.

Calibration: This instrument must be factory calibrated at least annually. The instrument is normally calibrated to one probe allowing direct measurement of the source.

Inherent Safety: Usually none required.

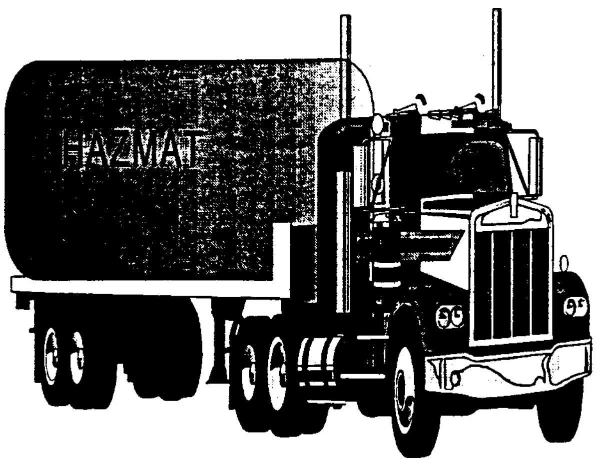
EPA ACTION GUIDES	
Background	**Continue investigation**
3-5 times background	**Consult health physicist**
>2 mR/hr	**Potential hazard - leave area and consult health physicist**

MODULE 5

TRAINING FOR SAFE TRANSPORTATION OF HAZARDOUS MATERIALS (HM 126F)

STUDENT MANUAL - PART II

• FUNCTION-SPECIFIC TRAINING •



ARIZONA STATE UNIVERSITY -- EAST

OFFICE OF ENVIRONMENTAL TECHNOLOGY

Table of Contents

SUGGESTED TABBING OF 49-CFR (BNA Parts 171 thru 178)
HAZARDOUS MATERIALS, SUBSTANCE, AND WASTE

SUBJECT	49-CFR REFERENCE	SUGGESTED TAB
GENERAL		
Definitions/Abbreviations	171.8	DEF/ABB
COMMUNICATIONS REQUIREMENTS		
Hazardous Material Table (Info)	172.101	HMT (Info)
Hazardous Material Table (Entries)	172.101	HMT (Entry)
Hazardous Substance Table	Appendix A	HAZ SUB
Marine Pollutants Table	Appendix B	MARINE POL.
Special Provisions	172.102	SPEC PRO
Shipping Papers	172.200	SHP PAP
Marking	172.300	MARKING
Labeling	172.400	LABELS
Placarding	172.500	PLACARDS
Emergency Response Info	172.602	EMERG INFO
Emergency Contact: Phone Number	172.604	EMERG PHONE
Training Requirements	172.700	TRAINING
CLASSIFYING and GENERAL PACKAGING (Exceptions) REQUIREMENTS		
Classifying Haz. Materials	173.2	CLASS INDEX
Precedence Table	173.2a	PRE TABLE
“Salvage Drums”	173.3	SAL DRUMS
Small Quantities	173.4	SMALL QUNT
Exceptions for Waste Shipments	173.12	WASTE EXP
Exceptions for Class 3, 4, 5, 6, & 8	173.13	EXP 3,4,& 8
Generator’s Responsibility	173.22	GENERATOR
General Packaging Req.	173.24	GEN PACK
Additional Packaging Non Bulk	173.24a	ADD NON BULK

CLASSIFYING and GENERAL PACKAGING (Exceptions) REQUIREMENTS		
Overpacks	173.25	OVERPACKS
Reuse of Packagings	173.28	REUSE
HAZARDOUS CLASS DEFINITIONS and SPECIFIC (Exceptions) PACKAGING REQUIREMENTS		
Class 1 Definitions(Explosives)	173.50	CLASS 1
Class 2 Definitions(Comp. Gas)	173.115	CLASS 2
Class 3 Definitions(Flm. Liquids)	173.120	CLASS 3
Class 4 Definitions(Flm. Solids)	173.124	CLASS 4
Class 5 Definitions(Oxidizers)	173.127	CLASS 5
Class 6 Definitions(Posion)	173.132	CLASS 6
Class 7 Definitions(Radioactive)	173.403	CLASS 7
Class 8 Definitions(Corrosive)	173.136	CLASS 8
Class 9 Definitions(Miscelaneous)	173.140	CLASS 9
(ORM-D)	173.144	ORM-D
Packaging Exceptions for Classes 3, 4, 5, 1, 6, & 8 (Ltd Qty, ect.)	173.150 thru 156	PACKAGE EXCEPTIONS
Non Bulk Packing	173.201 thru 213	NON BULK
Bulk Packaging	173.240 thru 249	BULK
CARRIER REQUIREMENTS		
Rail	174	RAIL
Air	175	AIR
Water	176	WATER
Highway	177	HIGHWAY
PERFORMANCE-ORIENTED NON-BULK PACKAGING		
Performance-oriented Standards	178.500	POP STAND
Performance-oriented Testing	173.600	POP TEST

YOUR COMPANY or ORGANIZATIONS D.O.T. EXERCISE

1. **WHAT HAZARDOUS MATERIALS ARE HANDLED BY YOUR ORGANIZATION**

NAME	SIZE AND TYPE OF CONTAINER	VIRGIN (V) WASTE (W)	HMTA REGULATION REQUIRED (Y or N)

2. **For each chemical above, that are regulated by 49CFR, prepare the following Analysis:**

   A. WHY IS THE MATERIAL REGULATED BY 49CFR?

   B. WHAT IS THE D.O.T DESCRIPTION?
   1) Proper Shipping Name –
   2) Hazard Class –
   3) I.D. Number –
   4) Packing Group –

   C. WHAT MARKINGS IS ON THE CONTAINER?

   1) Description of the Marking
      a) Regulation Reference Section = ____________________

   D. WHAT LABEL(s) ARE ON THE CONTAINER?
   1) Description of the Label(s)
      a) Regulation Reference Section = ____________________

E. WHAT IS THE CONTAINER SPECIFICATION

1) **Description of the Container Specification Marking**

a) **Regulation Reference Section = ____________________**

F. WHAT IS THE D.O.T. SHIPPING PAPER/MANIFEST DESCRIPTION?

1) **Proper Shipping Name –**
2) **Hazard Class –**
3) **I.D. Number –**
4) **Packing Group –**
5) **Weight –**
6) **Certification Signed –**
7) **Emergency Response Telephone Number –**
8) **Emergency Response Information i.e. MSDS or ERG reference –**

a) **Regulation Reference Section(s) = ________________**

G. WHAT PLACARD(s) WOULD YOU OFFER?

1) **Description of the Placard(s)**

a) **Regulation Reference Section(s) = ________________**

DEFINITIONS

HAZARDOUS MATERIALS

Definitions

A hazardous material, as defined by the U.S. Department of Transportation (DOT), is a substance or material, including a hazardous substance, in a quantity or form which may pose an unreasonable risk to health, safety, or property when transported in commerce.

Classification

Hazardous materials are classified according to their chemical and/or physical properties or their relative hazard to health. The Department of Transportation has adopted the United Nations (UN) system of identifying hazardous is materials by class number. The regulations in 49 CFR will show both the UN hazard class number and, in parentheses, the name of that hazard class. For example, under the UN system, flammable liquids will be "Class 3." This will be shown in 49 CFR as "Class 3 (flammable liquid)." Some materials are identified with a "Division number." For example, compressed gases could be Division 2.1 (flammable gas), Division 2.2 (nonflammable gas), or Division 2.3 (poisonous gas).

Also, most hazardous materials are assigned a Packing Group according to the degree of danger. There are three Packing Groups: I, II, and III. Group I packages are for the greater danger, Group II for medium danger, and Group III for minor danger. Materials in the same hazard class may require different Packing Groups. For example, Class 3 (flammable liquid) may be assigned Packing Group I, II, or III depending on the characteristics of the material, such as flash point and boiling point. Packing Groups are not assigned to Class 2 (gases), Class 7 (radioactive), combustible liquids or ORM materials. Section 173.2 contains a table listing the hazard classes, their names, and those sections which contain definitions for classifying materials.

Multi-Class Materials

Frequently materials will have properties which meet the definition of more than one hazard class. In such cases, the shipper must classify the material according to the Precedence of Hazardous Table in §173.2a. The Table in that section determines which is the "primary hazard class (or division)," or "how the material is classed." The primary hazard class (or division) is shown on shipping papers and is used to determine placarding (warning signs on vehicles) and other operating requirements for the carrier. Other hazards a materials may have are called "subsidiary hazards" and will be communicated through additional shipping paper entries and/or hazard warning labels on the packages. As an example, Crotonaldehyde, stabilized, is a material that is Class 3 (flammable liquid), Packing Group II, and also Division 6.1 (poisonous). According to the table in §173.2a, this material would have a primary hazard of Class 3 and would be identified on the shipping paper as having a subsidiary. hazard of Class 6.1.

DEFINITIONS

Definitions of Terms

You will be learning many new terms during this course so it is important that you know what these terms mean.

General Definitions: These apply throughout the regulations and are found in §171.8.

Specific Definitions: These apply to a specific subject and are found in the section(s) dealing with that subject. (See 173.403 for Radioactive Materials definitions.)

Turn to §171.8. Locate the following general definitions, read them carefully, and highlight the subject for future reference.

Bag	Hazardous Waste	Package
Box	Inner Packaging	Packaging
Bulk Packaging	Inner Receptacle	Packing Group
Cargo Tank	Limited Quantity	Person
Class	Manufacturer	Portable Tank
Combination Packaging	Marking	Primary Hazard
Compatibility Group	Mixture	Proper Shipping Name
Composite Packaging	Mode	Reportable Quantity
Consumer Commodity	Non-Bulk Packaging	Shipping Paper
Division	NOS	Solution
Flash Point	NRC	Strong Outside Container
Freight Container	ORM	Subsidiary Hazard
Hazardous Material	Outer Packaging	Technical Name
Hazardous Substance	Overpack	Transport Vehicle

Definitions of Hazard Classes

The hazard class definitions are not found in §171.8. Each class (or Division) is referenced to another section containing the specific hazard class (or Division) definition. The following pages contain work projects to help you become acquainted with the specific hazard class definitions. Remember these are definitions of hazard classes for Department of Transportation purposes.

49CFR CLASS/DIVISION REFERENCE TABLE

Class or Division	Definition Name	Ref.	Examples **	Type of Hazard **
1.1	Explosive *2	173.50	Black powder	Mass explosive
1.2	Explosive *2	173.50	Rocket motors	Projection hazard
1.3	Explosive *2	173.50	Fireworks Type C	Fire w/minor blast or projection
1.4	Explosive *2	173.50	Squibs	Small hazard, normally kept to package
1.5	Explosive *2	173.50	Water gels	Insensitive but mass explosion
1.6	Explosive *2	173.50		Insensitive articular mass explosion
2.1	Flammable Gas	173.115(a)	Propane	Contents under pressure and flammable
2.2	Non-Flammable Gas	173.115(b)	Nitrogen	Contents under pressure (300kPa/44PSIA) .
2.3	Poisonous Gas	173.115(c)	Chlorine	Contents under pressure and poisonous
3	Flammable Liquid	173.120(a)	Benzene	Flash point equal to or less than 141 °F (60.5^{0}C)
	Combustible Liquid	173.120(b)	Diesel fuel	Flash point equal to or more than 100°F can be reclassified for highway or rail
4.1	Flammable Solid	173.124(a)	Matches, Safety combustible	Cause fire by friction, readily
4.2	Flammable	173.124(b)	Fibers, Animal	Spontaneous combustion Solid

4.3	Flammable Solid	173.124(c)	Calcium Carbide	Reacts with water and spontaneously combustible/give off flammable gas
5.1	Oxidizer	173.127(a)	Potassium Bromate	Yields oxygen readily
5.2	Organic Peroxide	173.128(a)	Acetyl Benzoyl Peroxide	Thermally unstable
6.1	Poisonous	173.132(a)	Parathion Liquid	Poison based on LD50 or LC50 i.e. Oral LD50 500mg/kg (liquid)
6.2	Infectious Substances	173.134(a)	AIDS virus	Viable micro-organisms causing disease in humans/animals
7	Radioactive Material	173.403(y)	Uranium-234	Activity greater than 0.002 uCi/g (74k Bg/kg)
8	Corrosive	173.136(a)	Muriatic Acid	Destroys skin when exposed ≤ 4 hours or corrosion rate ≥ .25 IPY
9	Miscellaneous	173.140(a) 173.140(b)	Dry-ice Haz. Substance/ waste	Oxygen deprivation Effect on environment
ORM-D	Consumer Commodity	173.144	Drugs	Regulated domestically only

* Also have compatibility groups for explosives (Table 1, I73.52(b)).

** Summary only, check definition sections for specific.

CLASSIFYING HAZARDOUS MATERIALS USING 49CFR

A. STEP 1

1. Hazard Class

For a material to be regulated as a Hazardous Material under 49CFR it must meet the definition of one of the classes contained in Section 173 of 49CFR. The first step is to determine IF THE MATERIAL BEING SHIPPED is regulated as a hazardous material meeting the criteria of one or more of the classes and packing groups contained in Section 173 of 49CFR. If the material being shipped does NOT meet any of the criteria of one or more of the classes contained in Section 173 of 49CFR, it is not regulated as a hazardous material. If the material being shipped meets the criteria of one or more of the hazard classes contained in Section 173, the material is regulated as a hazardous material. The next step would be t^ find the most appropriate PSN listed in Column 2 of the Hazardous Material Table (HMT) with Column 3 and 5 entries that are the same Class and Packing Group as the hazardous material being shipped. The class or division and packing group if applicable, governs the selection of the PSN and other information related to it.

ILLUSTRATION:

A paint that has a flash point of 68°F (20°C) and an initial boiling point of over 95°F (35°C) would be regulated as a Class 3 with a Packing Group of II. The Hazardous Material Table contains two potential entries for the PSN paint, illustrated in Figure 2. The entry that must be used is the first one because the hazard class (Column 3) 3 and the Packing Group (Column 5) II agree with the class and packing group of the material.

Classification Terminology (Class numbered 1 through 9).

Each has its own definition which will be found in Subparts C and D, corresponding to the class "number" within Section 173 of 49CFR. The first paragraph within the section will contain the Class Definition. illustrates Subsection 173.120 which contains the definition paragraph for "Class 3 Flammable Liquids." A complete listing of the definition, references, and a summary of the hazards related to each class will be found in Figure 4 on pages III-7 and III-8.

Divisions. Hazardous Material Classes 1, 4; S; and 6 are broken down into divisions which are indicated by a decimal number after the primary class number. Reference to the Figure 4 Hazard Class: definition reference, division, and packing group
indicates that Class 4 has three divisions. The number to the left of the period is the class and the number to the right of the period is the division. Division 4.3 is Division 3 of Class 4.

2. **Packing Group**, or the degree of hazard. The class or division represents the type of hazard associated with the hazardous material. The packing group represents the degree of that type of hazard within the transportation system. Where applicable the packing group will be an upper case Roman numeral I, II, III.(172.101(f). The lower the packing group number, the greater the degree of risk and the more it will be regulated. Among other things, the packing group dictates the entries in Column 5 of the Hazardous Materials Table (HMT) to be used, governs the drop test for UN packaging, is a code marked on UN specification packaging, and is a required entry on the shipping paper for hazardous material.

Packing Group I	-	Greatest degree of risk - Most regulated.
Packing Group II	-	Moderate degree of risk - Moderately regulated.
Packing Group III	-	Least degree of risk - Least regulated, but still regulated.

For materials specifically identified by their technical name in the HMT, the packing group if applicable, will be found in Column 5 of the entry. In addition, certain classes and divisions such as 3, 4.1, 4.2, 4.3, 5.1, 6.1 and 8 have packing group criteria which must be considered in classifying hazardous materials not specifically identified in the HMT by their chemical (technical) name (I73.2a). The packing group if applicable, will be found in Column S of the EMT for the entry. In addition, Classes 3, 6, and 8 have packing group criteria which must be considered in classifying hazardous material not specifically identified in the EMT by their chemical (technical name) (173.2).

The packing group criteria will usually be found in a paragraph or paragraphs which closely follow the definition paragraph. . illustrates this _point for "Class 3 flammable liquids". The packing group criteria is found in Paragraph 173.121(a) which comes immediately after the Definition Paragraph 173.120.

173.120 Class 3 = FLAMMABLE LIQUIDS
Definition of Class 3 Hazardous Material

173.120(a) Means any liquid having a flash. point of not more than 60.5°C (141°F) with the following exceptions:

- Any liquid meeting one of the definitions specified in 173.115.
- Any mixture having one or more components with a flash point greater than 60.5°C (141°F) or higher making up at least 99 % of the total volume of the mixture.

PACKING GROUP CRITERIA -173.121

Packing Group	Flash Point (Closed Cup)	Initial Boiling Point
1		<= 95°F (35°C)
II	< 73°F (23°C)	> 95°F (35°C)
III	≥ 73°F (23°C) but ≤ 141°F (60.5°C)	> 95°F (35°C)

Technical Name. Recognized chemical name currently used in technical and scientific texts, formulas, and handbooks (17L8).

Technically Pure. As used in this text the term Technically Pure means a material (chemical) as it is commonly manufactured without the addition of any outside ingredients which would cause it to become a mixture or solution. It includes those impurities which are a natural result of the manufacturing process.

a. The Classification of Hazardous Materials

(1) Technically Pure Materials Specifically Identified by Their Technical Name. As a general rule, technically pure materials specifically identified in Column 2 of the HMT with a PSN that is their specific chemical or technical name will be regulated under the class specified in Column 3, and the packing group shown in Column 5 for the entry. Reference to Columns 2, 3, and 5 in Figure 5 for ".technically pure acetone" indicates its PSN is acetone, it is regulated as a Class 3, and has a Packing Group of II.

b. Mixtures and Materials not Specifically Identified Technical Names. Mixtures and materials NOT specifically identified in Column 2 of the MAT by a PSN that is their specific chemical or technical name must be classified by:

(1) Comparing their characteristics against the criteria listed in the appropriate Section 173.XXX to determine the class or classes under which the material is regulated, if any. A complete list of the classes, definitions, references, and a summary of the hazards involved will be found in Figure 4 on Page III-7 and III8.

For Classes 3, 4, or 8 and Divisions 5.1 and 6.1, classify by:

(2) Comparing their characteristics against the packing group criteria to determine the packing group.

(a) **Technically Pure Chemicals**. Technically pure Ethyl Cyclohexane has a flash point of 95°F (35°C) and an initial boiling point over 95°F (35°C) and is not listed by its chemical name in Column 2 of the HMT. A comparison of the characteristics with the different hazard class definitions in Section 173.XXX of 49CFR leads to the possibility of the material being regulated as a "3" flammable liquid. Information from Section 173.120 of 49CFR is contained in Figure 3. A comparison of the characteristics of Ethyl Cyclohexane against the Definition Paragraph 173.120 indicates that Ethyl Cyclohexane is regulated as a Class 3 flammable liquid because its flash point is less than 141°F (60.5°C). Further, a comparison of the flash point and initial boiling point of Ethyl Cyclohexane would be in Packing Group III because the flash point is above 73.4°F (23°C) and the initial boiling point is above 95°F (35°C). The PSN, class, UN number, and packing group would be: Flammable Liquid, n.o.s. (contains Ethyl Cyclohexane), 3, UN 1993, PG III.

(b) **Single Class Mixture**. A mixture of Acetone and Benzene having a flash point of 76°F (24.4°C) and an initial boiling point of more than 95°F (35°C) and is not specifically identified in Column 2 of the HMT by its chemical name would be classified as follows. Although both Acetone and Benzene are listed separately, their mixture is not. A comparison of the characteristics of the mixture against Class 3 definition and packing group criteria illustrated in Figure 4 indicates that the mixture of Acetone and Benzene would be classed as a "3" and have a Packing Group of "III", because the initial boiling point is above 95°F (35°C) and the flash point of 76°F (24°C). The PSN, class, UN number, and packing group would be:

Flammable Liquid, n.o.s. (contains Acetone/Benzene), 3, UN 1993, PG III.

(C) **Multiple Class Materials or Mixtures**. If a material that is not specifically identified in Column 2 of the HMT by its technical name or a mixture of materials that meets the definition of more than one class must be classed in accordance with the precedence indicated in Section 173.2a of 49CFR. For hazardous materials Classed as 3, 4.1, 6.1, or 8, the precedence is determined by the table in 173.2(b). Reference to the table will show that a mixture of Menthanol and Potassium Hydroxide meeting the definitions of a Class 3, Packing Group II and a Class 8, Packing Group II would be classed as a Class 3, Packing Group II because that is the class and packing group which appears at the point in the table where the two classes and packing groups of the material cross each other. The subsidiary risk of the mixture would be Class 8, Packing Group II. The PSN, class, UN number, packing group would be:

Flammable Liquid, Corrosive, n.o.s. (contains Methanol/Potassium Hydroxide), 3, UN2924, PG II.

(d) **Subsidiary Risk Under 49CFR**. In addition to the determination of the primary hazard class, a determination must also be made as to the applicability of the subsidiary risk, if any. In general, the term Subsidiary Risk is an international term for additional labeling and Will Most Often apply to materials meeting the definition of more than one hazard class.

- For materials being shipped in their technically pure form that are specifically identified in the HMT Column 6* as an additional label to the class label.

  Reference to Column 6 for the entry Allyl Acetate shows a second label of **Poison** in addition to the Class Label "Flammable Liquid."

- For materials or mixtures not specifically identified in the HMT by their chemical or technical names, the subsidiary risk determination is an extension of the classification process requiring a determination as to the additional hazard class definitions a given material meets. Once this information is obtained, reference to the Section 172.402 Table as illustrated in the section will give the subsidiary hazard.

<u>**DISCUSSION**</u>. The Methanol/Potassium, Hydroxide Mixture discussed on page III-7 under Item 1 (c) meeting the definitions of a Class 3, Packing Group II and a Class 8, Packing Group II would be classed as a Class 3, Packing Group II because that is the class and packing group which appears at the point in the table where the two classes and packing groups of the materials cross each other. The subsidiary risk of the mixture would be "8" and require a "Corrosive" label in addition the "Flammable Liquid" label.

3. Proper Shipping Name (PSN)

Importance of the **Proper Shipping Name**. The PSN determines the entry or line in the HMT (172.101) that is used to make many other determinations such as mode exceptions, hazard class, UN/ID number, labeling, UN packing groups, special provisions, packaging instructions, passenger and cargo aircraft quantities, and vessel storage requirements. The PSN is the key to regulatory compliance and safety. It is a required mark on the package and a required entry on the shipping paper. If a material has the wrong PSN the shipment cannot be considered neither safe nor in compliance.

a. How to determine the most appropriate PSN, hazard class, identification number, and packing group:

(1) General Rule, the most specific Column 2 entry in Roman print, the PSN is obtained from Column 2 of the HMT 172.101. The name in column 2 of the HMT 172.101 in Roman print that MOST appropriately (specifically) describes the hazardous material being shipped MUST be used. In determining the most appropriate PSN from Column 2, the most specific information available, chemical name used, product use, etc., should be used in the following order:

- **Chemical Name**. If a material or mixture is specifically identified by its chemical (technical) name in Column 2 of the HMT 172.101 the most appropriate PSN will generally be that entry. This is most applicable when shipping material in technically pure form and normal commercial mixtures for solutions of such materials as Acetone or dry Calcium Hypochlorite mixtures.

    - **Generic Chemical or Usage Name**. If a material or mixture is not identified in the EMT 172.101 by its chemical name, the next most appropriate PSN would be the generic chemical or usage name listed in Column 2 of the EMT 172.101 that best describes the hazardous material being shipped. Examples of such PSNs would be Alcohol, n.o.s.; Organophosphorus pesticides, liquid, toxic, n.o.s.; Paint.

    - **General Hazard Class Entry**. If the hazardous material is not more appropriately (specifically) identified in Column 2 of the HMT by any of the above it must be identified by the most appropriate General Hazard Class Entry in Column 2 such as Flammable Liquid, n.o.s; Corrosive Liquid, n.o.s.; Flammable Liquid, Poisonous, n.o.s.; etc.

(2) Using Column 2 of the HMT 172.101 the PSN for a shipment of technically pure Acetone is Acetone. This is determined as follows:

- Is the chemical name listed in Column 2 of the HMT in Roman print? The PSN MUST be Acetone. Flammable liquid, n.o.s. would not be an appropriate PSN even though Acetone is a flammable liquid because there is a more specific name in Column 2. In most cases the chemical or technical name listed in Column 2 will be the PSN.

(3) Technically pure Ethyl Cyclohexane with a flash point of 95 °F (35°C) meets the DOT definition of a flammable liquid and is used in organic synthesis. Using Column 2 of the HMT, the PSN for this material in its technically pure form would be determined as follows:

- Is the chemical name listed in Column 2 of the HMT in Roman print? No.
- Is a generic chemical or usage name listed in the HMT? No.
- Select the general hazard class entry from Column 2 of the HMT 172.101 that is most appropriate for the hazardous material being shipped: Flammable Liquid, n.o.s. (Ethyl Cyclohexane)

(4) Specifically Listed Materials Mixture Rule. Generally, if a hazardous material that is listed in the HMT 172.101 by its chemical (technical) name is MIXED with other materials that are not regulated as a hazardous material the PSN Must Be the chemical name of the listed material. The PSN for Acetone in its technical pure form, and in a mixture is the same - Acetone. The words "Mixture" or "Solution" as appropriate shall be added to the PSN in Column 2 (172.101(c)(10).

PERFORMANCE-ORIENTED PACKAGING

PACKAGING MUST MEET PERFORMANCE-ORIENTED STANDARDS

The U.S. DOT non-bulk specification packaging requirements are replaced by a system of performance-oriented packaging (POP) standards. This system helps shippers and manufacturers design packages suitable for the environments in which the shipment is transported. The UN "package performance" system provides a more rational and uniform basis for making packaging assignments. The POP system and standards emphasize risk avoidance and incident prevention.

PACKAGING MUST FIRST BE TESTED AND MARKED

Successful passage of the UN drop, leakproofness, hydrostatic pressure, and stacking test determines the UN marking of the package. This UN marking certifies that in transportation, the packaging is appropriate for the level of hazard contained.

PERFORMANCE-ORIENTED PACKAGING AND INTERNATIONAL STANDARDS

The performance-oriented packaging system is not a verbatim repetition of the international standards. Deviations have been made based on public comments and on U.S. DOT's own initiative. Some of these deviations include:

- For liquids and gases poisonous by inhalation, the new rules in HM-181 go beyond the UN system. Bulk and non-bulk packaging are upgraded for these high-hazard materials.
- A vibration standard has been added to ensure an acceptable level of safety because the international standards were believed inadequate. Packagings must be capable of passing this test.
- Domestic packaging exceptions are provided to account for transportation stresses unique to the U.S. distribution system.

MANUFACTURER/CERTIFIER/SHIPPER RESPONSIBILITY - GENERAL

Packaging manufacturers or others that certify that package design types meet HM 181 and shippers who prepare packagings for shipment, **SHARE THE RESPONSIBILITY FOR MAINTAINING THE STRUCTURAL INTEGRITY OF PACKAGES** when they are transported under normal transportation conditions.

Manufacturers/Certifiers

- Packagings are developed, tested, and marked by manufacturers or other persons who certify that the resulting design types perform to the hazard levels of the materials they are intended to contain.
- Shippers ensure that hazardous materials are properly certified to have met Part 178 requirements and are in proper condition for transportation.

MANUFACTURER/CERTIFIER/SHIPPER RESPONSIBILITY - SPECIFIC

Any person who certifies that a package complies with a DOT or UN standard:

- Applies the mark or directs another to apply it.
- Produces single or composite packagings, and applies the certifying mark before distribution.
- Assembles and closes a design type combination packaging, tests the completed package, and applies the certifying mark. (178.2(b))

THE CERTIFYING MARK SHOWS THAT:

- All requirements and performance tests of a DOT or UN standard have been met, and
- Everything the manufacturer does to establish a certified packaging, complies with the HM 181 requirements.

WRITTEN INSTRUCTIONS

The person who certifies a design type not in "full" compliance must provide written instructions to users on "how to bring a package into full compliance with the HM 181," before it is offered for transportation. (178.2(c))

FOR EXAMPLE: A drum manufacturer may not have provided a required closing device with the unit he sold to a shipper. The manufacturer must notify the shipper of the types of closure required to meet the performance requirements in Subpart B of Part 173.

SHIPPER RESPONSIBILITIES – SPECIFIC

BEFORE OFFERING A PACKAGE FOR TRANSPORTATION, a shipper must make sure the package complies with HM 181 packaging requirements; i.e., the shipper must:

- Complete all functions needed to bring a package into compliance (Part 178 - certifier's notification requirements).
- Ensure that under normal transportation conditions, the package maintains structural integrity (designed, built, filled, and closed properly).
- Packagings are compatible with lading.
- Packagings marked "USA" are capable of withstanding vibration test.
- Ensure compliance with packaging standards (Subpart L) and performance test requirements (Subpart M) of Part 178.

TESTING OF NON-BULK PACKAGINGS AND PACKAGES

Subpart M of Part 178 prescribes certain testing requirements for performance-oriented packagings identified in Subpart L of Part 178.

The test procedures are intended to ensure that packages containing hazardous materials can withstand normal conditions of transportation and are considered minimum requirements.

Each packaging must be manufactured and assembled so as to be capable of successfully passing the prescribed tests and conform to the requirements of 173.24 (General requirements for packagings and packages) at all times while in transportation. (178.600(a))

RESPONSIBILITY

It is the responsibility of the packaging manufacturer and the person who offers a hazardous material for transportation (dual responsibility), to the extent that assembly functions including final closure are performed by the person who offers the hazardous material, to assure that each package is capable of passing the prescribed tests.

A. Design Package

The non-bulk performance-oriented packaging standards for packaging design are listed in Subpart L of Part 178. These standards are summarized in the following charts.

CHART 11 - GENERIC UN Packaging Standards

§178.504	1A Steel Drums	§178.516	4G Fiberboard Boxes
§178.505	18 Aluminum Drums	§178.517	4H Plastic Boxes
§178.506	1N Other Metal Drums	§178.518	5H Woven Plastic Boxes
§178.507	1D Plywood Drums	§178.519	5H4 Plastic Film Bag
§178.508	1G Fiber Drums	§178.520	5L Textile Bag
§178.509	1H Plastic Drums and Jerricans	§178.521	5M Paper Bag
§178.510	2C Wooden Barrels	§178.522	6HA Composite Packaging (inner plastic receptacle)
§178.511	3A Steel Jerricans	§178.523	6PA Composite Packaging (inner glass or stoneware receptacle)
§178.512	4A Steel/Aluminum Boxes		
§178.513	4C Wooden Boxes		
§178.514	4D Plywood Boxes		

CERTIFICATION (ID CODES)§178.502
TYPES OF PACKAGES
Number = type of package

1 = drum	4 = box
2 = wooden barrel	5 = bag
3 = jerrican	6 = composite packaging

7 = pressure receptacle

Capital Letter = construction material

A = steel	G = fiberboard
B = aluminum	H = plastic
C = natural wood	L = textile
D = plywood	M = paper, multi-wall
F = reconstituted wood	N = other metal

P = glass, porcelain, stoneware

Number = category of packaging

1 = non-removable head   2 = removable head

Number = type of package

1 = drum	4 = box
2 = wooden barrel	5 = bag
3 = jerrican	6 = composite packaging

7 = pressure receptacle

Capital Letter = construction material

A = steel	G = fiberboard
B = aluminum	H = plastic
C = natural wood	L = textile
D = plywood	M = paper, multi-wall
F = reconstituted wood	N = other metal

P = glass, porcelain, stoneware

Number = category of packaging

e.g., drum:
1 = non-removable head   2 = removable head

e.g. bags:
5M1 = multi-wall bag   5M2 = multi-walled water resistant bag

B. Test Package

1. General

For liquid or solid hazardous materials required to be shipped in DOT or UN specification packaging, each "design type" package must:

- Conform to the appropriate standard in Subpart L;
- Pass the design qualification tests in Subpart M.

For specific details on testing, review §178.601 - §178.608.

Design qualification tests may be. conducted by any person who certifies the design type, that is:

- Manufacturer,
- DOT-certified third-party laboratory, or
- Non-certified testing agency to self-certify. (see 49 CFR 107.403)

Under performance standards, there are no detailed package specification requirements. Instead, "manufacturers" must maintain their own sets of detailed package test results. In effect, full detain documentation of "what was successfully tested" establishes the design type of the package. Test reports should contain enough detail to prove that the design type:

- Withstood the appropriate tests, and
- Meets all applicable UN standards

A summary of the design qualification tests is shown in the following chart.

DESIGN QUALIFICATION TESTS

TESTING OF DESIGN TYPES: Samples of package design types containing the hazardous (or *equivalent substitute)* materials they are intended to carry are tested according to:
- The hazard level of the materials (expected by Packing Groups 1, II, III)
- The vapor pressure or density of the material
- The nature of the material, liquid, or solid

DROP TEST (§178.603)
- Required for all packagings for both liquids and solids
- Required for all Packing Groups
- Drop height varies depending on the Packing Group
- Within a Packing Group, drop height increases with increasing specific gravities above 12

LEAKPROOF TEST (§178.604)
- Required for all packagings intended for liquids (except for inner packagings or combination packagings)
- Required for all Packings Groups
- Pressure required varies, and depends upon the Packing Group

HYDROSTATIC PRESSURE TEST (§178.605)
- Required for all packagings intended for liquids (except for inner packagings of combination packagings)
- Pressure applied to the test sample depends upon the vapor pressure of the hazardous material
- Minimum test pressure for Packing Group I is 250 kPa

STACKING TEST (§178.606)
- Required for all packagings for both liquids and solids

COOPERAGE TEST (§178.607)
- Required ONLY for bung-type wooden barrels

VIBRATION STANDARD (§178.608)
- All non-bulk packagings marked 'USA" must be capable of withstanding vibration test

COMBINATION PACKAGING TESTS
- Completely assembled combination packaging design types must undergo the drop and stacking tests.
- Inner packagings of combination package design types are not subject to leakproof or hydrostatic tests.

NOTE: For air transport, inner packagings must be capable of withstanding hydrostatic pressure tests to accommodate changes in altitude and temperature.

2. Retain Testing Documentation

- For as long as packages are produced PLUS an additional TWO YEARS,
- For each successfully tested design type,
- At each location where manufactured, and
- At each location where tested. (178.601(k)(1), (2))

3. Selective Testing - Variations to Packagings

"Selective" testing is an allowable design change without design qualification testing. HM-181 offers two variations: additional variations will soon be authorized.

SELECTIVE TESTING VARIATIONS (178.601(g))

All variations must *offer* an equal or greater level of performance.

	Variation	Condition
I.	Inner packaging	Variation offers equal or greater level of performance.
II.	Inner packaging of different design	Original design type withstands PG I drop test with the most fragile (glass) inner packaging.

Future Variations (Published as Competent Authority Notice)

III.	Up to 25% variation in outer. dimension	Single or composite packaging
IV.	Reduced dimension of outer packaging	Combination packagings
V.	Different closure and/or gasket device	Replacement closures and gasketing must be qualified through a test procedure.

4. Periodic Design Requalification, Production Testing §178.601

Periodic design requalification tests provide quality control in the production of packages built to design (tested/passed) types. The package "manufacturer" must requalify* design types, as shown in Chart 15.

THE "UN" CERTIFICATION MARK IS THE KEY TO THE PERFORMANCE-ORIENTED SYSTEM ADOPTED BY DOT UNDER HM-181. The following chart lists identification codes for the certification mark.

Manufacturer Marking Requirement §178.503

By October 1, 1996, every package is required to conform to the prescribed U.N. Standards. The required markings must be made in the sequence shown.

CERTIFICATION (Marking)

EXAMPLE		MARKING DEFINITION
u n	1.	The United Nations symbol
(1A1)	2.	Type of packagings (i.e., a nonremovable head steel drum)
X,Y,Z	3.	Letter (X, Y, or Z) indicating packaging performance standard appropriate to the hazardous material contained. "X" = PG I, II, **III; "Y" = PG II, III;** and "Z" = PG III.
(145)	4.	A designation of the specific gravity or gross mass which the package design type was tested.
(kPa) OR (S)	5.	Single and composite packages (for liquids) give test pressure in "kilopascals," or packages (for solids or inner packages) the letter .
(91)	6.	Last two digits of year of manufacture of package. Plastic drums and jerricans must be marked with a month of manufacture.
(USA)	7.	The letters "USA" indicate the packaging was marked in accordance with U.S. requirements.
(M1004)	8.	Name and address or symbol of the manufacturer or the approval agency certifying compliance with the UN standard. (Note: Do not have to register beforehand with U.S. DOT, if using name and address of manufacturer.)
(SP)	9.	The letter "V" indicates a combination package - selective testing variation #2. "V" signifies that a combination packaging has passed PG I drop test with the most fragile inner packaging.
(0.9mm)	10.	For metal or plastic drums or jerricans, intended for reuse, express the minimum thickness in millimeters, abbreviated "mm."
(RL)	11.	Reconditioned packaging marking.

The mark must be accessible, permanent, legible, durable, and clearly visible. Minimum letter size is 12.0 mm (0.5 inch) or 6.0 mm (0.25 inch) depending on package size.

Manufacturer Marking Requirement Examples

EXAMPLE 1

u n	4G/Y145/S/90	Fiberboard box/PG -II145/Solid/1990
	USA/RA	Correctly marked/manufacturer's name and address or registered symbol

EXAMPLE 2

u n	1A1/Y1.4/150/90	Removable head steel drum/PG-11 and specific gravity/test pressure/year
	USA/VL824	USA (correct marking)/manufacturer’s name and address or registered symbol
	1 mm	Thickness in mm

D. Non-Bulk Package Reuse and Reconditioning

Basic package reuse and reconditioning requirements are retained in HM-181. Section 173.28 is revised in HM-181 for clarity, simplicity, and application to a broader spectrum of packages.

Permitted drum reuse is based on requirements in Part 173 for maintaining original design type integrity of packages under normal transportation conditions.

1. Before reuse, packages must:

   - ♦ Pass a leakproofness test of internal air pressure:
     - ■ 7 psi for PG I liquids
     - ■ 3 psi for PG II liquids
     - ■ 3 psi for PG III liquids
   - ♦ Comply with the required minimum thickness permanently marked in millimeters (mm) on the packaging (drums and jerricans only)

2. If reused without reconditioning, packages must be marked with:

   - ♦ The name and address or symbol of the person who conducted the successful leakproofness test;
   - ♦ The month and last two digits of the year of the test; and
   - ♦ The letter "L" - indicates successful passage of test.

3. If reconditioned, packages must be marked with:

- ♦ The name and address or symbol of the reconditioner, and
- ♦ The letter "L" (passed leakproofness test).

A reconditioned package is marked near the original design-type certification mark.

CERTIFICATION (RECONDITIONING) §178.503

Where?	Country where reconditioning was performed
Who?	Reconditioner's name, address, or DOT-registered symbol
When?	Month/two-digit-year reconditioned, e.g., 4/90
What?	The letter "R" (reconditioned); the letter "L" (leakproofness tested/passed)

Non-Bulk Package Reuse and Reconditioning Examples

EXAMPLE 1

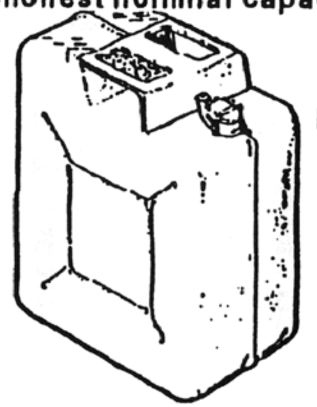
un	1AZ/Y1/4/150/88	Removable head steel drum/PG II and specific gravity/test pressure/year
	USA/VL824/1 mm	Country authorizing/manufacturer's name and address or registered symbol/thickness in mm
	USA/M-1002/07/91/RL	USA (correct marking)/reconditioner's name and address or registered symbol/date reconditioned/ leakproofness tested

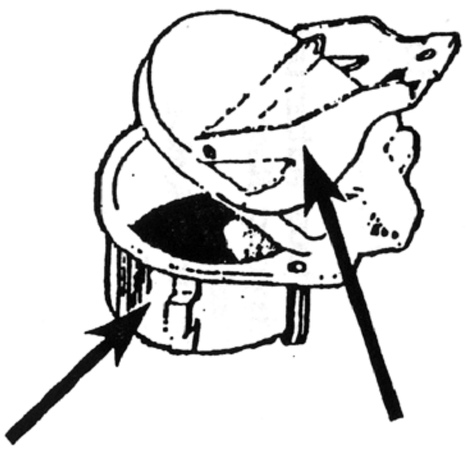
EXAMPLE 2

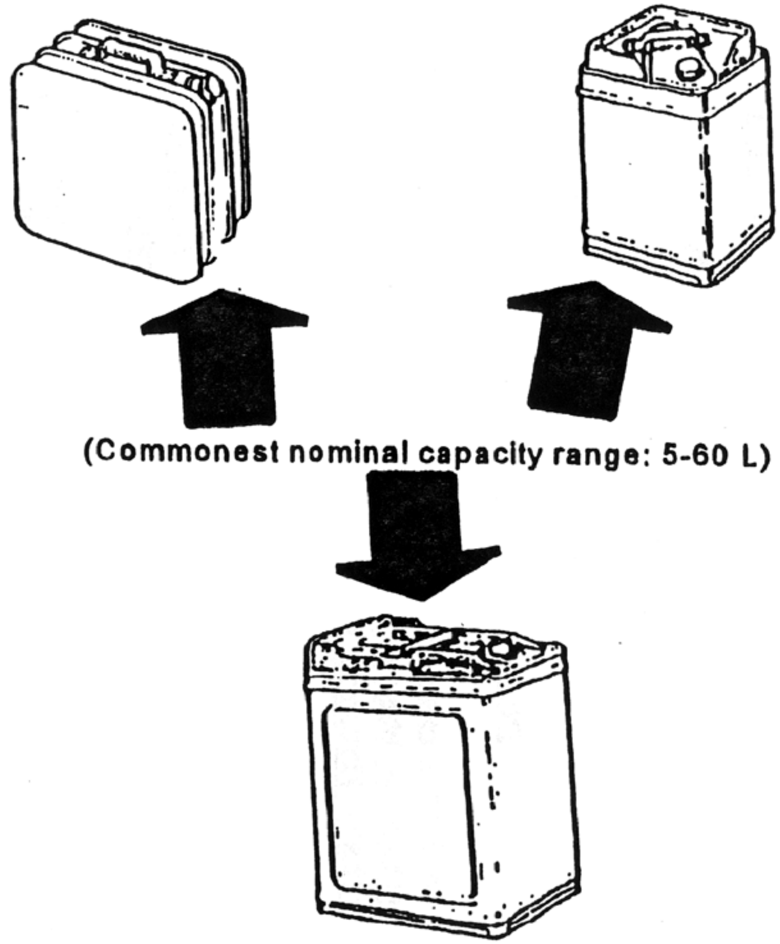
	1A2/Y1.4/150/88	Removable head steel drum/PG-II and specific gravity/test pressure/year
un	USA/VL824/1 mm	Country authorizing/manufacturer's name and address or registered symbol/thickness in mm
	USA/RB/10-90/RL	USA (correct marking)/reconditioner's symbol/date reconditioned/leakproofness tested

METAL JERRICANS

(Commonest nominal capacity range: 5-25 L)







(Commonest nominal capacity range: 5-60 L)

Customary name: "Square taper neck drum"

(Commonest nominal capacity range: 25-60 L)

Arizona State University
and
Rice Services Institute, Inc., 9622 East Keats Avenue
Mesa, Arizona 85212, (480)984-2263

Generator 's Procedure
(Using 40/49CFR)

	Reference
Step 1	
1. Determine the hazardous waste number for the material. <u>(Once a Waste Number is assigned you have a Hazardous Material)</u>	40CFR, Part 261, Subpart C & D
****Note**** ALL "HAZMAT" EMPLOYEES MUST BE TRAINED IN THEIR FUNCTIONS AS TO THE REQUIREMENTS OF 49CFR, (EITHER AWARENESS/FAMILIARIZATION or FUNCTION-SPECIFIC)	49CFR, Subpart H, (172.704)
2. Determine the Hazard Class or Division, and the Packing Group. If the material meets any of the Hazard Class Definitions listed in Part 173 "You Have A Hazardous Material."	Generator's knowledge of the material being shipped (MSDS's, Test)
a. <u>Items Listed by Name</u>: (Technical grade, or pure go to the Hazardous Material Table to find the required information)	
b. Item Not Listed by Name: (generic chemicals, generic use, hazard description, mixtures, solutions, and multiple hazards) Determine the Hazard Class or Division and Packing Group. Hazard Class or Division _______ Packing Group _________	
3. Using the Hazardous Material Table Determine the	172.101 (HMT)
a. Proper Shipping Name	Column 2
b. Hazard Class	Column 3
c. Identification Number	Column 4
d. Packing Group	Column 5
4. Modes or Types of Transportation the material is regulated by, unless Excepted in the Packaging Section for the material. (Air or Water, Domestic, International, or Plus Sign "+")	172.101 (HMT) Column 1

Step 2 **Hazardous Substance** 1. Determine IF you have a Hazardous Substance two (2) things are needed. a. The material must be listed by name in Column 1 of the Appendix to 172.101. b. You must have equal to or Greater than the amount listed in Column 3 or the Appendix to 172.101. **Marine Pollutants** 2. Determine IF you have a Marine Pollutants a. Transportation by water, bulk and non bulk 1. Marine pollutant 10% by weight 2. Severe marine pollutant 1% by weight b. Transportation by other than water, bulk 1. Marine pollutant 1% by weight (Any material meeting this definition is regulated by all Modes of Transportation) 3. Special Provision; Check the special provisions in Column 7 for the material as packaged. 172.102.	Appendix A Appendix "A" to 172.101 & 171.8 Column 1 Column 3 Appendix B Appendix "B" to 172.101 & 171.8 172.322(a), (b) 171.8 171.8 172.322(b) 171.8 171.8 171.8 Column 7 and 172.102

Reference

Step 3 1. Determine if an exception is authorized for the material being shipped. (Must have a reference in Column 8A of the Hazardous Materials Table) Are you going to use it? yes____ no___, none ______ 2. No exception authorized or not using one, then the item must be in UN Specific packaging reference in Column 8B. 3. Insure completed waste package meets the requirements as appropriate. 4. Insure completed package meets standards packaging requirements PLUS the General packaging requirements for the Hazard Class. Make sure "Performance Oriented Packaging" Test are done.	172.101 Column 8A 172.101 (HMT) Column 8B 173.12 173.24, 24a,

	172.301(a) 172.301(a) (2) 40CFR 262.32 172.301(a) (1)
Step 4 Marking the Package	
1. Mark the Proper Shipping Name on your package (for n.o.s. entries give technical names(s)) (the word “WASTE” not required if marked under EPA)	172.301(d)
2. Mark the Identification Number on your package	172.301(c) 172.301(e)
3. Mark consignor, consignee name and address	172.316(a)
4. Additional marking (as required)	172.320
a. Exception packaging	172.312
b. Previous marked packagings	172.310
c. ORM-D materials	172.203(c)
d. Explosives	
e. Orientation marking	172.313
f. Radioactive materials	172.301 & 173.25
g. Hazardous Substance (Add RQ & the name or waste number that makes it a RQ)	172.300’s &
h. Poison Inhalation Hazard	40 CFR 262.32(b)
i. Overpacks	
j. Hazardous Waste in non-bulk packages (Sticker (Label) may be used) a) Statement b) Generation Name and Address c) Manifest Document number	178 Subpart L & M
k. Specification Packaging	

	Reference
Step 5 Labeling the Package	172.400(a)
1. Label the package using the label(s) required in column 6 (unless excepted from labeling such as “Limited Quantity” or small quantity.	172.400a
2. With an appropriate additional label or multiple as may be required.	172.402

Step 6 Shipping Paper Requirements	
1. Uniform Hazardous Waste Manifest Entries	Appendix to Part 262
a. key 1 thru 10	
b. Key 11 thru 16	
1) Proper Shipping Name (and Technical names if required)(preceded by word Waste)	172.201(a)(1)
2) Hazard Class or Division	(2)
3) Identification Number	(3)
4) Packing Group (PG)	(4)
5) Waste number	172.203(C)
6) Number and Type of containers	
7) Total Quantity	172.201(C)
8) Unit (Wt/Vol) show G,P,T,Y,L,K,M, or N	
9) Emergency Response	172.600's
a) EMERGENCY CONTACT phone number in key 4 or 15	172.604(a)
b) Emergency Response Information must be provided	172.602(a),(b)
10) Key 16	
a) Name must be printed or typed	172.205(d)
b) Signature hand written	
c) Dated	
c. Additional Description (If required)	172.203
1) D.O.T. Exemptions	172.203(a)
2) Limited Quantity	172.203(b)
3) Hazardous Substances (Add RQ & the name or waste number that makes it a RQ)	172.203(c)
4) Radioactive Materials	172.203(d)
5) Empty packaging	172.203(e)
6) Transportation by Air	172.203(f)
7) Transportation by Rail	172.203(g)
8) Transportation by Highway	172.203(h)
9) Transportation by Water	172.203(i)
10) Dangerous when wet	172.203(j)
11) Technical names	172.203(k)
12) Marine Pollutants	172.203(l)
13) Poisonous Materials	172.203(m)

Reference

Step 7 Placarding Requirements 1. Placarding a. Shipper's Requirements to provide. b. Carrier's requirements for affixing.	 172.500's 172.500(a) 172.504(e) 172.504(b),(c)

WORK PROJECT (#1)
HAZARDOUS MATERIAL TABLE (172.101)

Indicate if the following Proper Shipping Names are correct. If no, mark no and go to the next Proper Shipping Name. If yes indicate the appropriate information for the commodity.

	Proper Shipping Name					
	Yes	No	Hazard Class	ID Number	Packaging Group	Label Required
Persuflates, inorganic, n.o.s.						
Mercury Batteries						
Marine Pollutant						
Butyl propionate						
Crotonic						
Fish Meal (Fish Scrap), unstabilized						
Nicotine Sulfate, Solid						
Phenylcarbylamine chloride						
Fusee Highway						

REVIEW OF THE HAZARDOUS PROPERTY

Hazardous Property Identification:

You no longer have a use for these item, and must declare them a Waste if possible. Answer the following questions yes or no, or fill in the blank;

1. Kepone (unused) in one fiberboard box containing 4 one gallon cam inside, Total Gross Weight 23 pounds, net weight 20 Pounds .

   a. Is it a Hazardous Material? _____
   b. Is it a Hazardous Substance? _____ (If yes, the RQ is ____)
   c. Is it a Marine Pollutant? ____ (If yes, the % is ______)
   d. Is it a Hazardous Waste? _____ (If yes.. the waste # is ____)

   The Proper Shipping Name is:

---

2. Adhesive (unused) (flash point 135 degrees F-, boiling point 221 degrees F.) , in one fiberboard box containing 4 one gallon cans Total Gross weight 28 pounds, net weight 25 Pounds- (Has no other hazard properties)

   a. Is it a Hazardous Material? _____
   b. Is it a Hazardous Substance? _____ (If yes, the RQ is ____)
   c. Is it a Marine Pollutant? _____ (If yes, the % is ____) Is it
   d. Is it a Hazardous Waste? _____ (If Yes, the Waste # is _____)

   The Proper Shipping Name is:

---

3. Adhesive (unused) (flash point 175 degrees F., boiling point 221degrees F.) , in one fiberboard box containing 4 one gallon cam Total Gross weight 28 pounds, net weight 25 pounds. (Has no other hazard properties)

   a. Is it a Hazardous Material? _____
   b. Is it a Hazardous Substance? _____ (If Yes. the RD. is ___)
   c. Is it a Marine Pollutant? _____ (If yes, the % is ____) Is it
   d. Is it a Hazardous Waste? _____ (If yes, the Waste # is ____)

   The Proper Shipping Name is:

---

4. Dimethyl Benzene, (spent) 55 gal. drum, with 52 gallons in it, weighing 400 pounds Gross (flash point is 81 degrees F., boiling point 281 degrees F.) (Has no other hazard properties) .
   a. Is it a Hazardous Material? _____
   b. Is it a Hazardous Substance? _____ (If Yes, the RQ is ___)
   c. Is it a Marine Pollutant? _____ (If yes, the % is ____) Is it
   d. Is it a Hazardous Waste? _____ (If yes, the Waste # is ____)

The Proper Shipping Name is:

WORK PROJECT
SHIPPER'S REQUIREMENTS

The following work project is to help you the shipper's requirements, and how to determine what is required for shipping hazardous materials.
(TO BE DONE BY THE INSTRUCTOR)

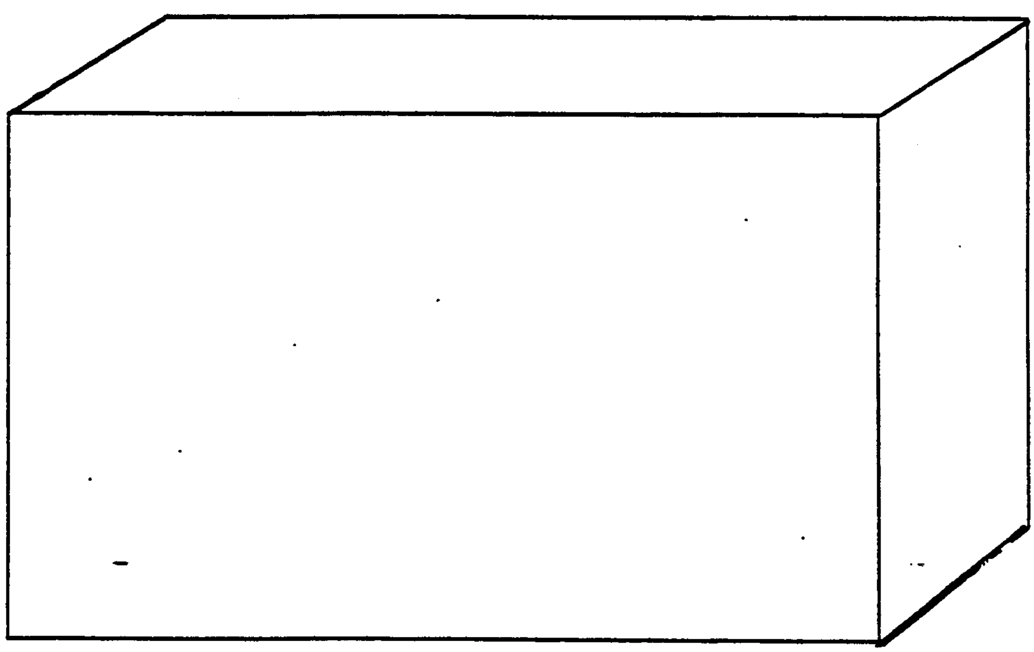
One glass battle with 5 pounds of Kepone (solid) in one box

1. What is the Proper Shipping Name? ______________________________
2. What is the Class or Division?______________________________________
3. What is the Identification Number?_________________________________
4. What is the Packing Group?____
5. Is this material a Hazardous Substance? yes ____ no ____
6. How mist this commodity be packaged? Name only one method, and list the reference. ____

Markings 172.300's
Labeling 172.400's

What Marking are required on the outside of the package?
What labels are required on the outside of the package?

Please mark and label the package below appropriately

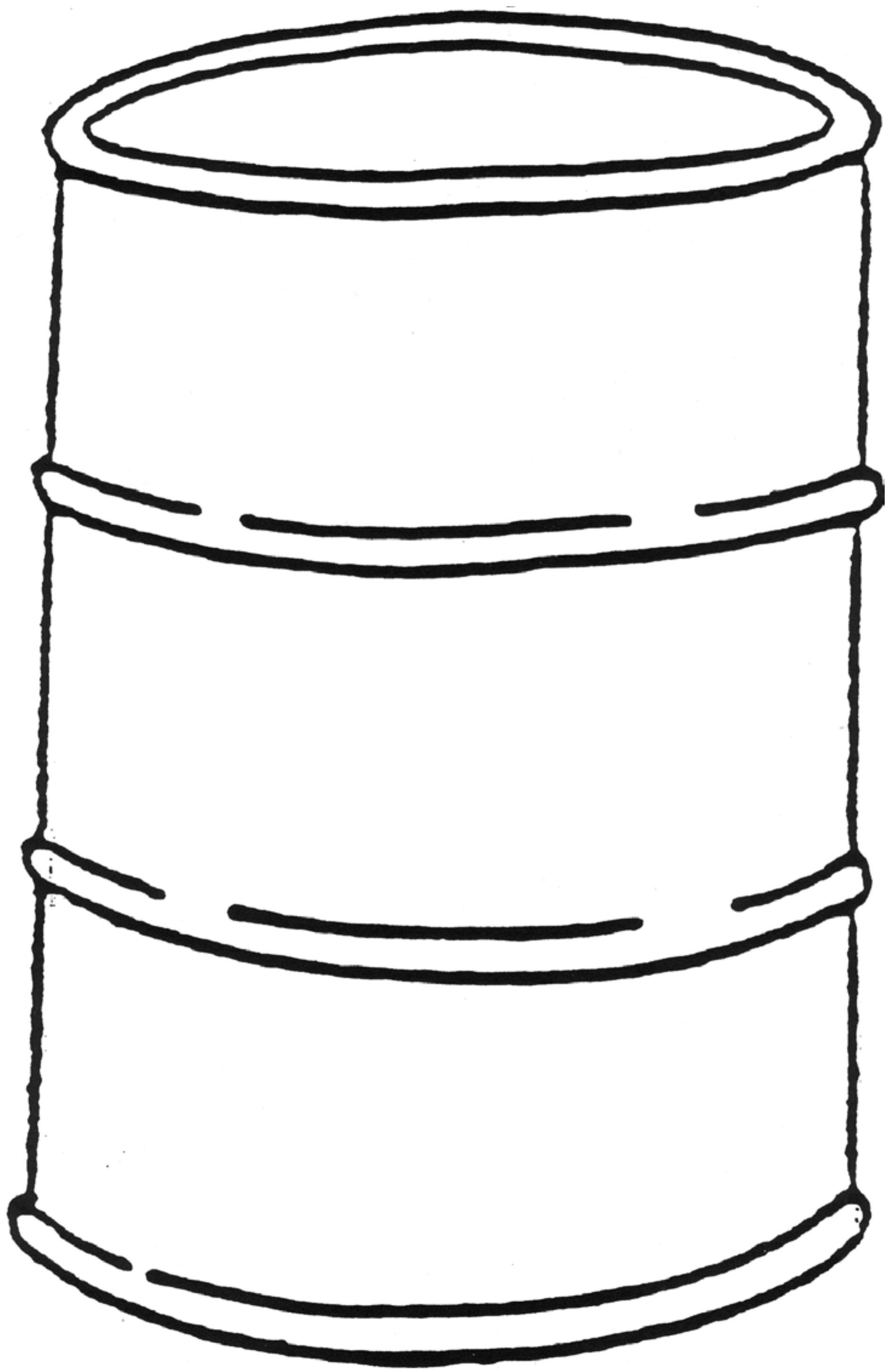


EXERCISE (#1)

You are asked by your boss to ship a 55 Gallon mental drum with 52 gallons of paint and paint thinner which has a flashpoint of 78°F and a boiling point of 268°F, it has no other waste characteristics.

Using a copy of the Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided. (show where the Hazard Label & EPA sticker goes)

Mode of Transportation:	Highway
Gross Weight:	440 lbs



HAZARDOUS WASTE

FEDERAL AND/OR STATE LAWS PROHIBIT IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, THE U.S. ENVIRONMENTAL PROTECTION AGENCY OR THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERATOR INFORMATION:

NAME ______________________________

ADDRESS ______________________ PHONE ______________

CITY ______________________ STATE ______ ZIP ______________

EPA ID NO. ______________________ STATE MANIFEST DOCUMENT NO. ______________

ACCUMULATION START DATE ______________________ EPA WASTE NO. ______________

[______________________________

____

______________________________]

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

Printed By: Lab Safety Supply Inc., Janesville WI 53547-1368

Reorder No. 30176

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form Approved OMB No. 2050-0039. Expires 9-30-99*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.

Manifest Document No.

2. Page 1 of

Information in the shaded areas is not required by Federal law.

GENERATOR

3. Generator's Name and Mailing Address

A. State Manifest Document Number

B. State Generator's ID

4. Generator's Phone

5. Transporter 1 Company Name

6. US EPA ID Number

C. State Transporter's ID

D. Transporter's Phone

7. Transporter 2 Company Name

8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address

10. US EPA ID Number

G. State Facility's ID

H. Facility's Phone

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handing Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

TRANSPORTER

17. Transporter 1 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

18. Transporter 2 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator. Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

EPA Form 8700-22 (Rev. 9-88) Previous edition is obsolete.

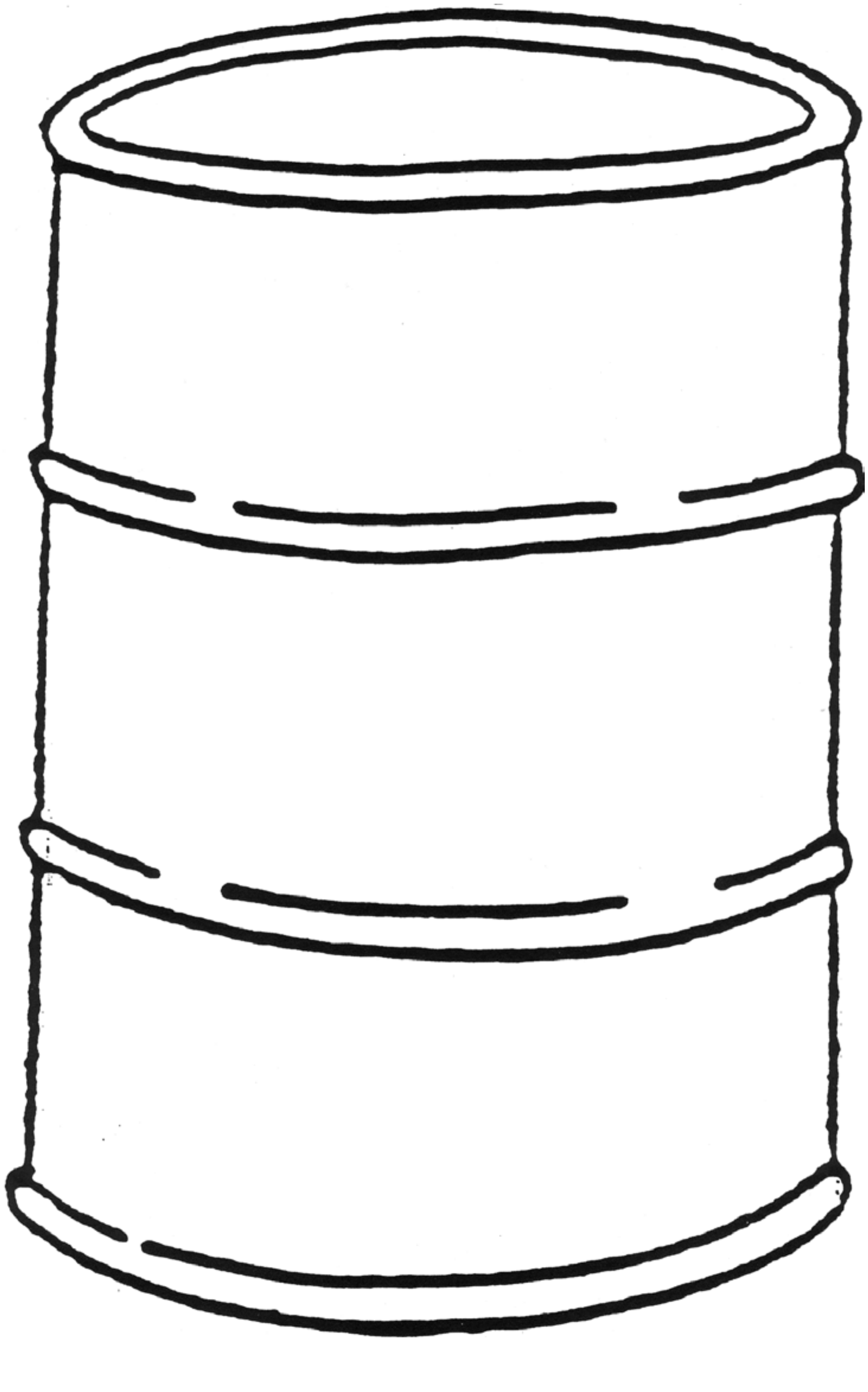
EXERCISE (#2)

You are asked by your boss to ship a 55 Gallon mental drum with 52 gallons of Acetone (Spent) solvents (30%), Xylene (30%), Toluene (30%), and Water (10%) which has a flashpoint of 70°F and a boiling point of 118°F.

Using a copy of the Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided. (show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway

Gross Weight: 360 lbs



HAZARDOUS WASTE

FEDERAL AND/OR STATE LAWS PROHIBIT IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, THE U.S. ENVIRONMENTAL PROTECTION AGENCY OR THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERATOR INFORMATION:

NAME ____

ADDRESS ______________________ PHONE ______________

CITY __________________________ STATE _____ ZIP __________

EPA
ID NO. ________________________ STATE MANIFEST
DOCUMENT NO. ______________

ACCUMULATION
START DATE ____________________ EPA
WASTE NO. ______________

[____

____

____]

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

Printed By: Lab Safety Supply Inc., Janesville WI 53547-1368

Reorder No. 30176

Please print or type. *(Form designed for use on elite (12-pitch) typewriter.)* *Form Approved OMB No. 2050-0039. Expires 9-30-99*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law.

GENERATOR

3. Generator's Name and Mailing Address

4. Generator's Phone

A. State Manifest Document Number

B. State Generator's ID

5. Transporter 1 Company Name | 6. US EPA ID Number | C. State Transporter's ID | D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number | E. State Transporter's ID | F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number | G. State Facility's ID | H. Facility's Phone

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handing Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name | Signature | *Month* *Day* *Year*

TRANSPORTER

17. Transporter 1 Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | *Month* *Day* *Year*

18. Transporter 2 Acknowledgment of Receipt of Materials

Printed/Typed Name | Signature | *Month* *Day* *Year*

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator. Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | *Month* *Day* *Year*

EPA Form 8700-22 (Rev. 9-88) Previous edition is obsolete.

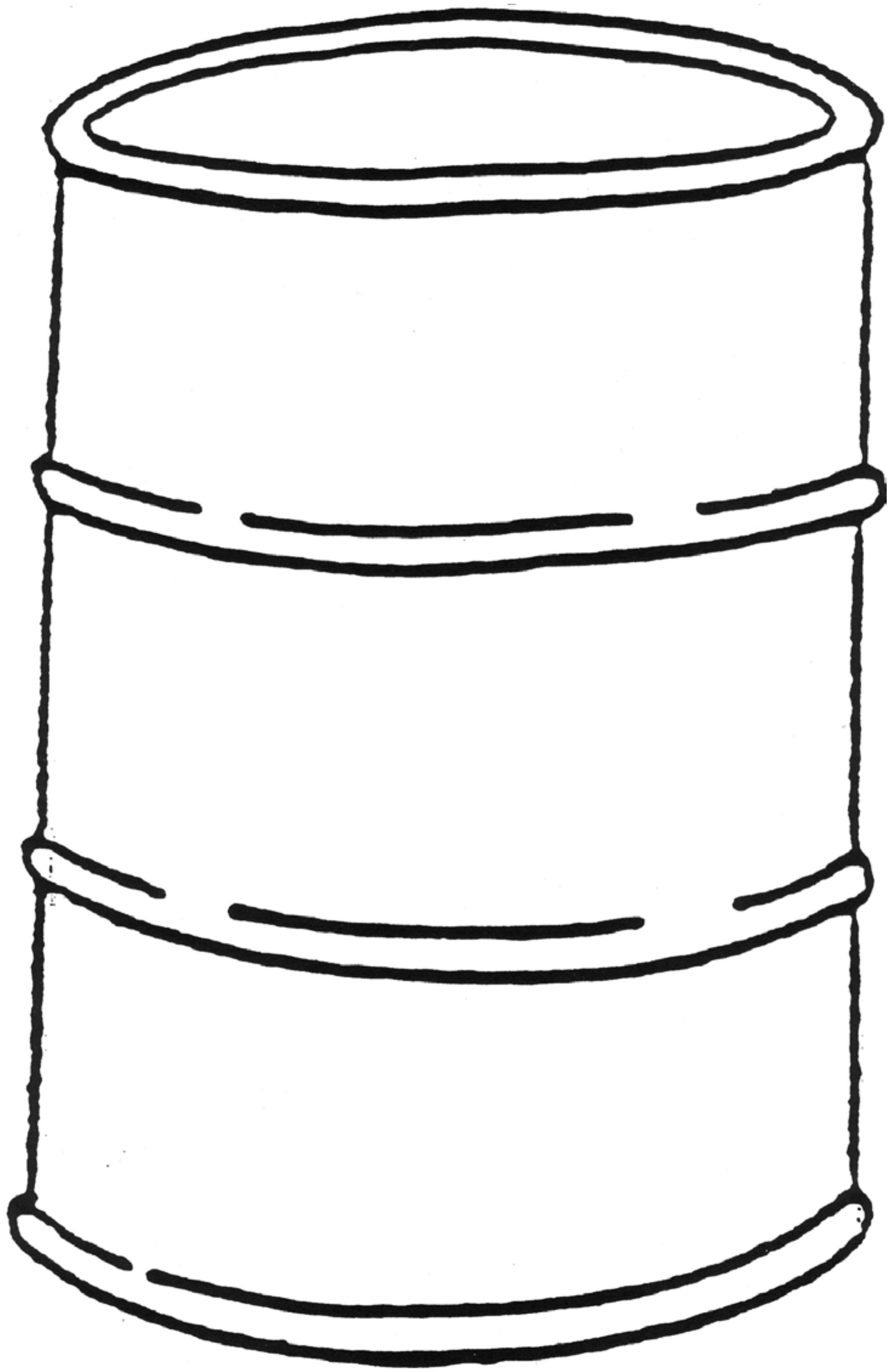
EXERCISE (#3)

You are asked by your boss to ship a 55 Gallon mental drum with 52 gallons of Acetone 60% and rain water 40%, (it contains no other regulated material) it has a flashpoint of 70°F and a boiling point of 118°F.

Using a copy of the Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided. (show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway

Gross Weight: 360 lbs



HAZARDOUS WASTE

FEDERAL AND/OR STATE LAWS PROHIBIT IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, THE U.S. ENVIRONMENTAL PROTECTION AGENCY OR THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERATOR INFORMATION:

NAME ______________________________

ADDRESS ______________ PHONE ______________

CITY ______________ STATE _____ ZIP ______________

EPA ID NO. ______________ STATE MANIFEST DOCUMENT NO. ______________

ACCUMULATION START DATE ______________ EPA WASTE NO. ______________

[______________________________
____
______________________________]

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

Printed By: Lab Safety Supply Inc., Janesville WI 53547-1368

Reorder No. 30176

Please print or type. ***(Form designed for use on elite (12-pitch) typewriter.)*** *Form Approved OMB No. 2050-0039. Expires 9-30-99*

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.	
3. Generator's Name and Mailing Address			A. State Manifest Document Number	
			B. State Generator's ID	
4. Generator's Phone				
5. Transporter 1 Company Name	6. US EPA ID Number		C. State Transporter's ID	
			D. Transporter's Phone	
7. Transporter 2 Company Name	8. US EPA ID Number		E. State Transporter's ID	
			F. Transporter's Phone	
9. Designated Facility Name and Site Address	10. US EPA ID Number		G. State Facility's ID	
			H. Facility's Phone	

GENERATOR

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers		13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
	No.	Type			
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above

15. Special Handing Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

TRANSPORTER

17. Transporter 1 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

18. Transporter 2 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator. Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

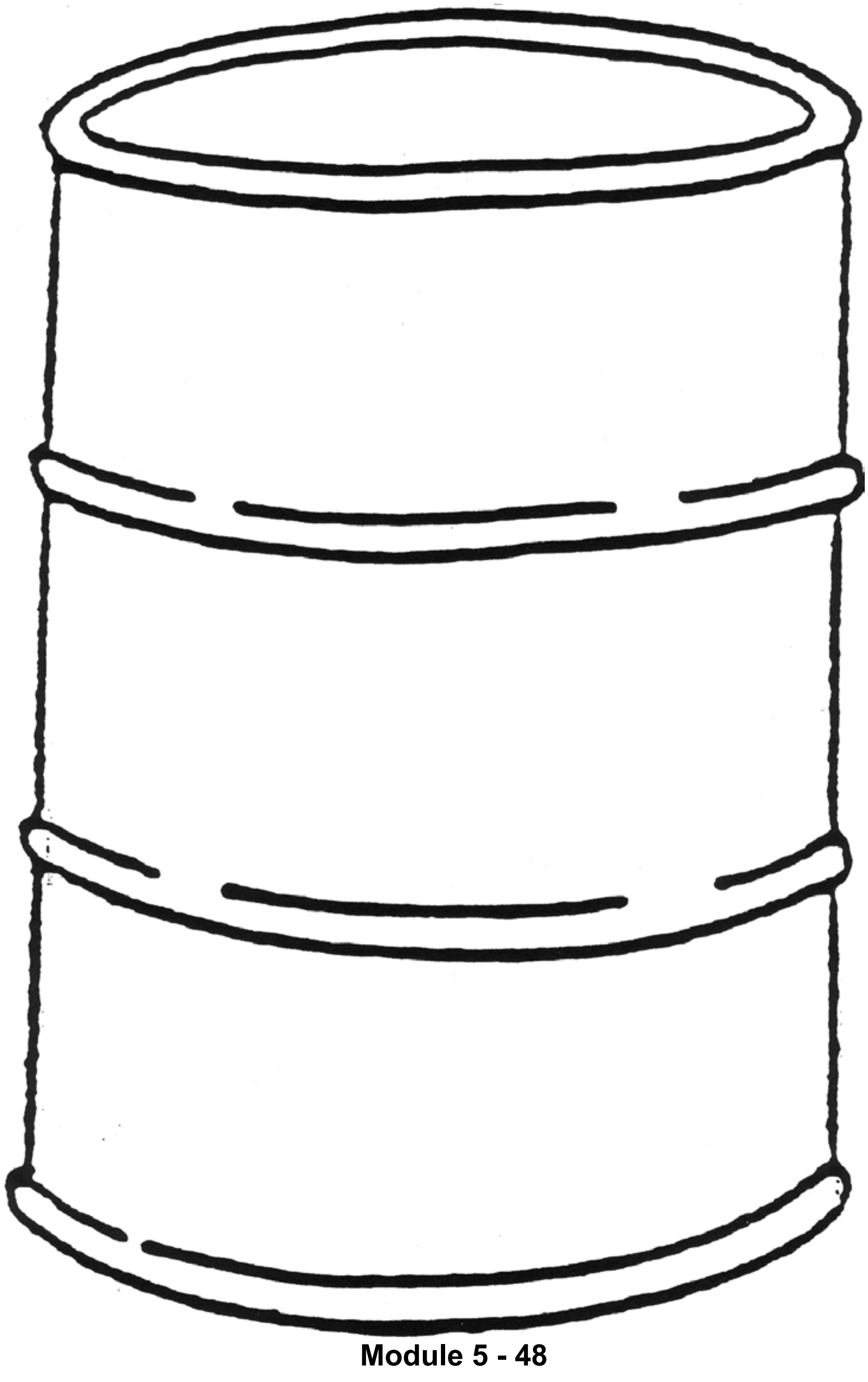
EPA Form 8700-22 (Rev. 9-88) Previous edition is obsolete.

EXERCISE (#4)

You are asked by your boss to ship a 20 Gallon fiberboard drum with 4 each, 1 gallon cans (net weight of each can is 4.0 lb.) of Lindane crystalline poweder, that is Lab packed.

Using a copy of the Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided. (show where the Hazard Label & EPA sticker goes)

Mode of Transportation:	Highway
Gross Weight:	35 lbs



HAZARDOUS WASTE

FEDERAL AND/OR STATE LAWS PROHIBIT IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, THE U.S. ENVIRONMENTAL PROTECTION AGENCY OR THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERATOR INFORMATION:

NAME ____

ADDRESS ______________________ PHONE ______________

CITY __________________________ STATE _____ ZIP __________

EPA
ID NO. ________________________ STATE MANIFEST
DOCUMENT NO. ______________

ACCUMULATION
START DATE ____________________ EPA
WASTE NO. ______________

[____
____
____]

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

Printed By: Lab Safety Supply Inc., Janesville WI 53547-1368

Reorder No. 30176

Please print or type. ***(Form designed for use on elite (12-pitch) typewriter.)*** *Form Approved OMB No. 2050-0039. Expires 9-30-99*

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal law.

GENERATOR

3. Generator's Name and Mailing Address		A. State Manifest Document Number
		B. State Generator's ID
4. Generator's Phone		
5. Transporter 1 Company Name	6. US EPA ID Number	C. State Transporter's ID
		D. Transporter's Phone
7. Transporter 2 Company Name	8. US EPA ID Number	E. State Transporter's ID
		F. Transporter's Phone
9. Designated Facility Name and Site Address	10. US EPA ID Number	G. State Facility's ID
		H. Facility's Phone

11. US DOT Description *(Including Proper Shipping Name, Hazard Class, and ID Number)*	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above	K. Handling Codes for Wastes Listed Above

15. Special Handing Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

TRANSPORTER

17. Transporter 1 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

18. Transporter 2 Acknowledgment of Receipt of Materials

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator. Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	*Month*	*Day*	*Year*

EPA Form 8700-22 (Rev. 9-88) Previous edition is obsolete.

Rice Services Institute, Inc.
9622 East Keats Ave.
Mesa, AZ 85212

GENERATOR'S HAZARDOUS WASTE SHIPMENT CHECKLIST
(Non-Radioactive)
Using 49CFR

1. Determine the hazardous waste number(s) for the material using 40CFR, Part 261, Subpart C, and D. (Once a Waste Number is assigned you have a Hazardous Material)

2. Determine which Hazard Class or Division, and the Packing Group fits your material, using Part 173 definitions

   What is the Hazard Class or Division, Packing Group for your material ?

   ______, ______

3. Determine the Proper Shipping Name and other information that is to be used for this shipment from the Hazardous Materials Table (HMT) (172.101) :

   a. <u>Items Listed by Name</u>: (technical grade, or pure).

   b. <u>Items Not Listed by Name</u>: (generic chemicals, generic use, hazard description, mixtures, solutions, and multiple hazards).

   c. The following information will be used for this Shipment:

      1) Proper Shipping Name: ____
      2) Hazard Class or Division: ______________
      3) Identification Number: _______________
      4) Packing Group number: _______________
      5) Label(s) Required: __________________________, ____________________________

4. Do you have a Hazardous Substance Or Marine Pollutant?

   a. Hazardous Substance; yes: _______ or n/a: _____
      (Listed in Appendix A to 172.101 + RQ per package = Hazardous Substance) (171.8)
   b. Marine Pollutants yes: _______ or n/a: ______
      (1) (Listed in Appendix B to 172.101 + being transported by Water)

         (a) With a "PP" <u>BULK & NON-BULK</u> packaging 1%, with-out 10%.

      (2) (Listed in Appendix s to 172.101 + NOT being transported by water

         (a) With a "PP" BMX packaging 1%, with-out 10%.

5. Do any of the Special Provisions (in Column. 7) apply to what is being shipped?

   yes: _______ or n/a: ________

6. Which Packaging Sections are you using?
   a. **Exception** (Col.. 8A) (Spec. packaging not required "IF" material fits are of the listed Packaging exceptions)
      yes: _______ or n/a: ________
   b. **Non Bulk** (Col.. 8B) (as required by packaging Section "UN" packaging is required by Air or Vessel (1 Oct 1996 for Highway) yes: _____ or n/a:_______
   c. **Bulk** (Col. 8C) (My be UN or DOT spec.Packaging)
      yes: _______ or n/a: ________
   d. Or are you using one of the following?
      (1) Packaging and Exceptions (173.3) (Salvage Drum) Yes: _________ or n/a: ___________
      (2) Exceptions for Waste materials (173.12) Yes: _________ or n/a: ___________
   e. All UN Packaging must meet the Marking and Testing requirements of Part 178, does yours?
      Yes: _________ or n/a: ____________
   f. Are you using an overpack (173.25) Yes: _________ or n/a: ____________

COMPLETING THE UNIFORM HAZARDOUS WASTE MANIFEST (CHECKLIST)

Checks made

yes	no	n/a		
___	___		Key (1)	Generator's US EPA number & Manifest Document No.
___	___		Key (2)	Pages of Pages
___	___		Key (3)	Generator's Name & Mailing Address
___	___		Key (4)	Generator's Phone No. (May be the "EMERGENCY CONTACT Telephone number required by DOT", (49CFR, 172.6.04(a))
___	___		Key (5)	Transporter 1, Company Name
___	___		Key (6)	Transporter 1, US EPA ID number
___	___	___	Key (7)	Transporter 2, Company Name
___	___	___	Key (8)	Transporter 2, US EPA ID number
___	___		Key (9)	Designated Facility Name & Site Address
___	___		Key (10)	Designated Facility US EPA Number
			Key (11)	US D.O.T. Description (a),(b),(c),(d), Including
___	___			(1) Proper Shipping Name; (172.202(a)(1))(the word "WASTE" preceding)
___	___			(2) Hazard Class; (172.202(a)(2))
___	___			(3) UN or NA Number; (172.202(a)(3))
___	___			(4) Packing Group; (172.202(a)(4))
			"Note" These next Items MAY or MAY NOT be required in Key 11	
___	___	___	Exemption; "DOT-E-XXXX" Must be entered if app. (172.203(a))	
___	___	___	"Limited Quantity" or "Ltd Qty" (172.203(b))	
___	___	___	Hazardous	Substance; "I the name does not identify the hazardous substance, then one of the following will be used: Name, Waste Stream number, EPA Characteristic, or corresponding "D", Plus add the letters "RQ" in front of the Proper Shipping Name. (172.203(c)(1),(2))
___	___	___	Empty Packaging; "Residue Last Contained*****" (172.203(e))	
___	___	___	"Dangerous When Wet"; (172.203(j))	
___	___	___	"Technical names" for N.O.S. & Generic (172.201(d), 172.203(k))	
___	___	___	Marine Pollutants;	"Identify the component in parentheses, add the words <u>MARINE POLLUNTANT</u> with the description. (172.203(1)(1), (2))
___	___	___	Poisonous Materials;	"Poison" , or "Poison-Inhalation Hazard" and the Hazard Zone, A,B,C,& D". (172.203(m))
___	___		Key (12)	Containers; No. & Type: (example 001, DF) one fiberboard Drum
___	___		Key (13)	Containers; Total Quantity each Line: (Example 00055)
___	___		Key (14)	Units; By wt/Vol, "G" gallon, "P" pounds, "T" tons, "Y" Cubic yards, "L" liters, "K" Kilograms, "M" metric tons, and "N" Cubic meters.
___	___	___	Key (15)	Special Handling Instructions & Additional Information: "The EMERGENCY CONTACT telephone number may be entered here or in Key 9", If carrier has the Emergency Response Guidebook you may reference it in Key 11 or here: (Example for Key 11; Use ERG 26, after the required entries), (for Key 15; Use ERG 26 for Item (a) in key 11), or (See attached Emergency Response Information)
___	___		Key (16)	GENERATOR'S CERTIFICATION: (Includes; Printed or typed name,

			Hand written Signature, Date.

COMPLETING THE UNIFORM HAZARDOUS WASTE MANIFEST (CHECKLIST)

Checks made

yes	no	n/a	
___	___		Container marked UN or DOT spec. (check Bottom head)(Part 178)
			Using a Hazardous Waste Sticker for the Marking requirements
___	___		Hazard Waste Statement as required by (40CFR, 262.32(b))
___	___		Generator's Name and Address as required by (40CFR, 262.32(b))
___	___		Manifest Document Number as required by (40CFR, 262.32(b))
___	___		EPA Waste Number(s) (See Hazardous Substances below for D.O.T. requirements)
___	___		Generator's EPA ID Number
___	___		Accumulation Start Date
___	___		Proper Shipping Date (172.301(a))
___	___		UN/NA number 172.301(a)
___	___	___	(Technical name for N.O.S. and Generic (172.301(b))
___	___	___	Exemption "DOT-E-XXX" (172.301(c))
___	___	___	Orientation Marking for Liquid in combination packaging (172.312(a))
___	___	___	Inhalation Hazard (172.313(a))
___	___	___	Hazard Substances; If the name does not identify the hazardous substance, then one of the following will be used in parentheses and marked near the proper Shipping Name: Name, Waste Stream number, EPA Characteristic, or corresponding D" number Plus add the letters "RQ" in front of the Proper shipping Name. (172.324(a),(b))
___	___	___	Marine Pollutants: "Identify the component in parentheses, add the MARINE POLLUNTANT marking near the hazard warning label (172.322(e))
___	___	___	Salvage Drums; for Damage, Defective, or Leaking containers must be marked "Salvage Drum" (173.3(c))
___	___	___	Overpacks; Mark the same as the inside packages, excpet for the Spec. marking, each package subject to the Orientation marking arrows must be so marked on two opposite sides, and must also be marked with a statement "Inner packagees comply with prescribed specifications" (173.25(a)(4))
___	___	___	Packaging containing Poison Inhalation Hazards;must be marked with the words "Inhalation Hazard" (172.313(a))

COMPLETING THE HAZARDOUS WASTE LABELING (CHECKLIST)

Checks made

yes	no	n/a	
___	___		Apply the hazard Label that is called for in Column 6 of the Hazardous Materials Table 172.101
___	___	___	Overpacks, Label the same as the inside packages (172.400(a)(5))
___	___	___	Additional Label(s) Subsidiary Hazard (172.402(a))

___	___	___	Place the Hazard label near the marked Proper Shipping Name (172.406(a))

COMPLETING THE UNIFORM HAZARDOUS WASTE MANIFEST (CHECKLIST)

PLACARDS requirements (172.500's)

checks made

yes	no	n/a	
___	___		Generator's Requirements is to "Provide" (172.506(a))
___	___	___	Generator's Requirements is to "Affix" IF you are Loading & closing the Transport Vehicle, Freight Container, Unit Load Device or Bulk Packaging (172.506(a))
___	___	___	Are the proper Placards applied to the Transport vehicle, Freight Container, unit load Device, or Bulk Packaging (172.504(a))
___	___	___	Any amount of an "Poison Inhalation Hazard" must be placarded "Poison" or Poison Gas. (172.505(a)) **Note*** "The 1001 pound Exception applies only to Transportation by Highway and Rail"

Comments:

Checked By: Signature:

Place: Date:
Time:

*** IF ANY QUESTION IS ANSWERED WITH A "NO" DO NOT OFFER THE SHIPMENT UNTIL THEY ARE CORRECTED. THIS FORM IS TO BE COMPETED BY THE SHIPPER.**

LIST OF AVERAGE WEIGHT PER GALLON OF LIQUIDS
AND LIQUIFIED GASES (AT 60°F UNLESS INDICATED OTHERWISE)
Department of Transportation, Transportation Safety Institute

The following list of commodities, while not totally complete, does show the approximate weight per gallon of many hazardous materials. It may be used in estimating weights with regard to the placarding requirements and also may be used in estimating weight with regard to the weight limitations of various specification packages.

Certain factors such as density, chemical properties and temperature are important in determining true weight by volume, therefore, during any investigation it would be necessary to obtain data sheets on the specific commodity or a statement from the shipper as to its factual weight.

Pounds/Gallon	Commodity
6.93	Acetal
6.65	Acetaldehyde
8.65	Acetic Acid - 28% strength
8.94	70% strength
8.94	84% strength
8.75	Glacial strength
9.04	Acetic Anhydride
6.64	Acetone
7.75	Acetone Cyanahydrin
6.87 to 7.19	Acetone Oils (Ketone Oils)
6.51	Acetonitrile
8.6	Acetophenone
8.11	Acetylacetone
9.18	Acetyl Chloride
10.7	Acetylene Dichloride
13.3	Acetylene Tetrachloride
6.97	Acrolein
7.48 to 7.90	Acrylic Esters
6.64	Acrylonitrile
6.6	Alcohol, Anhydrous
6.8	Alcohol
6.9	Aldehol
9.2	Aldol
7.14	Allyl Alcohol
11.6	Allyl Bromide
7.7	Allyl Chloride
8.56	Allyl Mercaptan
11.1	Average - Alum
8.7	Aluminum Subacetate Solution
7:68	Aminoethyl Ethanolamine
5.14	Ammonia, Anhydrous (liquified)

Pounds/Gallon	Commodity
8.0	Ammonia Solution, (10%)
7.5	Ammonia Solution, Strong (18%)
7.4	Amyl Acetate
6.78	Amyl Alcohol, Normal
6.76	Amyl Alcohol, Refined
6.30	Amyl Amine
7.38	Amyl Chloride
6.7	Amylene Hydrate
7.1	Amyl Mercaptan
7.1	Amyl Nitrite
7.2	Amyl Oleate
8.1	Amyl Phenol
7.7	p-tert-Amyphenol
8.5	Amyl Phthalate
7.3	Amyl Propionate
8.8	Amyl Salicylate
8.2	Anethole
8.5	Aniline
8.2	Anise Oil
9.1	o-Anisidine
8.3	Anisole
7.44	Aqua Ammonia
7.5	Aromatic Ammonia Spirit
	Asphalt - Averages at Transport Temperatures
7.8	RC-0
7.9	RC-1
8.0	RC-2
8.1	RC-3 -
8.2	RC-4
8.3	RC-5
8.6	40-50 Penetration

Pounds/Gallon	Commodity	Pounds/Gallon	Commodity
8.5	60-150 Penetration	8.0	Butyric Acid
8.3	Emulsified	8.1	Butyric Anhydride
8.3	Balsam Canada	7.32	Butyric Ether (Ethyl Butyrate)
8.1	Bay Oil	8.83	Calcium Bisulfite Solution
10.5	Benzal Chloride	7.7	n-Caproic Acid
8.7	8enzaldehyde	7.6	Caprylic Acid
7.3	Benzene	7.5	Caraway Oil
11.5	Benzotrichloride	82	Carbitol
10.2	Benzoyl Chloride	8.5	Carbitol Acetate
8.8	Benzyl Acetate	8.88	Carbolic Acid (Phenol)
8.7	Benzyl Alcohol	8.76	Carbon Dioxide (-50°F, Liquified)
9.3	Benzyl Benzoate	10.5	Carbon Disulfide
8.9	Benzyl Cellosolve	13.3	Carbon Tetrachloride
9.2	Benzyl Chloride	7.8	Cardamon Oil
8.7	Benzyl Ether	8.31	Carnauba Wax
7.3	Bergamot Oil	8.1	Carvacrol
8.7	Bitter Almond Oil	8.0	Carvone
7.1	Bitter Orange Oil	5.5 to 5.8	Casinghead Gasoline
8.2	Bornyl Acetate	8.01	Castor Oil
26.0	Bromine	12.7	Caustic Soda 50% Strength
12.5	Bromobenzene	14.7	73% Strength
11.6	Bromethytbenzene	7.8	Cellosolve
24.0	8romoform	8.1	Cellosolve Acetate
11.9	o-Bromotoluene	8.0	Chenopodium Oil
11.7	p-Bromotoluene	12.6	Chloral
5.16	Butadiene	13.4	Chlordane
4.86	Butane	12.17	Chlorine (Liquified)
8.06	Butyl Acetoacetate	11.37	Chloroacetic Acid
7.8	Butyl Acetyl Ricinoleate	9.55	Chloroacetone
6.74	Butyl Alcohol, Normal	10.1	o-Chloroaniline
6.72	Butyl Alcohol, Secondary	9.2	Chlorobenzene
6.56	Butyl Alcohol, Tertiary	9.6	b-Chloroethyl Acetate
6.69	Butyl Aldehyde, Normal	8.7	Chloroethylbenzene
6.22	Butylamine	12.3	Chloroform
10.6	n-Butyl Butyrate	10.2	Chloronaphalene Oils
8.0	Butyl Carbitol	9.6	b-Chlorophenetole
7.5	Butyl Cellosolve	10.3	o-Chlorophenol
7.4	n-Butyl Chloride	13.8	Chloropicrin
8.7	Butyl Citrate	7.99	Chloroprene
8.3	1,3 Butyleneglycol	14.7	Chlorosulfonic Acid
6.4	n-Butyl Ether	9.0	Chlorotoluene
6.3	Butyl Ethyl Ether	8.8	Cinnamon Oil
8.1	Butyl Lactate	7.1	Citronellal
7.48	Butyl Methacrylate	7.5	Citronella -0il
8.3	Butyl Oxalate	8.7	Clove Oil
8.7	n-Butyl Phthalate	7.7	Coconut Oil
7.2	Butyl Propionate	7.7	Cod Liver Oil
7.2	Butyl Stearate		
6.8	n-Butyraldehydge		

Pounds/Gallon	Commodity
6.4	Collodion
7.62	Copra Oil
11.82	Corn Syrup
7.68	Cottonseed Oil
8.96	Creosote
8.55	Cresol
8.62 to 8..76	Cresytic Acid
7.15	Crotatdehyde
7.2	Crotonaldehyde
7.3	Crotonyl Alcohol
	Crude Oil
6.76	Pennsylvania
7.21	Wyoming
725	Oklahoma
7.3	Texas
7.6	Cubeb Oil
7.2	Cumene
6.5	Cyclohexane
8.0	Cyclohexanol
8.05	Cyclohexanol Acetate
7.9	Cyclohexanone
6.7	Cyclohexene
8.6	Cyclohexyl Glycolate
6.2	Cyclopentane
7.9	Cyclopentanol
7.9	Cyciopentanone
6.4	Cyclopentene
7.2	m-Cymene
7.3	o-Cymene
7.1	p-Cymene
6.92	Decylaidehyde
7.8	Diacetone Alcohol
6.7	Diallyl Ether
6.42	Diamylamine
6.4	Dibutylamine
8.24	Dibutyl Phthalate
7.79	Dibutyl Sebacate
13.1	Diahloroacetic Acid
10.9	o-Dichlorobenzene
10.47	Dichloroethylene
10.2	sym: Dichloroethyl Ether
9.3	Dichloroisopropyl Ether
9.02	Dichloropentane
7.05	Diesel Fuel (approximate)
9.08	Diethanolamine
5.8	Diethylamine
7.34	Diethyl Benzene
7.2	2-Diethylaminoethanol

Pounds/Gallon	Commodity
6.8	Diethyl Carbinol
7.6	Diethyl Carbitol
8.13	Diethyl Carbonate
8.61	Diethylene Ether (Dioxane)
9.32	Diethylene Glycol
8.24	Diethylene Glycol Diethyl Ether
8.0	Diethylene Glycol Monolaurate
7.5	Diethylformamide
6.8	Diethyl Ketone
9.4	Diethyl Phthalate
9.8	Diethyl Sulfate
9.7	Diglycol Chlorohydrin
8.1	Diglycol Laurate
7.7	Digtycol Oleate
6.7	Diisobutyl Ketone
8.3	Diisopropanolamine
6.0	Diisopropylamine
10.3	Dimercaprol
8.4	Dimethoxytetraglycol
5.7	Dimethylamine
8.0	Dimethylaniline
5.5	Dimethyl Ether
7.9	Dimethylformamide
7.4	Dimethyl Furan
8.3	Dimethyl Glyoxal
9.9	Dimethyl Phthalate
11.1	Dimethyl Sulfate
6.7	Dioctylamine
8.6	1,4Dioxane
8.9	Dioxolane
9.7	Diphenylamine
6.1	Dipropylamine
8.6	Dipropylene Glycol
6.8	Dipropyl Ketone
7.73	Divinylbenzene
6.32	Dodecene
7.2	Dwarf Pine Needle Oil
9.9	Epichlorohydrin
8.5	Ethanolamine
6.0	Ether (at 20°F)
7.8	Ethohexadiol
7.5	Ethyl Acetate
8.6	Ethyl Acetoacetate
7.62	Ethyl Acrylate
6.53	Ethyl Alcohol (Ethanol)
5.9	Ethylamine

7.8	Dithylaniline	8.0	m-Ethylaniline

Pounds/Gallon	Commodity	Pounds/Gallon	Commodity
8.8	Ethyl Benzoate	9.4	Ethyl Salicylate
11.9	Ethyl Bromide	7.8	Ethyl Silicate
6.9	2-Ethylbutyl Alcohol	11.0	Ethylsulfuric Acid
6.8	Ethyl Butyl Ketone	11.5	Ethyl Trichloroacetate
6.8	2-Ethylbutyl Alcohol	8.2	Ethyl Irethan
7.3	Ethyl n-Butyrate	7.7	Eucalyptol
7.7	2-Ethylbutyric Acid	7.6	Eucalyptus Oil
7.5	Bethyl Caproate	8.9	Expressed Almond Oil
8.1	Ethyl Carbonate	8.0	Fennel Oil
9.7	Ethyl Chloroacetate	11.0	Ferric Chloride Solution
9.5	Ethyl Chlorofomate	12.9	Ferric Subsulfate Solution
8.8	Ethyl Cinnamate	11.4	Ferrous Iodide Syrup
9.5	Ethyl Citrate	10.73	Fluosilicic Acid
5.07	Ethylene (32°F)	9.13	Formaldehyde
10.05	Ethylene Chlorohydrin	9.0	Formaldehyde Solution
8.66	Ethylene Cyanohydrin	9.5	Formamide
7.5	Ethylene Diamine	10.12	Formic Acid
7.5	Ethylene Diamine,	10.0	Formic Acid, 90%
	Anhydrous	8.8	Formic Acid, 25%
18.2	Ethylene Dibromide	6.79	Fuel Oil #1
10.5	Ethylene Dichloride	7.01	#2
7.68	Ethylene Formate	7.09	#3
9.3	Ethylene Glycol	7.14	#4
9.2	Ethylene Glycol Diacetate	7.38	#5
9.2	Ethylene Glycol	8.13	#6
	Monoacetate	8.00	Residual
7.7	Ethyl Formate	7.8	Furan
7.2s	Ethyl Hexyl Acetate	9.7	Furfural
6.94	Ethyl Hexyl Alcohol	9.4	Furfuryl Alcohol
16.1	Ethyl Iodide	6.92	Fusel Oil
7.2	Ethyl Isobutyrate	6.19 average	Gasoline
6.2	Ethyl Isopropyl Ether	7.4	Geranial
7.2	Ethyl lsovalerate	7.4	Geraniol
8.6	Ethyl Lactate	10.51	Glycerine
8.9	Ethyl Maleate	13.2	Glycerophosphoric Acid
8.8	Ethyl Malonate	8.2	Glyceryl Laurate
7.56	Ethyl Methacrylate	9.2	Glycol Diacetate
6.0	Ethyl Methyl Ether	10.22	Glycol Diformate
6.86	Ethyl Methyl Ketone	7.5 to 8.0	Greases
7.5	Ethyl Nitrite	7.7	Halibut Liver Oil
6.9	Ethyl Nitrite Spirit	7.1	Heptadecanol
9.0	Ethyl Oxalate	6.1	2,4-Heptadiene
8.7	Ethylphenylethanolamine	5.7	n-Heptane
8.5	Ethyl Phenyl Ketone	6.8	Heptyl Ether
9.4	Ethyla Phthalate	5.7	1,5-Hexadiene
7.4	Ethyl Propionate	5.9	2,4-Hexadiene
7.1	2-Ethyl-3-Propylacrolein	10.8	Hexaethyltetraphosphate

6.1	Ethyl-n-Propyl Ether	6.9	n-Hexaldehyde
6.8	Ethyl Propyl Ketone	5.48	Hexane

Pounds/Gallon	Commodity
6.82	Hexyl Alcohol
6.39	Hexylamine
7.69	Hexyalene Glycol
6.8	n-Hexyl Methyl Ketone
8.4	Hydrazine
12.5	Hydriodic Acid 47%
11.5	Hydrobromic Acid 40%
	Hydrochloric Acid:
9.4	18° Baume
9.65	20° Baume
9.89	23° Baume
9.8	Hydrochloric Acid
5.8	Hydrocyanic Acid 97%
9.8	Hydrofluoric Acid 55%
10.6	Hydrofluosilicic Acid 30%
12.2	Hydrogen Peroxide, Anhydious
	Hydrogen Peroxide:
9.19	28% Strength
9.26	30% Strength
9.44	35°I. Strength
11.6	90% Strength
12.1	100% Strength
9.2	Hydroxybutyraldehyde
9.4	Hypophosphorous 30%
9.0	Indalone
8.0	Indan
4.81	Industrial Gas Hydrocarbon gas)
7.9	b-lonone
7.3	Isoamyl Acetate
6.8	Isoamyl Alcohol
8.3	Isoamyl Benzoate
10.2	Isoamyl Bromide
7.1	Isoamyl Butyrate
7.4	Isoamyl Chloride
6.5	Isoamyl Ether
7.1	Isoamyl Isovalerate
7.3	Isoamyl Nitrite
8.6	Isoamyl Phthalate
8.9	Isoamyl Salicylate
4.63	Isobutane
7.7	Isobutenyl Chloride
7.3	Isobutyl Acetate
6.8	lsobutyl Alcohol

Pounds/Gallon	Commodity
10.5	Isobutyl Bromide
7.2	Isobutyl n-Butyrate
6.78	Isobutyl Carbinol
7.4	Isobutyl Chloride
6.3	isobutyl Ether
7.3	Isobutyl Formate
7.2	Isobutyl Nitrite
7.4	Isobutyl Propionate
7.9	lsobutyric Acid
9.1	lsoeugenol
5.74	Isoctane
5.19	Isopentane
7.68	Isophorone
5.7	Isoprene
7.3	Isopropyl Acetate
6.5	Isopropyl Alcohol
5.8	Isopropylamin^{e} -
7.2	Isopropylbenzene
10.9	Isopropyl Bromide
7.2	Isopropyl Chloride
6.0	Isopropyl Ether
7.8	Isovaleric Acid
6.5	Isovaleronitrile
6.06 to 6.87	Jet Fuel
6.79	Kerosene
	Ketones (See by specific type, viz. Methylethyl Keton)
10.38	Lactic Acid
7.61	Lard Oil
8.0 to 8.3	Latix
7.74	Lauryl Alcohol
7.4	Lavender Oil
10.4	Lead Subacetate Solution
7.5	Lemon Grass Oil
7.1	Lemon Oil
7.0	d-Limonene
7.5	Linoleic Acid
7.72	Linseed Oil
4.25 to 4.86	Liquefied Petroleum Gas
8.9	Liquified Phenol
7.4	Liquid Petrolatum
7.1	Liquid Petrolatum, Light
7.75	Menhaden Oil
7.4	1-Menthol
112.9	Mercury

6.64	Isobutyl Aldehyde	7.13	Mesityl Oxide
6.09	Isobutyl Amine	8.48 to 9.24	Methacrylate Polymers
8.3	Isobutyl Benzoate	7.7	Methyl Acetate

Pounds/Gallon	Commodity	Pounds/Gallon	Commodity
8.9	Methyl Acetoacetate	7.63	Neatsfoot Oil
7.9	Methyl Acrylate	5.54	Neohexane
7.1	Methylal		Nitric Acid:
6.6	Methyl Alcohol	11.25	38° Baume
7.1	Methyl Amyl Acetate	11.7	42° Baume
6.7	Methyl Amyl Alcohol	11.7	Nitric Acid (68%)
6.8	Methyl Amyl Carbinol	12.5	Nitric Acid, Fuming
6.8	Methyl n-Amyl Ketone	10.0	Nitrobenzene
8.2	n-Methylaniline	8.74	Nitroethane
6.9	Methyl Butyl Ketone	7.9	Nitrogen Fertilizer Solutions
8.6	Methyl Carbitol	13.3	Nitroglycerin
8.0	Methyl	9.4	Nitromethane
8.4	Methyl Cellosolve Acetate	9.6	m-Nitrotoluene
6.51	Methyl Cyanide	9.7	o-Nitrotoluene
7.7	Methyl Cyclohexanone	5,9	n-Nonane
20.8	Methylene Bromide	6.8	Octanal
11.07	Methylene Chloride	5.9	Octane
27.7	Methylene Iodide	7.3	Octyl Acetate
6.7	Methyl Ethyl Ketone	6.9	Octyl Alcohol
8.1	Methyl Formate	6.87	Octyaldehyde
6.8	Methyl Hexyl Ketone	6.6	Octyl Amine
8.8	Methyl-3-Hydroxybutyrate	6.96 to 7.33	Oil, Fuel, #2 or 3
18.8	Methyl Iodide	7.5 to 8.5	Oil Fuel, #4, 5, and 6
6.7	Methyl Isobutyl Ketone	7.2 to 7.7	Oil, Lubricating
7.4	Methyl Isobutyrate	7.4	Oleic Acid
9.0	Methyl Lactate	7.6	Olive Oil
9.9	Methyl Phthalate	7.2	Orange Flower Oil
6.75	Methyl Propyl Carbinol	7.0	Orange Oil
6.1	Methyl Propyl Ether	8.0 to 12.0	Paint
6.73	Methyl Propyl Ketone	7.03	Palmitic Acid
9.9	Methyl Salicylate	7.92	Palm-Nut Oil
8.42 to 8.64	Milk	7.98	Paraffin Wax
6.4 to 6.55	Mineral Spirits	8.29	Paraldehyde
11.75	Molasses	7.62	Peanut Oil
10.1	Monacetin	7.57	Pelargonic Acid
9.26	Monochlorobenzene	7.8	Pennyroyal Oil, American
11.1	a-Monochlorohydrin	14.0	Pentachloroethane
8.2	Monoisopropanolamine	5.2	Pentane
8.3	Morpholine	7.5	Peppermint Oil
13.12	Motor Fuel Antiknock	14.0	Perchloric Acid, 70%
	Compound	13.39	Perchloroethylene
	Muriatic Acid:	7.6	Persic Oil
9.49	18 °	9.7	Peruvian Balsam
9.65	20° Baume	5.5.	Petroleum Benzin
9.89	23° Baume	5.26 to 5.48	Petroleum Ether

7.6	Mustard Oil
7.5	Myristica OH
6.2 to 7.99	Naphtha
7.16 to 7.46	Naphtha Solvent

8.0	Phenetole
8.88	Phenol
8.6	Phenylacetaldehyde
8.9	Phenyl Acetate

Pounds/Gallon	Commodity
9.2	Phenyl Cellosolve
9.0	Phenylethanolamine
8.6	Phenyl Ethyl Acetate
8.5	Phenylethyl Alcohol
7.31	Phorone
	Phosphoric Acid:
9.2	20% Strength
10.1	35% Strength
11.1	50% Strength
13.1	75% Strength
14.9	85% Strength
13.92	Phosphorus Oxychloride
13.1	Phosphorus Trichloride
11.7	o-Phthalyl Chloride
8.0	3-Picoline
8.6	Pimenta Oil
7.1	dl-Pinene
7.4	Pine Needle Oil
7.8	Pine Oil
7.2	Piperidine
9.4	Polyethylene Glycol 300
9.4	Polyethylene Glycol 400
9.0	Polysorbate 80
9.2	Polyvinyl Acetate Emulsion
10.06	Polyvinyl Alcohol
7.7	Poppy Oil
12.7	Potassium Hydroxide Solution 50%
10.4 to 11.56	Potassium Silicate Solutions
6.7	Propionaldehyde
8.3	Propionic Acid
8.3	Propionie Anhydride
6.5	Propionitrile
7.4	Propyl Acetate
6.7	n-Propyl Alcohol
6.72	Propyl Alcohol
7.4	Propyl Chloride
9.2	
7.3	Propylenediamine
9.7	Propylene Dichloride
8.6	Propylene Glycol
6.9	Propylene Oxide
6.1	Propyl Ether

Pounds/Gallon	Commodity
9.5 to 10.5	Resins, Synthetic
7.5	Rosemary Oil
7.1	Rose Oil
9.2	Safrol
9.7	Salicylaldehydge
8.1	Santal Oil
8.9	Sassafras Oil
7.6	Sesame Oil
9.1	Sodium Carbonate Solution 10%
12.8	Sodium Hydroxide Solution 50%
10.0	Sodium Silicate
11.0	Sorbitol
10.4	Sorbitol Solution
7.7	Soya Oil
7.68	Soybean Oil
7.7	Spearmint Oil
≤ 15.3	Spent Acid
7.3	Sperm Oil
7.04	Stearic Acid
6.98	Stoddard Solvent
7.66	Styrene
8.9	Succinaldehyde
16.8	Sulfur (molten)
14.03	Sulfur Chloride
	Sulfuric Acid:
12.54	53° Baume
14.19	60° Baume
15.25	66° Baume
15.92	2O% Oleum
15.3	Sulfuric Acid, 96%
8.5	Sulfuric Acid, 6%
7.68	Sunflower Oil
11.0	Syrup
7.99 to 8.31	Tall Oil
7.44	Tallow
9.0 to 10.37	Tar
7.8	Terebene
7.78	Terpineol
13.6	Tetrachloroethylene
7.0	Tetradecanol
9.4	Tetraethylene Glycol
7.4	Tetrahydrofuran

8.2	Pyridine	8.8	Tetrahydrofurfuryl Alcohol
5.1	Quinoline	8.1	Tetralin -
7.6	Rapeseed Oil	11.0	Thioglycollic Acid
7.4	Red Oil	13.6	Thionyl Chloride
11.0	Refrigerant Gases	8.9	Thiophene

Pounds/Gallon	**Commodity**
7.7	Thyme Oil
14.66	Titanium Tetrachloride
7.21	Toluene
8.74	Toluidine
9.7	Triacetin
6.5	Tributylamine
8.7	Tributyl Citrate
8.1	Tributyl Phosphate
12.16	Trichlorobenzene
12.0	1,1,2-Trichloroethane
12.2	Trichloroethylene
11.54	Trichtorosilane
9.36	Triethanolamine
6.07	Triethylamine
9.35	Triethylene Glycol
8.9	Triethylphosphate
8.8	Trimethylene Glycol
10.1	Trimethyl Phosphate
7.6	Triolein
7.8	Tung Oil
7.2	Turpentine Oil
7.2	Turpentine Oil, Rectified
6.2	Undecane
6.9	1-Undecanol
7.6	Undecylenic Acid
11.08	Urea Solutions, Average
7.9	Valeric Acid
6.7	Valeronitrile
7.73	Varnish
7.75	Vinyl Acetate
7.57	Vinyl Chloride
6.42	Vinyl Ether
6.22	Vinyl Methyl Either
7.2	Vinyl Toluene
8.1	Vitamin K
8.3	Water
7.7	Whiskey
8.2	Wine

7.2	m-Xylene (Xylol)
7.5	o-Xylene (Xylol)
8.09 to 8.26	Xylidine
7.8	Ylang-Ylang Oil

TABLES OF EQUIVALENCE

WEIGHT CONVERSION TABLES

a. Conversion Factors

MULTIPLY	BY	TO OBTAIN
Grams	0.03527	Ounces
Grams	0.002205	Pounds
Kilograms	35.2736	Ounces
Kilograms	2.2046	Pounds
Ounces	28.3495	Grams
Pounds	16	Ounces
Pounds	453.59	Grams
Pounds	0.45359	Kilograms
Hundredweight	112	Pounds
Hundredweight	50.802	Kilograms

b. Pounds to kilograms and vice versa.

When the central value in any row of these weight conversion tables is taken to be in pounds, its equivalent value in kilograms is shown on the left; when the central value is in kilograms, its equivalent in pounds is shown on the right.

kg	←lb kg→	lb	kg	←lb kg→	lb	kg	←lb kg→	lb
0.227	0.5	1.1	23	50	110	90.7	200	441
0.454	1	2.2	25	55	121	95.3	210	463
0.907	2	4.41	27	60	132	99.8	220	485
1.36	3	6.61	30	65	143	102	225	496
1.81	4	8.82	32	70	154	104	230	507
2.27	5	11	34	75	165	109	240	529
2.72	6	13.2	36	80	176	113	250	551

3.18	7	15.4	39	85	187	118	260	573
3.63	8	17.6	41	90	198	122	270	595
4.08	9	19.8	43	95	209	125	275	606

kg	←lb kg→	lb	kg	←lb kg→	lb	kg	←lb kg→	lb
4.54	10	22	45	100	220	127	280	617
4.99	11	24.3	48	105	231	132	290	639
5.44	12	26.5	50	110	243	136	300	661
5.9	13	28.7	52	115	254	159	350	772
6.35	14	30.9	54	120	265	181	400	882
6.8	15	33.1	57	125	276	204	450	992
7.26	16	35.3	59	130	287	227	500	1102
7.71	17	37.5	61	135	298	247	545	1202
8.16	18	39.7	64	140	309	249	550	1213
8.62	19	41.9	66	145	320	272	600	1323
9.07	20	44.1	68	150	331	318	700	1543
11.3	25	55.1	73	160	353	363	800	1764
13.6	30	66.1	77	170	375	408	900	1984
15.9	35	77.2	79	175	386	454	1000	2205
18.1	40	88.2	82	180	397			
20.4	45	99.2	86	190	419			

LIQUID MEASURE CONVERSION TABLES

(a) Conversion factors

MULTIPLY	BY	TO OBTAIN
Liters	02199	Imperial gallons
Liters	1.759	Imperial pints
Liters	02643	U.S. gallons
Liters	2.113	U.S. pints
Gallons	8	Pints
Imperial gallons	4.546	Liters
Imperial gallons / Pints	120095	U.S. gallons / Pints
Imperial pints	0.568	Liters
U.S. gallons	3.7853	Liters
U.S. gallons / Pints	0.83268	Imperial / Pints
U.S. pints	0.473	Liters

(b) Imperial pints to liters and vice versa
When the central value in any raw of these liquid measure conversion tables is taken to be in pints, its equivalent value in liters is shown on the left; when the central value is in liters, its equivalent in pints is shown on the right.

L	←pt L→	pt
0.28	0.5	0.88
0.57	1	1.76
0.85	1.5	2.64
1.14	2	3.52
1.42	2.5	4.4
1.7	3	5.28
1.99	3.5	6.16
2.27	4	7.04
2.56	4.5	7.92

2.84	5	8.8
L	←pt L→	pt
3.12	5.5	9.68
3.41	6	10.56
3.69	6.5	11.44
3.98	7	12.32
4.26	7.5	13.2
4.55	8	14.08

(c) Imperial gallons to liters and vice versa.
When the central value in any row of these liquid measure conversion tables is taken to be in gallons, its equivalent value in liters is shown on the left; when the central value is in liters, its equivalent in gallons is shown on the right.

L	←gal L→	gal	L	←gal L→	gal
2.27	0.5	0.11	159.11	35	7.7
4.55	1	0.22	163.65	36	7.92
9.09	2	0.44	168.20	37	8.14
13.64	3	0.66	172.75	38	8.36
18.18	4	0.88	177.29	39	8.58
22.73	5	1.10	181.84	40	8.80
27.28	6	1.32	186.38	41	9.02
31.82	7	1.54	190.93	42	9.24
36.37	8	1.76	195.48	43	9.46
40.91	9	1.98	200.02	44	9.68
45.46	10	2.20	204.57	45	9.90
50.01	11	2.42	209.11	46	10.12
54.55	12	2.64	213.66	47	10.34
59.10	13	2.86	218.21	48	10.56
63.64	14	3.08	222.75	49	10.78
68.19	15	3.30	227.30	50	11.00
72.74	16	3.52	250.03	55	12.09

L	←gal L→	gal	L	←gal L→	gal
77.28	17	3.74	272.76	60	13.20
81.83	18	3.96	295.49	65	14.29
86.37	19	4.18	318.22	70	15.40
90.92	20	4.40	340.95	75	16.49
95.47	21	4.62	363.68	80	17.60
100.01	22	4.84	386.41	85	18.69
104.56	23	5.06	409.14	90	19.80
109.10	24	5.28	431.87	95	20.89
113.65	25	5.50	454.60	100	22.00
118.19	26	5.72	613.17	135	29.69
122.74	27	5.94	681.90	150	32.98
127.29	28	6.16	909.20	200	43.99
131.83	29	6.38	1022.85	225	49.48
136.38	30	6.60	1136.50	250	54.97
140.92	31	6.82	1363.80	300	65.99
145.47	32	7.04	1591.10	350	76.96
150.02	33	7.26	1818.40	400	87.99
154.56	34	7.48	2045.70	450	98.95

TEMPERATURE CONVERSION TABLES

Degrees Fahrenheit to degrees Celsius and vice versa.

When the central value in any row of these temperature conversion tables is taken to be in ^{O}F, its equivalent value in °C is shown on the left' when the central value is in °C, its equivalent value in °F is shown on the right.

General Formula: °F = (°C x (9/5)) + 32; °C = (°F - 32) x (5/9)

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
-73.3	-100	-148.0	-31.1	-24	-11.2	-18.9	-2	28.4
-67.8	-90	-130.0	-30.6	-23	-9.4	-18.3	-1	30.2
-62.2	-80	-112.0	-30.0	-22	-7.6	-17.8	0	32.0
-56.7	-70	-94.0	-29.4	-11	-5.8	-17.2	1	33.8
-51.1	-60	-76.0	-28.9	-20	-4.0	-16.7	2	35.6
-45.6	-50	-58.0	-28.3	-19	-2.2	-16.1	3	37.4
-40.0	-40	-40.0	-27.8	-18	-0.4	-15.6	4	39.2
-39.4	-39	-38.2	-27.2	-17	1.4	-15.0	5	41.0
-38.9	-38	-36.4	-26.7	-16	3.2	-14.4	6	42.8
-38.3	-37	-34.6	-26.1	-15	5.0	-13.9	7	44.6
-37.8	-36	-32.8	-25.6	-14	6.8	-13.3	8	46.4
-37.2	-35	-31.0	-25.0	-13	8.6	-12.8	9	48.2
-36.7	-34	-29.2	-24.4	-12	10.4	-122	10	50.0
-36.1	-33	-27.4	-23.9	-11	12.2	-11.7	11	51.8
-35.6	-32	-25.6	-23.3	-10	14.0	-11.1	12	53.6
-35.0	-31	-23.8	-22.8 .	-9	15.8	-10.6	13	55.4
-34.4	-30	-22.0	-22.2	-8	17.6	-10.0	14	57.2
-33.9	-29	-20.2	-21.7	-7	19.4	-9.4	15	59.0
-33.3	-28	-18.4	-21.1	-6	21.2	-8.9	16	60.8
-32.8	-27	-16.6	-20.6	-5	23.0	-8.3	17	62.6
-32.2	-26	-14.8	-20.0	-4	24.8	-7.8	18	64.4
-31.7	-25	-13.0	-19.4	-3	26.6	-7.2	19	66.2

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
-6.7	20	68.0	5.6	42	107.6	17.8	64	147.2
-6.1	21	69.8	6.1	43	109.4	18.3	65	149.0
-5.6	22	71.6	6.7	44	111.2	18.9	66	150.8
-5.0	23	73.4	7.2	45	113.0	19.4	67	152.6
-4.4	24	75.2	7.8	46	114.8	20.0	68	154.4
-3.9	25	77.0	8.3	47	116.6	20.6	69	156.2
-3.3	26	78.8	8.9	48	118.4	21.1	70	158.0
-2.8	27	80.6	9.4	49	120.2	21.7	71	159.8
-2.2	28	82.4	10.0	50	122.0	22.2	72	161.6
-1.7	29	84.2	10.6	51	123.8	22.8	73	163.4
-1.1	30	86.0	11.1	52	125.6	23.3	74	165.2
-0.6	31	87.8	11.7	53	127.4	23.9	75	167.0
0.0	32	89.6	12.2	54	129.2	24.4	76	168.8
0.6	33	91.4	12.8	55	131.0	25.0	77	170.6
1.1	34	93.2	13.3	56	132.8	25.6	78	172.4
1.7	35	95.0	13.9	57	134.6	26.1	79	174.2
2.2	36	96.8	14.4	58	136.4	26.7	80	176.0
2.8	37	98.6	15.0	59	138.2	27.2	81	177.8
3.3	38	100.4	15.6	60	140.0	27.8	82	179.6
3.9	39	102.2	16.1	61	141.8	28.3	83	181.4
4.4	40	104.0	16.7	62	143.6	28.9	84	183.2
5.0	41	105.8	17.2	63	145.4	29.4	85	185.0

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
30.0	86	186.8	45.6	114	237.2	71.1	160	320.0
30.6	87	188.6	46.1	115	239.0	76.7	170	338.0
31.1	88	190.4	46.7	116	240.8	82.2	180	356.0
31.7	89	192.2	47.2	117	242.6	87.8	190	374.0
32.2	90	194.0	47.8	118	244.4	93.3	200	392.0
32.8	91	195.8	48.3	119	246.2	98.9	210	410.0
33.3	92	197.6	48.9	120	248.0	104.4	220	428.0
33.9	93	199.4	49.4	121	249.8	110.0	230	446.0
34.4	94	201.2	50.0	122	251.6	115.6	240	464.0
35.0	95	203.0	50.6	123	253.4	121.1	250	482.0
35.6	96	204.8	51.1	124	255.2			
36.1	97	206.6	51.7	125	257.0			
36.7	98	208.4	52.2	126	258.8			
37.2	99	210.2	52.8	127	260.6			
37.8	100	212.0	53.3	128	262.4			
38.3	101	213.8	53.9	129	264.2			
38.9	102	215.6	54.4	130	266.0			
39.4	103	217.4	55.0	131	267.8			
40.0	104	219.2	55.6	132	269.6			
40.6	105	221.0	56.1	133	271.4			
41.1	106	222.8	56.7	134	273.2			
41.7	107	224.6	572	135	275.0			
42.2	108	226.4	57.8	136	276.8			
42.8	109	228.2	58.3	137	278.6			
43.3	110	230.0	58.9	138	280.4			
43.9	111	231.8	59.4	139	282.2			
44.4	112	233.6	60.0	140	284.0			
45.0	113	235.4	65.6	150	302.0			

MODULE 6

EMERGENCY RESPONSE PLANNING

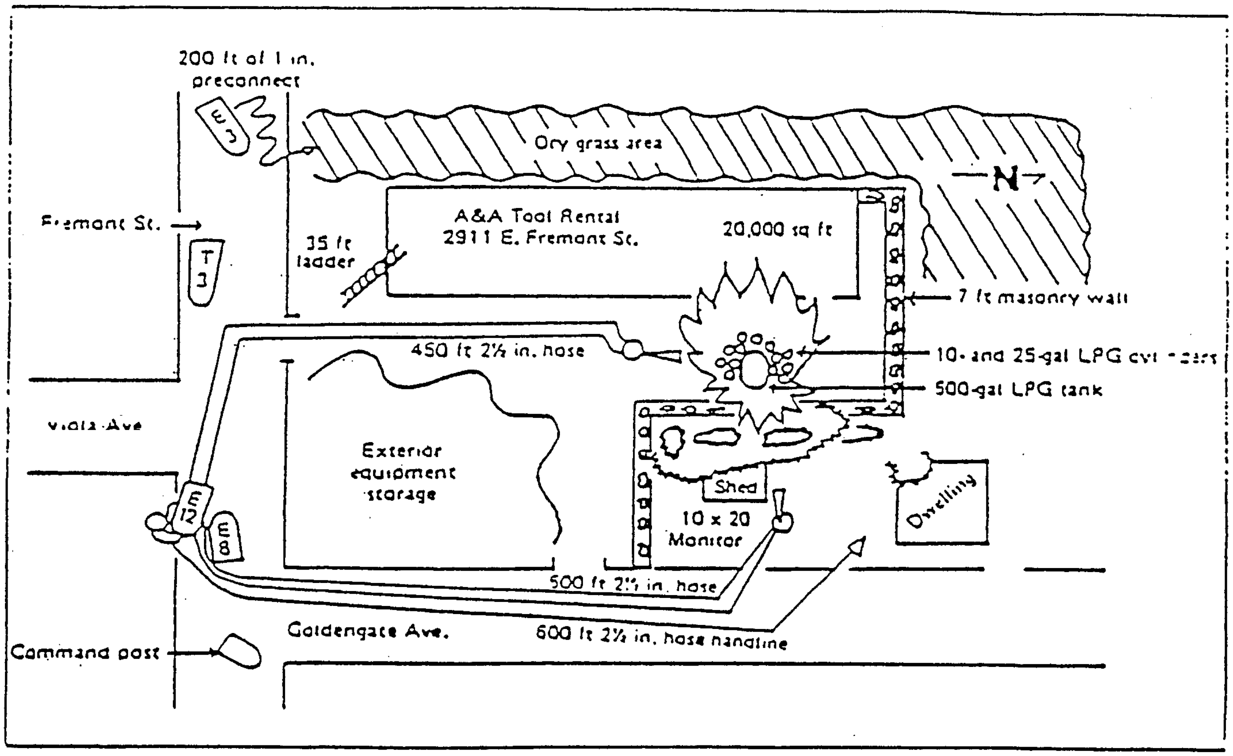
OBJECTIVES

Trainees will be able to:

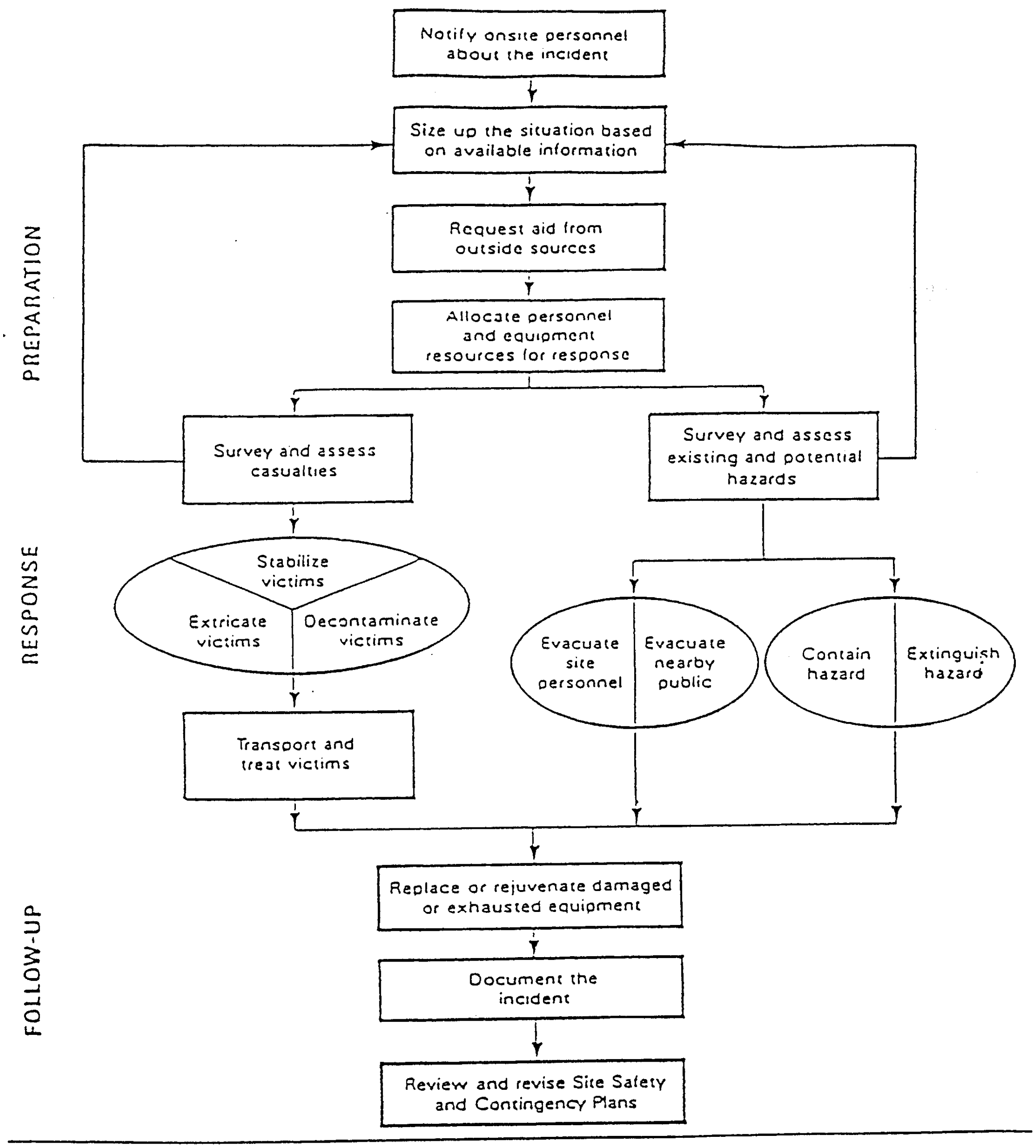
1. List and rank the three key priorities to consider during an emergency.

2. Identify three causes of emergencies, and use a "checklist" for emergency planning.

3. Prepare an Emergency Response Plan for the group case study.



Above: This site plan of the A & A Tool Rental Company shows the position of apparatus, hose lines and the command post. Below: The aftermath of the fire and BLEVE shows looped LPG cylinders strewn about the storage yard. Other cylinders fragmented and rocketed for distances of as much as 600 feet. Photo by Richard A. Cowan, Stockton Fire Department.



Emergency Response Operations.

From: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October 1985.

SCENARIO 1

A one-ton cylinder of chlorine located near the cooling tower of Oilchem Corp. becomes overheated, causing the relief valve to burst and release its contents. A yellow-green vapor cloud has drifted over the hazardous waste unit and is moving towards other units. One worker is down in the area of the cloud. You are the first person to discover the situation.

What should you do? Arrange the cards in order of the first step you should take, the second step, and so on.

SCENARIO 2

A large abandoned manufacturing plant/warehouse has undergone an extensive mitigative effort to remove the hazardous wastes left on the site. Your firm, an environmental consulting company, has handled the entire site clean-up and all that is left to do is to supervise the hazardous waste removal, which will be done this morning. The drums are being loaded onto the tractor trailer trucks, and the manifests are being prepared. It is during this loading operation that your troubles begin.

While picking up drums with forklift, the operator pierces two drums with the forks of the forklift. The drums are beginning to leak. Both of the drums contain toluene diisocyanate (TDI). In his extreme state of excitement, the forklift operator backs his forklift off the loading dock, where it crashes onto a pile of already staged drums. These drums similarly begin to leak. These drums contain acetic anhydride. The forklift operator appears to be injured and can be heard moaning.

Adjacent to leaking drums of acetic anhydride is a storm sewer. Because of the age of the community, the storm sewers are hooked into the sanitary system. The weather is hot and humid, a brief summer thunderstorm has just passed by. It is 7:30 a.m. on a Friday morning. CONGRATULATIONS! Your clean-up has now become an emergency response. Using all of the information available to you, answer the following questions, being able to discuss and defend all of your answers.

1. What are the particular hazards of the chemicals involved?

2. What are the potential pathways of dispersion for the spilled chemicals?

3. What problems can be anticipated if the chemicals follow these dispersion paths?

4. What level of protective clothing would the responders wear to handle the various tasks involved with this incident?

5. What actions would you prescribe for the public?

6. What type of decontamination will be appropriate?

7. ANYTHING ELSE?

SCENARIO 3

Your crew is excavating at the site of a former heavy equipment rental facility which has been out of business for several months. The facility is located in the fringes of the industrial district. There are residences and a variety of worksites in the immediate vicinity. The local agencies have received complaints of strong odors and fumes in the vicinity of the site. A freeway passes within a few hundred feet of the site.

The local and state regulators have contracted with you to remove an underground fuel storage tank. Testing has indicated that the tank is leaking a petroleum product, and a chemical odor is very evident in a drainage ditch at the rear of the property. As the work proceeded, your crew discovered that another tank is in place near the known tank. When you returned from using a nearby telephone to report this development to your regulators, you find that you have a major problem on your hands.

The backhoe operator is slumped over at the controls of the machine, the bucket is in the excavation near what appears to be a length of Romex cable. The end of the cable is arcing and spraying sparks into the excavation. The laborer whom you hired yesterday is lying, motionless, at the bottom of the excavation with his shovel near the arcing wire. The soil around the exposed tank is wet, apparently due to leakage from one of the tanks. What must you do?

CAUSES OF EMERGENCIES AT HAZARDOUS WASTE SITES

A. Worker-Related Causes

- Minor accidents (slips, trips, falls)
- Chemical exposure
- Medical problems (heat stress, aggravation of a pre-existing condition)
- Personal protective equipment failure (air source failure, tearing or permeation of protection, facepiece fogging)
- Physical injury (injury from hot or flying objects, loose clothing entangling in machinery, serious falls, accident)
- Electrical (burns, shock, electrocution)

B. Waste-Related Causes

- Fire
- Explosion
- Leak
- Release of toxic vapors
- Reaction of incompatible chemicals
- Collapse of containers
- Discovery of radioactive materials

C. Environment-Related Causes

- Weather change (rain, lightning, etc.)
- Earthquake

EMERGENCY RESPONSE PLANNING AT HAZARDOUS WASTE SITES: WHAT'S REQUIRED?

The Hazardous Waste Operations Standards requires all employers at hazardous waste sites to develop and implement an emergency response plan, which includes:

1. A written plan, covering specific topics. This plan is a section of the overall Site Safety & Health Plan.

2. The plan must be available for inspection and copying by all employees.

3. The plan must be rehearsed regularly as a part of the overall training program for site operations.

4. The plan must be compatible and part of the local or regional government's emergency plan (as required by Arizona and federal EPA community response planning laws).

5. There must be an alarm system at the site to notify employees of emergency situations.

6. The plan must be reviewed and updated to include new information.

7. During an emergency, the employer must evaluate the emergency and available onsite resources, and implement the plan.

For more information, see OSHA 1910.120, paragraph (1).

WHAT'S IN AN EMERGENCY PLAN?

Employers at hazardous waste sites must prepare a written emergency response plan which includes:

1. Pre-emergency planning and coordination with outside agencies.
2. Job descriptions, lines of authority, and communication methods for those people responsible for emergency response.
3. How to recognize and prevent emergencies.
4. Procedures for alerting all workers in an emergency.
5. Evacuation routes and procedures.
6. Safe distances and places of refuge.
7. Methods for providing emergency medical treatment and first aid.
8. Decontamination procedures.
9. Site security and control.
10. Personal protective equipment and emergency equipment.
11. Evaluation and follow-up for response actions.
12. Site topography, layout, and prevailing weather conditions.
13. Procedures for reporting incidents to local, state, and federal agencies.

PROMOTING SAFE, EFFECTIVE WORKER DECISION-MAKING AND RESPONSE IN EMERGENCIES

Before assisting in an emergency response action, workers must be able to:

1. recognize that there is a hazard or incident in progress,
2. interpret the hazard or incident as a potential danger or emergency situation,
3. decide to take action, to take personal responsibility, and,
4. decide what action to take.

Emergencies result in exceptional, sudden, urgent, and demanding situations. Think of your own workplace and consider the decision-making steps above and the potentially hazardous situations you might face there. List below some of the obstacles to appropriate decision-making at your workplace and list also at least one potential solution to each problem.

OBSTACLES	SOLUTIONS

EMERGENCY RESPONSE
TELEPHONE NUMBERS TO KNOW

For hazardous substance release, fire, or explosion:

U.S. COAST GUARD/DOT National Response Center	1-800-424-8802

For emergency response and information after a hazardous chemical spill:

CHEMTREC	1-800-424-9300
BUREAU OF EXPLOSIVES, ASSOCIATION OF AMERICAN RAILROADS EMERGENCY NUMBER	1-202-639-2222
DOT HOTLINE	1-202-426-2075

QUICK REFERENCE
ARIZONA AND FEDERAL EMERGENCY RESPONSE TELEPHONE NUMBERS

Circumstances Involving	Event	Agency Unit	Telephone
All Hazardous Materials	Releases emergencies (Business hours)	Arizona Department of Environmental Quality (ADEQ) Emergency Response Unit (ERU)	392-4085 392-4004 392-4005 392-4064
	(After hours)	Department of Public Safety	223-2212
	Involving rail transportation (24 hours)	ACC Safety Division Rail Duty Off.	255-3316 252-4232 252-4232
	Involving pipeline (24 hours)	ACC Pipe Duty Off.	255-3316 252-4449
Hazardous Materials Exceeding RQs	Release (24 hours)	ADEQ ERU	257-2330
		National Response Center	1-800-424-8802
		EPA Region 9 Spill Phone	1-415-974-8131
Hazardous wastes	Nonemergency release, disposal, cleanup	ADEQ Compliance Unit	257-2211
RCRA, UST, Superfund	RCRA Hotline	EPA Headquarters EPA Region 9	1-800-424-9346 1-800-231-3075
		ADEQ Hazardous Waste Compliance	257-2342
Underground Storage Tanks	Leaks	ADEQ UST Compliance	257-6984
Radioactive Materials	All	Arizona Radiation Regulatory Agency	255-4845
Agrichemicals	Other than transportation	Arizona Department of Agriculture - Division of Environmental Services	542-0949
Agrichemicals	Laboratory	State Chemist	833-5442
All Mines	Emergencies	State Mine Inspector	255-5971

STATE OF ARIZONA
HAZARDOUS MATERIALS RESPONSE AND RECOVERY PLAN

Emergency Response Directory
State, County, Federal, and Private Agencies

STATE OF ARIZONA

Arizona Corporation Commission, 1200 W. Washington, Phoenix, AZ 85007

Railroad Duty Officer	(24 hours) (602) 252-4232
Pipeline Duty Officer	(24 hours) (602) 252-4449

Arizona Department of Emergency and Military Affairs, 5636 E. McDowell Road, Phoenix, AZ 85008

Plans, Operations, and Military Support	(602) 267-2774
Duty Officer	(24 Hours) (602) 257-9078

Arizona Department of Environmental Quality, 3033 N. Central, Phoenix, AZ 85006

Emergency Response Unit	(602) 257-2330
Office	(24 hours) (602) 207-2381
Spill/Release Reporting	(602) 257-2330

Arizona Department of Health Services, 1520 W. Adams, Phoenix, AZ 85007

State Laboratory	(602) 542-1188
Pager	(602) 259-2913
Division of Disease Prevention, 3008 N. 3rd Street, Phoenix, AZ 85012	(602) 230-5808

Arizona Department of Public Safety/Highway Patrol Bureau, Special Services Division

Duty Officer, 2101 W. Encanto Boulevard, Phoenix, AZ 85005-6638	(24 hours) (602) 223-2212
Hazardous Material Unit, 2610 S. 16th Street, Phoenix, AZ 85034	(602) 223-2502; (24 hours) 223-2212

Arizona Department of Transportation

Motor Vehicle Division, 1801 W. Jefferson,
Phoenix, AZ 85007 (602) 255-8152
Central Maintenance, 206 S. 17th Avenue, Rm. 176A,
Phoenix, AZ 85007 (602) 255-8278
Hazardous Materials Specialist, Safety Section, 1801 W. Jefferson,
Mail Drop 531M, Phoenix, AZ 85007 (602) 255-8133

Arizona Division of Emergency Services

Hazardous Materials Section, 5636 E. McDowell Road,
Phoenix, AZ 85008 (602) 231-6326; (24 hours) 223-2212
Title III Coordinator, 5636 E. McDowell Road,
Phoenix, AZ 85008 (602) 231-6309

Arizona Emergency Response Commission, 5636 E. McDowell Road, Phoenix, AZ 85008

Chairman (602) 231-6245; (24 hours) 223-2212
Executive Director (602) 231-6326; (24 hours) 223-2212

Arizona Game and Fish Department, 2222 W. Greenway Road,
Phoenix, AZ 85023-4399 (602) 942-3000

Arizona Industrial Commission, Division of Occupational Safety and Health, 800 W. Washington, Phoenix, AZ 85007 (602) 542-5765

Arizona Poison and Drug Information Center, Health Sciences Center, Rm. 3204 K, 1510 N. Campbell Avenue, Tucson, AZ 85724 (24 hours) 1-800-362-0101

Arizona Radiation Regulatory Agency, 4814 S. 40th Street,
Phoenix, AZ 85040 (602) 255-4845; (24 hours) 223-2212

Arizona State Fire Safety Committee, 701 E. Jefferson, Suite 200,
Phoenix, AZ 85034 (602) 255-4072

Arizona State Land Department, Fire Suppression, 1616 W. Adams, Rm. 329,
Phoenix, AZ 85007 (24 hours) (602) 542-4052

Attorney General's Office, 1275 W. Washington, Phoenix, AZ 85007

Civil Division	(602) 542-1610
Environmental Crimes Section	(602) 542-4853
24 Hours	(602) 227-0476

Arizona Department of Agriculture - Division of Environmental Services (602) 542-0949

Office of the State Chemist (602) 833-5442

Agricultural Chemical and Environmental Services Division, 1688 W. Adams, Phoenix, AZ 85007 (602) 542-4373

Office of the State Marshall, 701 E. Jefferson, Suite 200, Phoenix, AZ 85034 (602) 255-4072

Office of the State Mine Inspector, 1616 W. Adams, Suite 411, Phoenix, AZ 85007-2627

Mine Emergencies (a recording will indicate a referral number after hours) (602) 542-5971

COUNTY

Apache County Emergency Planning Committee, P.O. Box 238, St. Johns, AZ 85936 (602) 337-4363 ext. 295

Cochise County Emergency Planning Committee, P.O. Box 696, Bisbee, AZ 85603 (602) 432-5471 ext. 400

Coconino County Emergency Planning Committee, C/O Arizona Emergency Response Commission, 5636 E. McDowell Rd., Phoenix, AZ 85008 (602) 231-6309
(24 hrs) (602) 223-2212

Gila County Emergency Planning Committee, 1400 E. Ash St., Globe, AZ 85501 (602) 425-3231 ext. 360

Graham County Emergency Planning Committee, 800 Main St., Safford, AZ 85546 (602) 428-0410

Greenlee County Emergency Planning Committee, Box 908, Clifton, AZ 85533 (602) 865-4762

La Paz County Emergency Planning Committee, Rt. 2, Box 721,
Parker, AZ 85344 (602) 667-3321

Maricopa County Emergency Planning Committee, 2035 N. 52nd St.,
Phoenix, AZ 85008 (24 hrs) (602) 273-1411

Mohave County Emergency Planning Committee, P.O. Box 390,
Kingman, AZ 86401 (602) 753-0725

Navajo County Emergency Planning Committee, P.O. Box 668,
Holbrook, AZ 86025 (602) 524-3366

Pima County Emergency Planning Committee, 2545 E. Ajo Way,
Tucson, AZ 85713-6296 (602) 624-2379

Pinal County Emergency Planning Committee, P.O. Box 827
Florence, AZ 85232 (602) 868-5801

Santa Cruz County Emergency Planning Committee, P.O. Box 1150,
Nogales, AZ 85621 (602) 287-6321

Yavapai County Emergency Planning Committee, C/O Yavapai
County Emergency Services, Courthouse Plaza,
Prescott, AZ 86301 (602) 445-7450 ext. 121

Yuma County Emergency Planning Committee, 298 W. 4th St.,
Yuma, AZ 85364 (602) 783-1271 ext. 261

FEDERAL

National Response Center, 2100 Second St., S.W.,
Washington, D.C. 20593-0001 (24 hrs) (800) 424-8802

National Weather Service, 2633 E. Buckeye Rd.,
Phoenix, AZ 85034 (24 hrs) (602) 379-3599 or 379-3596

U.S. Department of Energy, Radiological Operations Center,
P.O. Box 5400, Albuquerque, NM 87115 (24 hrs) (505) 844-4667

U.S. Environmental Protection Agency, Region XI,
215 Fremont St., San Francisco, CA 94015 (415) 974-7511
(24 hrs) (415) 974-8131

U.S. Environmental Protection Agency, ATTN: Toxic Chemical Release Inventory, P.O. Box 70266, Washington, D.C. 20024-0266 (800) 535-0202

U.S. Nuclear Regulatory Commission Headquarters, Washington, D.C. 20555 (24 hrs) (301) 951-0550

PRIVATE SECTOR

Association of American Railroads, Bureau of Explosives, 1920 L St., N.W., Washington, D.C. 20036 (24 hrs) (202) 639-2222

Chemical Referral Center, C/O Chemical Manufacturers Association, 2501 M St., N.W., Washington, D.C. 20037 (800) 262-8200

CHEMTREC, 2501 M St., N.W., Washington, D.C. 20037 (24 hrs) (800) 424-9300

Hydrogen Fluoride Emergency Plan
Hydrogen Cyanide Emergency Plan
Chlorine Emergency Plan
Phosphorus Emergency Plan
LPG Emergency Plan
CHRIS
Pesticide Safety Team Network

International Bird Rescue, Aquatic Park, Berkeley, CA 94710 (24 hrs) (415) 841-9086

Southern Pacific Transportation Company, 400 E. Toole Ave., Tucson, AZ 85701 - Dispatcher (24 hrs) (602) 629-2130

The Atchison, Topeka, and Santa Fe Railroad (24 hrs) (602) 289-7235

Dispatcher (24 hrs) (602) 289-7236
Winslow, AZ (24 hrs) (602) 289-7269

CHECKLIST — PLANNING FOR EMERGENCIES[3]

1. Has a Contingency Analysis been conducted to determine what emergencies might arise?

2. Have emergency plans and procedures been developed for potentially catastrophic events such as:

    a. Fires?
    b. Blasts and explosions?
    c. Leaks and spills?
    d. Extreme weather?
    e. Floods?
    f. Earthquakes?

3. Do these plans provide for procedures for extinguishing different types of fires which might occur in the plant?

4. Do these plans have adequate evacuation and recovery procedures for each type of emergency?

5. Have responsibilities been assigned in the plan to specific personnel to direct operations to counter emergencies? Are these persons aware of their responsibilities? Are they qualified to lead in the necessary actions which might be required?

6. Are emergency crews qualified, designated, and on station?

7. Are different communication channels assigned to support emergency operations?

8. Are there plans to evacuate personnel from each work area in the event of emergencies?

9. Are evacuation route and warning signals information posted in each work area? Are the evacuation routes and exits marked?

10. Are the emergency plans and procedures posted in prominent areas?

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[3]Source: *Occupational Safety, Management, & Engineering*, W. Hammer, 3rd Ed., Prentice Hall, Inc., Englewood Cliffs, NJ (1985).

11. Have personnel received training in emergency procedures:

    a. Workers?
    b. Supervisory personnel?
    c. Firefighters?
    d. Medical personnel?
    e. Communications personnel?

12. Are there drills on simulated emergencies being conducted periodically for personnel?

13. Is there a procedure to ensure that all personnel have been alerted to the emergency and those who will not combat it have been evacuated?

14. Are the egress provisions adequate (i.e., doors, stairways, elevators) for the evacuation in the event of an emergency?

15. Do all doors open in the proper direction to facilitate egress of personnel in emergencies?

16. Are there procedures to preclude obstructions to personnel or equipment in critical evacuation or emergency equipment access routes or areas?

17. Can egress routes from work areas be followed by personnel in the dark or in smoke?

18. Is the emergency equipment called out in the emergency procedures available at the facility, and is it operational? Can the equipment be reached easily if an emergency occurs?

19. Are warning systems installed (sirens, loudspeakers, etc.) and are they tested periodically? Area all personnel familiar with the meanings of warning signals and required action to be taken?

20. Is there a fire detection system at each facility? Are fire extinguishers sized, located, and of the types required by OSHA standards, and are they suitable for the types of fires which might occur?

21. Is there firefighting equipment located near flammables or hazardous areas?

RESPONSE EQUIPMENT

The following list of equipment encompasses the entire range available for responding to incidents involving hazardous substances. Not all of this equipment may be needed on any given incident. The various categories of response equipment are:

Communication Gear

Handheld radios

Personnel Clothing and Equipment

See Schedule A

Field Equipment

Combustible gas indicator
HNu photoionizer
Century Systems Organic Vapor Analyzer (OVA)
Oxygen meters
Colorimetric indicator tubes
Specific gas detectors
Radiation detector
Metal detector
Pressure-demand, self-contained breathing apparatus with extra air cylinders
Full-face, air-purifying respirators with appropriate canisters
Fit-testing kit
Photographic equipment
Film badges
Dosimeters
Organic vapor badges
First aid kit (see Schedule B)
Hand tool kit (see Schedule C)
Reference materials (see Schedule D)
Field support kit (see Schedule E)
Soil sampling set (see Schedule F)
Water sampling set (see Schedule G)
Air sampling set (see Schedule H)
Other field equipment (see Schedule I)
Emergency oxygen inhalator
Portable wash unit
Fire extinguisher

Miscellaneous Items

See Schedule J

SCHEDULE A: PERSONNEL CLOTHING AND EQUIPMENT

Fully encapsulating suit
Chemical-resistant splash suit
Chemical-resistant, steel-shank and toe boots
Safety work boots, leather
Work gloves
Rain suit
Windbreaker
Medium-weight jacket
Appropriate winter clothing
Coveralls (work)
Coveralls (Nomex)
Uniform pants and shirts
Socks (regular)
Socks (heavy)
Underclothes
Earplugs
Clipboard
Hardhat with and without face shield
Hardhat for cold weather
Safety goggles, soft sides for full eye protection
Safety glasses

SCHEDULE B: FIRST AID KIT

A medical first aid kit consisting of:

First aid guide
Aspirin
Pain aid
Cold tablets
EEZ lozenges
Trail antacid
Gelusil tablets
Ex-Lax
Syrup of Ipecac
Vasoline
Antibiotic ointment
Insect repellent

SCHEDULE B: FIRST AID KIT (cont.)

Sting relief
Chigger/tick remover
Poison ivy treatment
Snake bite kit
Ammonia inhalants
Blood clotter
Tourniquet
Ice pack
Ice pack (large)
Salt tablets
Scissors
Forceps (Dumont 5")
Tweezers
Cotton swabs
Clean wipe alcohol swabs
Antiseptic swabs
Antiseptic spray
Burn septic spray
Spray-on bandage
Eye drops
Eye/skin neutralizer
Eye wash
Adhesive tape
Cohesive tape
Telfa sterile pads
Bandaids
Curad bandage (2¼"X3½")
Fingertip bandages
Knuckle bandages
Elastic strip bandage
Triangle bandage
Carlisle compress dressing
Gauze bandage (1"X18')
Gauze bandage (2"X12')
Gauze bandage (3"X3")
Gauze bandage (2"X2")
Litter
Butterfly closure (medium)
Finger splint
Blanket
Powdered charcoal
Traction splints (arm and leg)

SCHEDULE C: HAND TOOL KIT

Wood mallet
Rubber mallet
Ball peen hammer
Claw hammer
Hand hammer (nonsparking, 2 doubleface, beryllium-copper)
Hacksaw
Lumberjack's knife
Duckbill snips (12")
Rod and bolt cutter (24")
Diagonal cutting pliers (8")
Lineman's pliers (8")
Slipjoint pliers (8")
Locking plier wrench (10")
Pipe wrench (nonsparking)
Wrench set (combination)
Screwdrivers (5 slotted, 4 phillips)
Heavy-duty stapler and staples
Pressure gauge
Lock-type measure tape
Winding reel tape
Electrical tape
Strapping tape
Duct tape

SCHEDULE D: REFERENCE MATERIALS

NFPA Guide on Hazardous Materials
CHRIS Condensed Guide to Chemical Hazards
Sax Dangerous Properties of Industrial Materials
Toxic and Hazardous Industrial Chemical Safety Manual
Matheson Gas Data Book
NIOSH/OSHA Pocket Guide to Chemical Substances
TLVs for Chemical Substances and Physical Agents in the Work Environment

SCHEDULE E: FIELD SUPPORT KIT

Binoculars (7X25mm wide angle) (2)
Rangefinder (2)
Spotting scope
Stereoscopes
Compass (2)
Hand level (2)

SCHEDULE E: FIELD SUPPORT KIT (cont.)

Hand calculator (2)
Cassette recorder (1-hr tape)

SCHEDULE F: SOIL SAMPLING SET

Soil auger (cork screw, tube)
Auger extensions
Power head (electric)
Soil sample tubes (1½"X5/8")
Replacement tips for tube samplers (regular)
Wet, heavy-duty tips
Scoops for bottom sediments
Stainless steel pipe section 2" 10/taper on penetrating end)
Electrical resistivity apparatus
Labels
Logbook for soil profile
Stainless steel spoons
Post hole digger
Pickax
Shovel
Stainless steel pans

SCHEDULE G: WATER SAMPLING SET

Weighed battle sampler
Pond sampler
Glass and polyethylene containers
Scoops and dippers
Suction devices (hand pumps)
Water level indicator
Cased thermometers/thermistors
Teflon bailer
Dissolved oxygen meter
Conductivity meter with 50 ft cord

SCHEDULE H: AIR SAMPLING SET

Colorimetric indicator tubes and preweighed filters
Hi-vol sampler
Impinger tubes
Carbon adsorption tubes
Particulate samplers

SCHEDULE H: AIR SAMPLING SET (cont.)

Wind direction indicator
Wind speed indicator
Barometric pressure indicator
Temperature indicator

SCHEDULE I: OTHER FIELD EQUIPMENT

1 Rope (300', polypropylene, 16 lb)
1 Heavy duty tow chain (15')
1 Heavy duty extension cord (100')
1 Garden hose (50' 5/8" 10)
4 Scrub brushes
4 Plastic buckets
1 Large logbook
2 Safety flares (vehicle use)
2 Rechargeable lanterns
1 Wrecking bar (nonsparking 30" X 3/4")
2 Spud bars
2 Sledge hammers (4 lb)
2 Shovels (0 handle, square point, nonsparking)
2 Shovels (0 handle, round point, nonsparking)
2 Shovels (long handle, round point, nonsparking)
5 Buna N gloves
5 Jasper work gloves
5 PVC disposable gloves
5 Neoprene gloves
5 Solvex gloves
5 Natural rubber gloves
5 PVC disposable boots
5 Life vests
5 Hip/chest waders
5 Rainsuits

SCHEDULE J: MISCELLANEOUS ITEMS

Redwood plugs (various sizes)
Valve packing
Revere miracle seal (synthetic rubber)
Nylon wire
Paper clips and alligator clips
Magnetic hangers
Rubber bands

SCHEDULE J: MISCELLANEOUS ITEMS (cont.)

Paper and note pads
Pens, pencils, markers
Clipboards
Kimwipes
Kleenex
Detergent (large)
Plastic drop sheet
Black spray paint
Yellow spray paint
Green marking tape (perimeter)
Color coding DOT security tags (red, yellow, green)
Restricted Area signs
Rubber tarp tiedown straps
Electric power outlet strip (8 outlets)
Airtight container for sample storage
Clean water supply
Antifog solution

SPILL CONTROL

MODULE 7

OBJECTIVES
Participants will be able to: • Identify two key methods for controlling spills, ie. Confinement and Containment • Identify three general techniques used for confinement • Identify methods to contain leaks in non-pressurized and pressurized containers • Identify methods to contain liquid spills

This module will deal with the methods to control spills of hazardous materials by the use of CONFINEMENT and CONTAINMENT techniques. The need to perform either of these techniques and the various methods associated with each of them will depend upon both the nature and severity of the spill.

CONFINEMENT:

In general confinement techniques are those actions necessary to CONFINE a product release to a limited area ie. to prevent it from spreading beyond a specified boundary. These actions usually take place in areas remote from the actual point of release and therefore they can be regarded as defensive in nature. The advantages of this procedure are:

(1) Direct personnel exposure to the hazardous substance can normally be avoided or minimized.

(2) The operation can often be carried out with a minimum of PPE.

(3) Specialized control equipment to deal with the source of the hazard may not be required.

(4) The operations can usually be carried out with a minimum of supervision.

CONFINEMENT METHODS:

1. **Diversion**
   Controlling the flow of the material to an area where it will be less harmful.

2. **Diking**
   Constructing a barrier to prevent material from flowing to an area where it will be more harmful. (Note: This should only be a temporary measure.)

3. **Retention**
   Temporary containment of the material in an area where it can be treated for proper disposal, such as with the use of absorbents or neutralizing chemicals.

"The decision to use diversion, diking or retention tactics is based on the availability of time, personnel, equipment, and supplies. It also should be made with a review of the potential harmful effects of the leaking material downhill and downwind of the spill.

For example, a decision to divert a flowing diesel fuel spill from a storm drain to a roadside ditch may be based on the observation that the fuel is flowing too fast, and sufficient personnel and equipment are not available to construct a dike. Finally, the fuel will cause substantially less environmental damage in the ditch than in the storm system.

Diversion can begin immediately upon the arrival of the ERP unit. Diking can e started with basic first-responder equipment as more ERP arrive. Retention techniques will then follow as specialty teams and equipment become available.

Don't make the mistake of concentrating all resources on one tactic. It is easy to assign all ERP to the construction of a dike, for example, which may fail and force everyone to move to a safer location to begin again."[4]

1. Diversion Techniques

"A flowing, land-based spill can quickly be diverted by placing a barrier, normally dirt, ahead of the spill. As when fighting a fast moving brush fire, the barrier should be placed well ahead of the actual spill. This may well mean sacrificing some intermediate territory to the hazmat in order to establish complete control at the final diversion site.

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[4] "HAZARDOUS MATERIALS: Managing the Incident." Noll, Hildebrand, Yvorra. 1988 Peake Productions, Inc. Pg. 158.

Constructing a diversion barrier requires teamwork. When a team with the right equipment works quickly, a large area can be rapidly controlled. A typical four-person crew can build a twenty yard by eight inch diversion wall in about 10 minutes, if the proper materials are available.[5]

2. Diking Techniques

"Dikes are effective when they can be built quickly and can contain about 90 percent of the hazmat. Although any available material will do the job, the best quickly acquired supplies are dirt, tree limbs, boards, roof ladders, pike poles, and salvage covers. Bagged materials such as tree bark, sang, and kitty litter can be found at hardware and garden supply stores when more substantial control is required. However, when really large spills occur, dump truck-sized deliveries will be required.

Dikes will usually be constructed by first responders using whatever equipment is available on the scene. When you are considering building a containment dike, quickly compare your resources to the quantity of the spilled material. Most ERP overestimate the amount of spill and underestimate the personnel required to complete a dike.

Slow-moving or heavy materials should be confined by use of a circle dike. Faster moving products will require a "V" shaped dike located in the best available low-lying area.

Dike construction should begin by choosing large materials for reinforcement, followed by an outer layer of lighter material such as dirt. Plactis or salvage covers can then be draped over the entire dike and a final seam of dirt paced along the leading edge between the plastic and the ground as shown in Figure 10-2.

Factors which limit dike construction include situations where:

- **The surrounding area is concrete or asphalt with no available soil--Either sacrifice the area for better turf or truck in necessary materials.**

- **The ground is frozen--Snow may be used in conjunction with materials such as plastic and ladders. Otherwise, truck in necessary materials.**
- **Essential equipment is unavailable--At least three, pointed shovels are necessary. When possible, construct dikes upwind in safe areas. Be sure to consider the need for SCBA."[6]**

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[5] **Noll, et. al. 1988. Pg. 158.**

[6] **Noll, et. al. 1988. Pg. 159-160**

TYPES OF DIKES

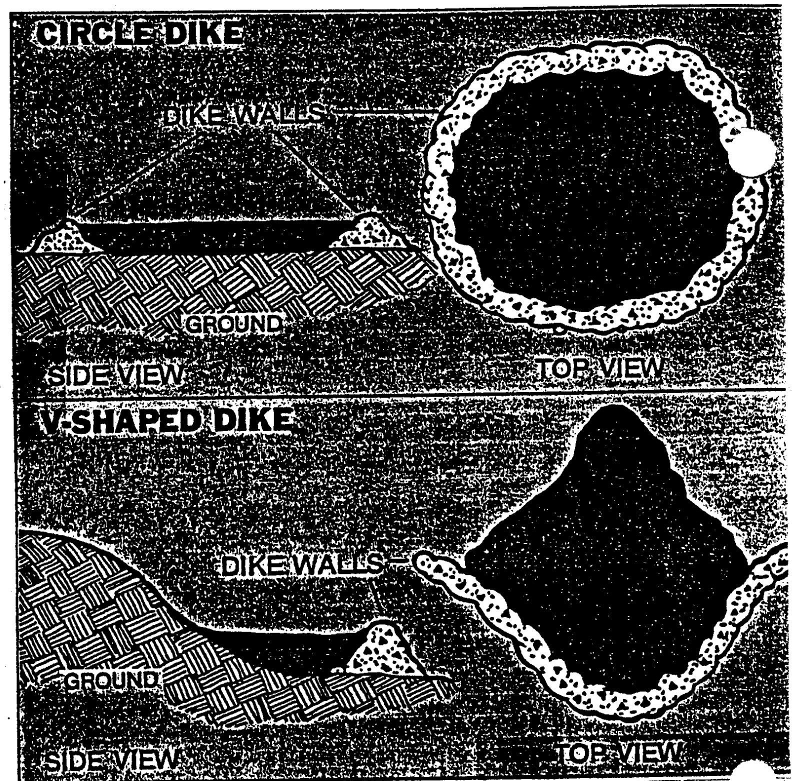

FIGURE 10-2: TYPES OF DIKES

AN EFFECTIVE DIKING TECHNIQUE

FIGURE 10-4: AN EFFECTIVE DIKING TECHNIQUE

3. **Retention Techniques**

"Sometimes retention techniques can be implemented independently of diversion or diking to act as a back-up to the other methods. Storm systems can be protected by placing salvage covers or plastic over drains and covering them with dirt. The same procedure can be used for sewer system manways.

When the hazmat is primarily liquid or slurry, has a specific gravity less than water, and is not water reactive, it may be possible to flood the retention area with water from an engine or hydrant. The hazmat will then float on the water. Any subsequent leakage into the storm system would then be water."[7]

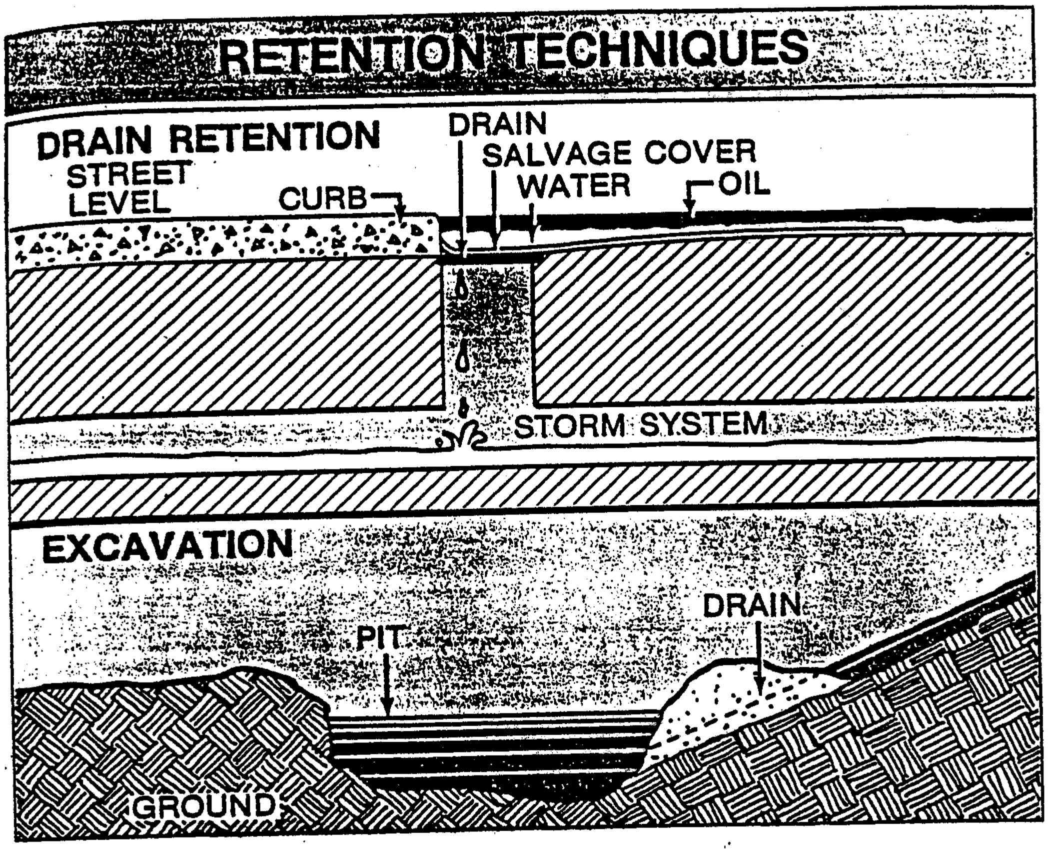

FIGURE 10-3: RETENTION TECHNIQUES

[7] Noll, et. al. 1988. Pg. 160

CONTAINMENT:

In general CONTAINMENT actions are those operations designed to contain the product in it's original container and also to prevent the spread of the hazardous material in the area at or close to the source of the release. This will normally require entering the Hot Zone and performing actions which are offensive in nature. They would therefor require the use of PPE and the application of Hazardous entry procedures where specially trained personnel would be required.

"Although containment operations may pose higher risks, they may be necessary to:

- **Minimize environmental damage--This is particularly true for hazardous liquids which threaten storm systems or water supplies.**

- **Reduce operating time--Leaks confined to the area immediately around the container usually limit the spread of material and the need for evacuation, particularly when faced with a gas or toxic chemical.**

- **Reduce clean-up costs--Contaminants are usually limited to small areas or have not entered ground or surface waters.**

Situations well-suited for aggressive offensive operations include when:

1. **The hazmat is in a gaseous form and threatens to migrate away from its container.**

2. **The hazmat is in a solid, powder form and weather conditions threaten to carry it from its original site.**

3. **When defensive options have been attempted but have not produced the desired results.**

4. **The situation is getting worse and increasing in risk, as time progresses.**

Successful offensive operations should be preceded by a thorough reconnaissance. Recon may be as simple as having a trustworthy individual relay his observations or as complex as a complete entry team survey which documents the entire work site with a video camera.

No emergency situation is worth taking unreasonable risks. Rapid withdrawal from the Hot Zone is always an option. Aggressive/offensive does not mean quick and stupid.

Leak control tactics are simple. Plug the hole and the leak will slow or stop. Likewise, moving the container to place the hole above the liquid or solid level minimizes the hazmat release.

The same applies for hazmats which may be going from a liquid to a vapor state. For example, a leaking one-ton chlorine container has two valves. One is usually above and one below the liquid chlorine. When the leaking valve is on the bottom, chlorine escapes

in liquid form and expands 800 times to become a gas. Rotating the cylinder 180^o places the defective valve above the liquid, which then significantly reduces the size of the leak. Simply standing up a drum may be sufficient to control the leak. Use the designed openings, close the valves, tighten the caps, or replace the lids.

When these common-sense techniques aren't effective, try to:

- **Plug or patch the opening. (Control it at the source.)**
- **Lower the container pressure. (Limit its magnitude.)**
- **Use vapor suppression agents such as foam. (Limit its vaporization.)**
- **Neutralize using another chemical.**
- **Control the leak and dispose in place."[8]**

CONTAINMENT METHODS

- **Methods of Plugging and Patching Non Pressurized Containers**
- **Special Kits for Pressurized Vessels**
- **Absorbants**
- **Neutralizing Chemicals and Foams**

Depending upon the nature of the material released and the source of the release, the following methods are generally used:

1. PLUGGING AND PATCHING

"Simple homemade or hardware store-bought equipment can control most hazmat container leaks. For example, a small hole in a tank truck can sometimes be plugged by driving a wooden wedge into the opening with a rubber mallet.

Plugs and patches can be fabricated on the scene, but you can save a great deal of time by manufacturing a variety of devices before the fact and carrying them on response vehicles. Preplan potential container leaks and confer with other ERP to determine what works.

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[8] Noll, et. al. 1988. Pg. 162-163.

Plugging techniques are usually used in conjunction with synthetic rubber gaskets or special chemical resistant putty to ensure a good seal by filling the cracks around the plug. Small holes (less than one inch in diameter) which are not under pressure can be filled with putty or epoxy resin compounds. The longevity of these compounds is limited due to material compatibility, the hole size, and the head pressure of the container. These should be viewed as only temporary first aid techniques.

When the container has a large gash or hole in its side, it can sometimes be patched with sheet metal in conjunction with a gasket or other compatible materials. In these cases, the hazmat will probably have leaked to below the level of the opening before ERP arrive Patching can reduce vaporization and minimize the spill area. It may also be necessary when the container must be moved to allow access to valves or other loading points.

To properly organize a patching operation:

1. **Select a patch/device half a size larger than the estimated opening. Smaller devices may be drawn inside the container as attachments such as nuts and bolts are tightened.**

2. **Select a device that is compatible with the hazmat.**

3. **Plan the work with SCBA operating times in mind. Several trips may be required. Overlap work crews so that one is always working, one crew is ready to step in, and the third is reservicing.**

4. **Brief personnel on the tools required to complete the job. The more complicated the job, the more extensive the briefing. It's easy to forget tools when crews are under pressure. Forgetting one tool may add an hour to the operation since decontamination is required for the entry team member who makes the second trip."[9]**

2. SPECIAL KITS FOR PRESSURIZED CONTAINERS

Patching and Capping Leaking Containers

Introduction

The most common source of leaking tank cars or trucks is from the dome and bottom outlet valves. In many cases, it is only necessary to tighten a valve or fitting, but if this does not work, capping or plugging is probably necessary. Before capping is attempted, the particular part of the dome or valve system must be identified to locate the leak.

It is possible to contain some leaks temporarily by capping or patching. This will depend on the position and condition of the leaking container, the risk to those working on or around the container(s) and the availability of equipment and also if the leaking containers

[9] Noll, et. al. 1988. Pg. 163-164.

are exposed to certain weather conditions. Capping pressurized containers require the use of specialized kits and materials. In special situations, some plugs can be used on pressurized containers; however, as a general rule, plugs, patches, or seals are used in cases involving little or no pressure.

Capping Leaking Containers

To cap a leaking valve or fitting effectively, the kit matching the leaking container must be used, the container must be in a position suitable for capping, and the cap must be applied properly and securely to insure a tight liquid and vapor seal. There are some limitations to capping to be considered:

a. **Limited pressure capacity - cap may not be able to withstand container pressure, therefore the time the cap will be useful is shortened.**

b. **corrosion of capping material - the product may corrode or otherwise react with the capping material causing it to fail in turn causing a bigger problem.**

c. **open valve cover - on railroad tank cars the valve housing cover must remain open once the cap is applied, which may lead to a problem moving the car.**

d. **gasket size, shape and material composition - the gasket material must be the proper size and able to withstand contact with the leaking product.**

Patching Leaking Containers

Two basic guidelines must be followed for capping. First, capping requires not less than two (2) people and more depending upon the container's position. Second, caps must be vented while they are being installed to ensure a tight vapor seal around the gasket.

Patches, plugs, and seals are relatively simple to apply, but still care should be taken to ensure the patching material will not deteriorate rapidly when it comes in contact with the leaking material. The type of container and its construction must be taken into consideration Insulated containers may disguise the actual leak location or the insulation material may not allow a good fit for the patch or plug. High pressure containers may blow out typical plugging devices.

Other considerations include the location and type of leak, the way the patch or plug will be held in place, and the final disposal of the container. A jagged tear may be more difficult to plug than a gauge or puncture. Leaks along seams frequently require more attention in order to get a good seal. In many cases the area around the leak should be cleaned to remove any paint, rust, grease, or other foreign materials that might interfere with the sealing ability of certain patches, plugs or sealants. Insulation material may have to be removed. Certain plugs wedge themselves well into the leaking opening, while other patching devices require straps or bands.

One system has an inflatable leak seal bandage which relies on straps to hold it in place over the leak. Plumbers plugs of various sizes expand to form a very effective seal when the plug is tightened. Boiler plugs, metal screws with gasket material, toggle bolts/rubber plugs, wood wedges, and tapered wood plugs all serve as an effective patching and plugging devices.

The final disposal of the container should not be overlooked. the patch or seal must be able to withstand the action of the product inside and the handling of the container until the material is transferred to another container.

Reference: Kits List

TABLE 1

<u>EXPANDED DRUM REPAIR KIT</u> (5 Gal to 85 gal)

1	scissors
2	paint scrapers (1-1/4"w H.D. chisel nose + 2-1/2" or 3"w
1	channel lock pliers
1	tin snips
1*	wire brush
1*	nylon brush
2	utility knives with blades
2	putty knives
2	screwdrivers (6" and 10")
2	8" crescent wrenches
1	combination square
2	ball peen hammers (2 oz and 8 oz)
1	pack lead wool
1	hacksaw with blades
1	rubber vulcanizing plug kit
1	assorted wooden plugs
4*	plastic steel kits
2	rolls duct tape
6	drum clamps
1	assorted sandpaper
1	assorted ss sheet metal screws, toggle bolts, etc.

1	assorted patches (ss sheet metal, niton, neoprene, TFE)
1	pack of felt & cloth
1	saw
1	pack of wood (1"x2", 12" long use for packer)
2*	rolls surveyor tape

TABLE 2 PLUG KIT

1	small plastic bucket	2	2" emerg. pipe & bore test plugs
	assorted tapered wooden plugs	2	3/4" female emerg. pipe & bore test plugs
1	tapered rubber plug	2	1¼" female emerg. pipe & bore test plugs
1	1½" plumber's plug	2	1½" female emerg. pipe & bore test plugs
1	2" plumber's plug	2	2" female emerg. pipe & bore test plugs
1	3" plumber's plug	1	4" pump & test plug
1	4" plumber's plug	1	2" plumber's plug (capped)
1	5" plumber's plug	1	4" plumber's plug (capped)
1	6" plumber's plug	1	8" plumber's plug (capped)
2	3/4" emerg. pipe & bore test plugs	2	3/8" ball valves (stainless steel)
2	1¼" emerg. pipe & bore test plugs	2	½" ball valves (steel)
2	1½" emerg. pipe & bore test plugs		

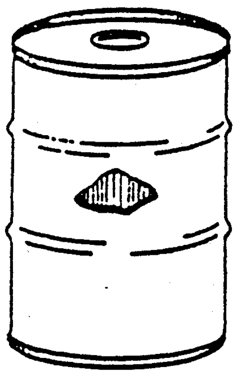
TABLE 3 EMERGENCY & DISASTER KIT BOX #6
VALVES & FITTINGS KIT

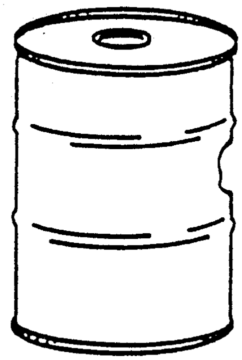
2 - wire brushes	3 - 1" -3/8 brass reducer
1 - hand brush	4 - 1/8" stainless steel 90^o fittings
1 - dust brush	3 - bushing 3/8" x ¼"
4 - rail routing boards	1 - elbow 45^o comp. fitting 2"
4 - 1" ball valves	2 - elbow 45^o comp. fitting 1½"

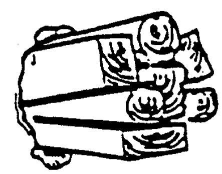
TABLE 4 EMERGENCY & DISASTER KIT BOX #2
PACKING/SEALANT KIT

assorted packing	2 - rolls joint sealant
2 - rolls duct tape	3 - rolls electrical tape
1 - roll masking tape	4 - packaged safety discs
4 - clevis 7/16"	1 - lead sheet
6 - swivel hooks	1 - bicycle pump
1 - 3/8" drill	2 - packing puller

TECHNIQUES FOR PATCHING AND STABILIZING LEAKING CONTAINERS

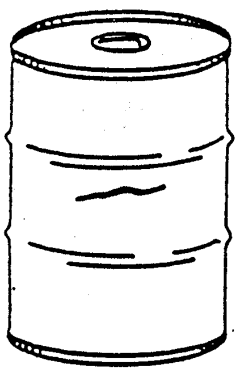


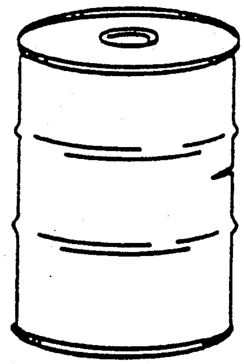


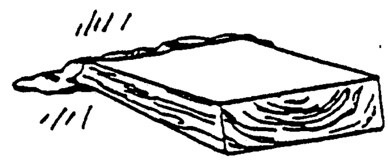


Combinations of square, conical, and wedge-shaped wooden plugs (Wrap plugs with felt or cloth before inserting)

Larger Holes

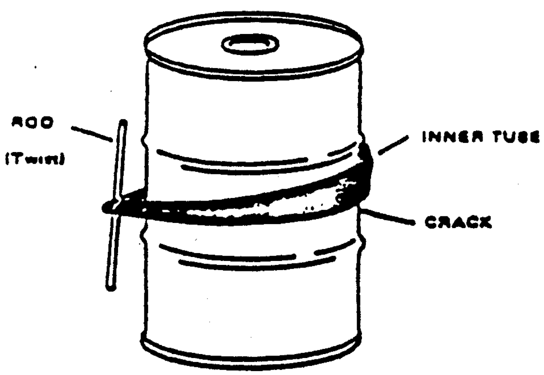


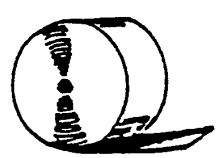




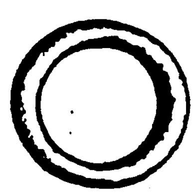
Drive oakum, mastic, or cloth into crack with wedge

Small Linear Cracks

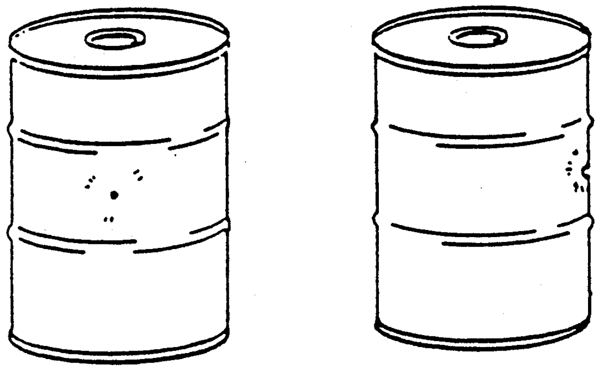




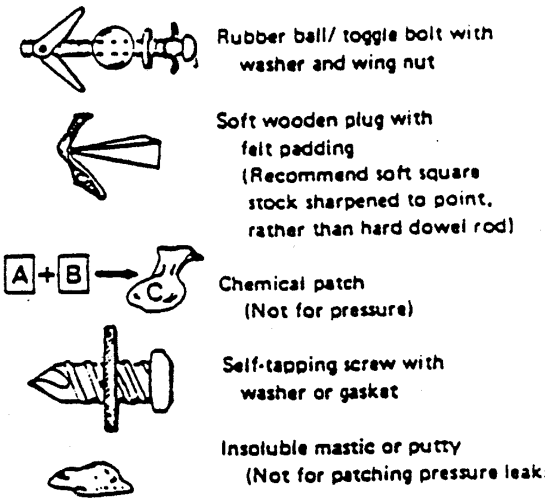
Heavy duty duct tape makes a good temporary seal in many cases

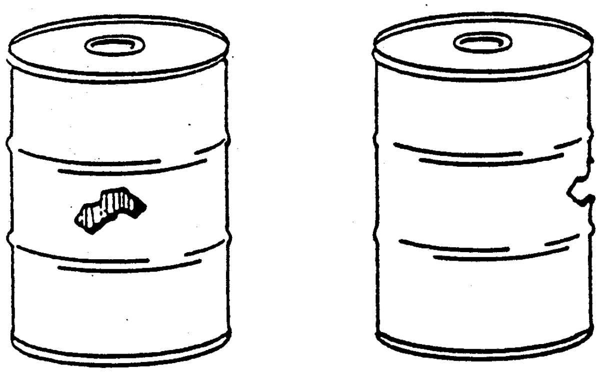


A broad inner tube placed over the crack in a drum can be tightened with a rod or stick to form a fairly good seal

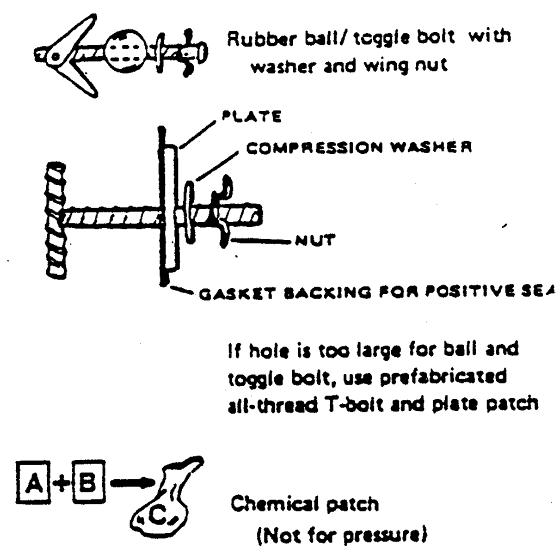


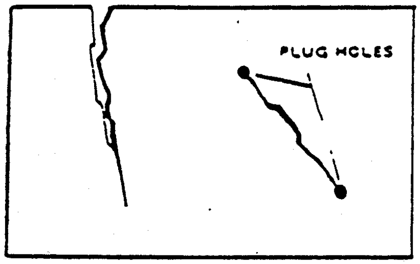
Small Simple Puncture



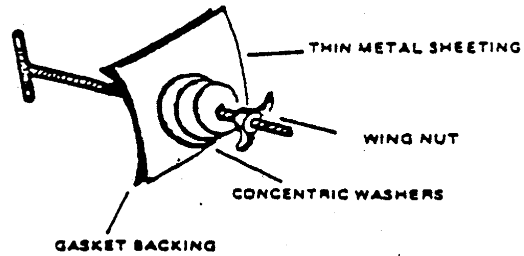


Larger Irregular Hole

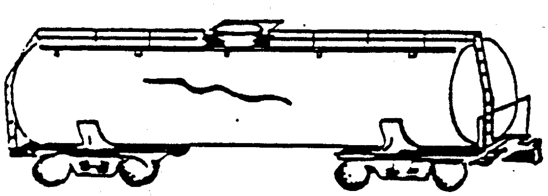




Holes may be drilled at both ends of a crack and plugged to prevent further extension and expansion of cracks
(Useful in handling cracks in metal plates)

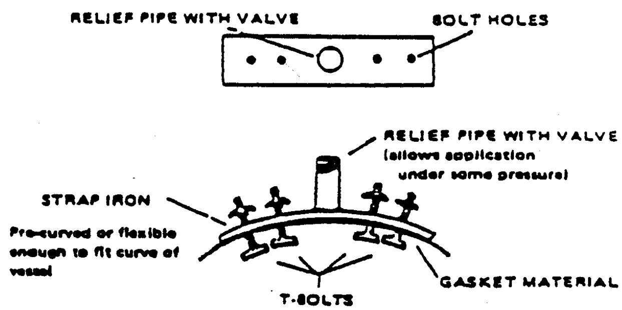


A small diameter all-thread T-bolt assembly, with thin, pliable metal sheeting and concentric washers can be inserted along the middle of the crack

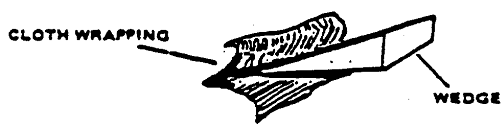


Larger Cracks

Strap Iron "BandAid" with T-bolts



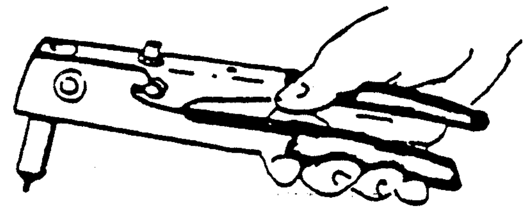
Cloth Wrapped Wedge



Larger cracks can also be plugged to some extent with a combination of felt or cloth-wrapped wedges

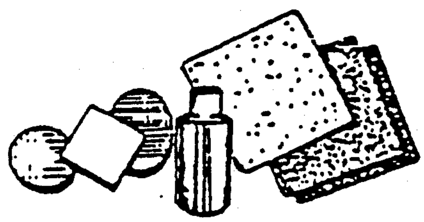
Other useful patching equipment includes:

1. Pop-Rivet Tool

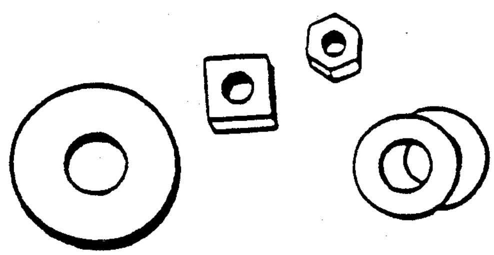


2. Tubeless Tire Plug Patch Kit

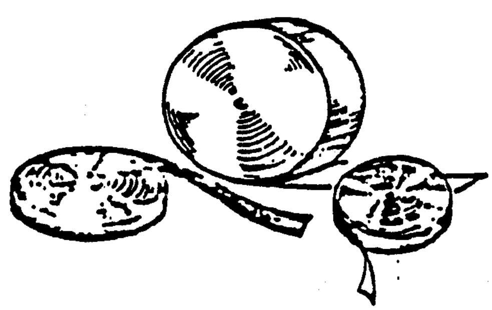
3. Assorted Rubber Patches, Cement, and Gasket Material



4. Assorted O-rings, Washers, and Nuts

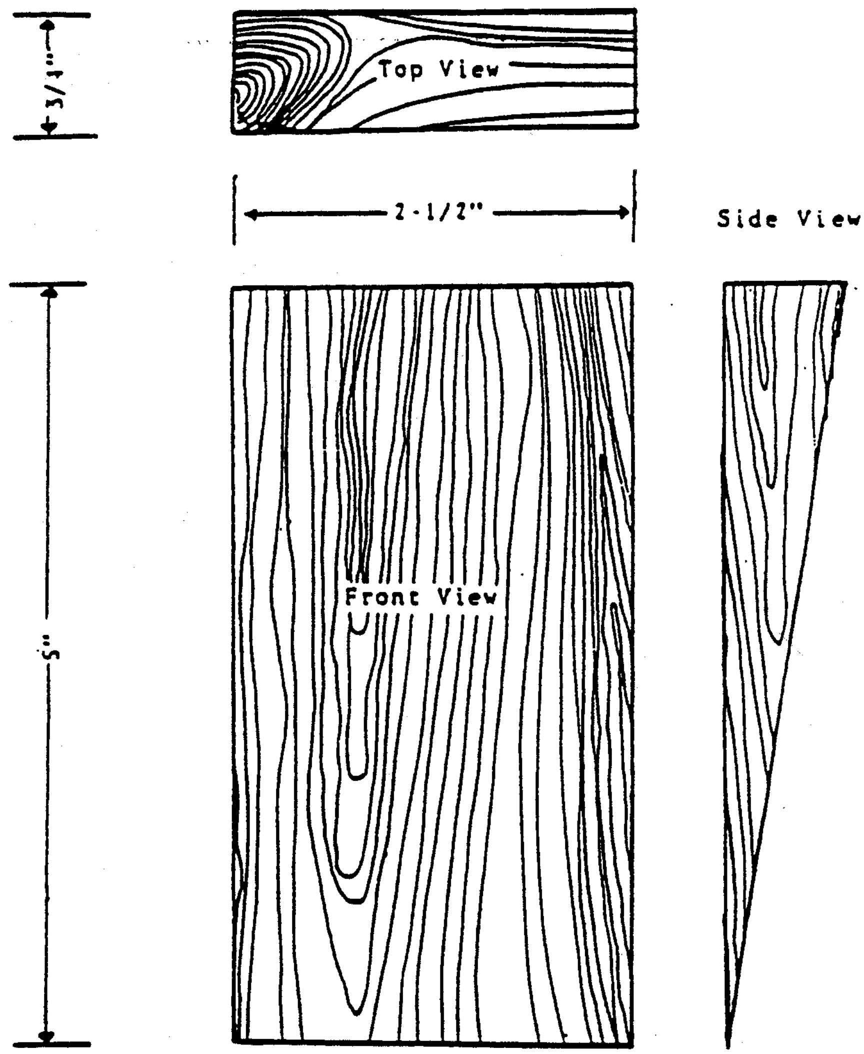


5. Various Tapes - Duct Tape, Teflon Tape, Electrician's Tape, etc.



SOFT WOOD WEDGE

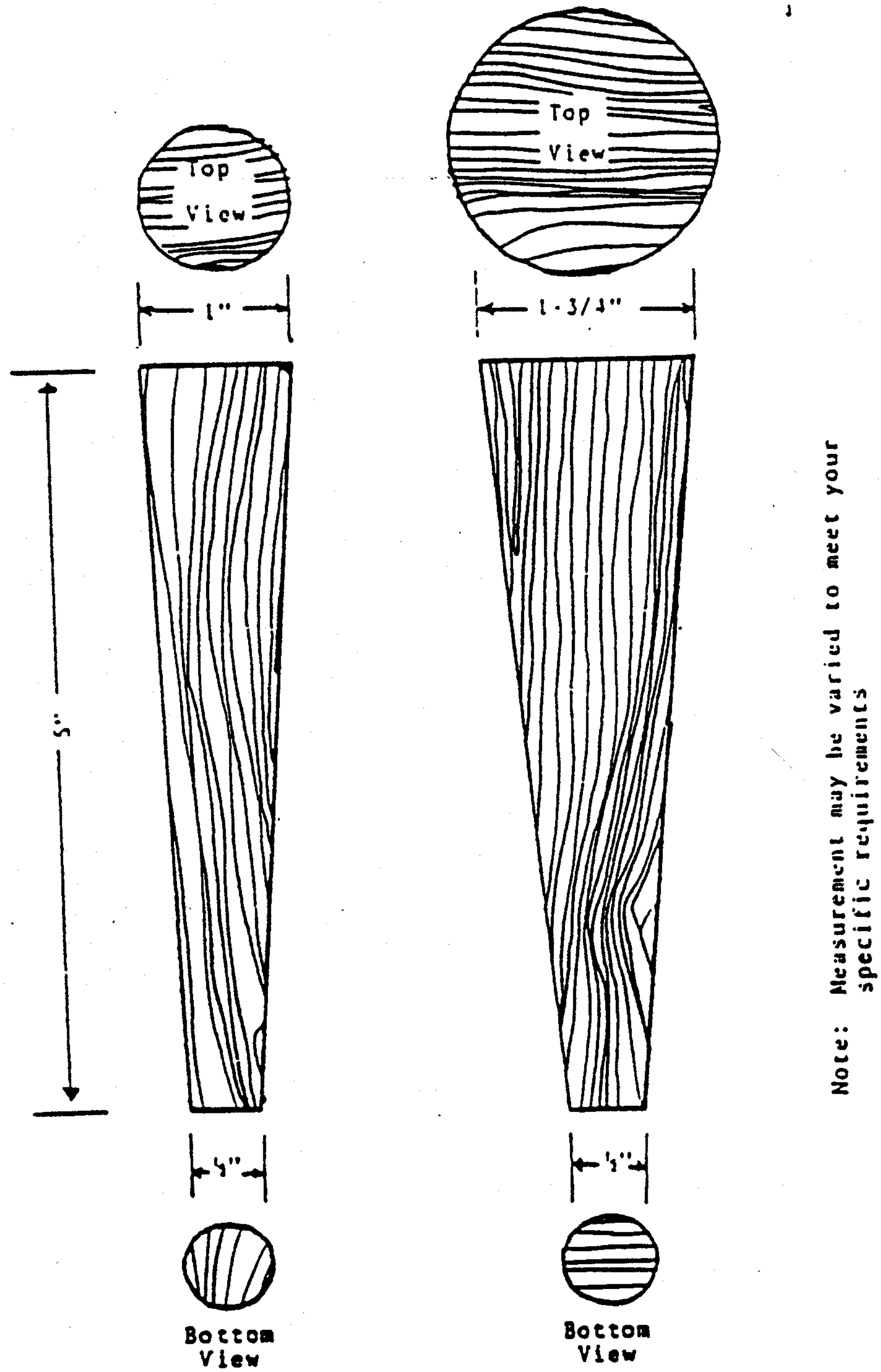
Emergency Response
Drum Wedge



Note: Measurements may be varied to meet your specific requirements

SOFT WOOD ROUND PLUGS

Emergency Response
Drum Plugs



Pressure Reduction

"Many hazmat containers are designed to store their contents under pressure. Cylinders, process vessels, specific tank trucks, rail cars, and pipelines are examples. It is also possible for non pressurized containers to become abnormally pressurized because of internal chemical reactions, external fires, or accidentally diverted pressure.

Pressurized containers are dangerous because:

- **They can rupture under stress and travel great distances as fragments or in one piece. This happens quickly and does not allow any reaction time.**

- **Pressure kills quickly. ERP cannot usually determine the operating pressure of a given container without close inspection. High pressure can propel valve caps, cut protective clothing, or sever SCBA air lines. Ultra high pressures (5,000 to 15,000 psi) can penetrate the skin and cause an air embolism which will be followed by death within minutes.**

- **Cryogenic pressurized containers are stored at temperatures below -150°F. Cryogenics can freeze tissue and damage protective clothing.**

Many pressure leaks are located in and around the valves used for filling and discharging product. Most valves can be closed by turning the valve wheel clock wise, unless it is damaged. There are exceptions to this design.

Leaks from an in-service container may also be found in the associated piping. The leak usually stops when the supply valve is closed. If the leak continues after the valve is closed, tighten down the connected tubing until the leak stops or try tightening the packing nut on the valve.

Some pressurized vessels are charged by an independent source such as a pumping system or compressor. the magnitude of the leak can be reduced significantly when the pump pressure is lowered or shut down entirely. Experts familiar with the system must be consulted before any shut-down operations begin since a single change in the system may over-pressurize other vessels. Lack of pressure may also produce unstable chemical reactions.

Product specialists and engineers should also be contacted whenever ERPs face large or complex vessels. Simply shutting down general power to pressure systems may ruin chemical batch processing equipment, cause dangerous pressure build-ups in other locations, and disable critical safety devices. In some cases, safety systems can kick in and dump hazardous materials to neutralizing scrubbers, flares, or exhaust systems.

The nature of some hazmats and their containment systems makes them vulnerable to external heating. A Liquified Petroleum Gas container may be heated by a fire and spring a leak through one of its safety attachments. As the heat is transmitted internally, the container pressure increases proportionately. Eventually the LP gas will escape to the outside atmosphere through one of its attachments, or it will fail violently.

Effectively placed hose streams can lower the pressure in most small containers (e.g., cylinders), however, the risk associated with advancing hose lines or monitors can exceed the possible benefits.

CAUTION: Any decision to approach a burning LP gas container showing direct flame impingement on its vapor space must be made on a case-by-case basis after a hazard and risk assessment. Large LP gas containers (8,000 to 29,000 gallons) have ruptured and traveled up to one-half mile, even with functioning relief valves. These containers can fail within 10 to 20 minutes of direct flame impingement or days after a fire has been extinguished, e.g., during wreck-clearing operations."[10]

"CHLORINE INSTITUTE EMERGENCY KIT 'A' FOR 100 LB. & 150 LB. CHLORINE CYLINDERS[11]

1. General

1.1 Introduction

The Chlorine Institute Emergency Kit 'A' is designed for use with the standard DOT 3A480 cylinder for 100 and 150 pound capacity in chlorine service only. These cylinders have outside diameters between 8-1/4 and 10-3/4 inches and overall height from 39-1/2 to 59 inches. The kit is not designed to be used on liquid full cylinders. (See Section 8 for other kit limitations.)

1.2 Kit Contents

The Chlorine Institute Emergency Kit 'A' contains devices to stop leaks at valves and fusible plugs, and in the sidewalls of cylinders. This kit does not contain respiratory equipment which must always be worn when investigating and correcting chlorine leaks. The kit, packed in a steel box measuring 10" x 10" x 27", weighs approximately 122 pounds.

1.3 Kit Maintenance

For kit maintenance, see SECTION 7

[10] Noll, et. al. 1988. Pgs. 164-166.

[8] This section reprinted with permission. All rights reserved. "CHLORINE INSTITUTE EMERGENCY KIT 'A' FOR 100 LB. & 150 LB. CHLORINE CYLINDERS". © 1986 The Chlorine Institute, Inc.

1.4 Emergency Training

Training in the use of the kit and respiratory equipment is recommended. Teaching aids consisting of slides with accompanying script are available from the Institute.

1.5 Tank Inspection

Daily inspection of loaded chlorine cylinders is recommended, whether or not they are connected to unloading lines. Through these means a leak usually can be detected in an early stage when it can be stopped readily by applying appropriate remedies.

1.6 Leak Detection

As soon as there is any indication of the presence of chlorine in the air, authorized, trained personnel equipped with suitable respiratory equipment should investigate promptly. All other persons should be kept away from the affected area. The location of a leak in a chlorine containing system can usually be detected by the reaction of ammonia vapor with the escaping chlorine. The reaction is a dense white cloud. The most convenient way to use ammonia for this purpose is to direct the vapor from a plastic squeeze bottle containing aqua ammonia at the suspected leak. Do not squirt liquid aqua ammonia on pipe and fittings. Any efforts to detect the source of a leak should be carried out with full consideration for potential hazards.

1.7 Assistance

promptly notify your chlorine supplier. If the supplier cannot be reached, then summon help by activating CHLOREP, the CHLORine Emergency Plan, by utilizing the proper telephone number in the U.S. or Canada.

1.8 Reproduction

The contents of this instruction booklet are not to be copied for publication, in whole or in part, without prior Institute permission.

1.9 Approval

The Institute's CHLOREP Committee approved the Sixth Edition of this kit instruction booklet at a meeting held on February 6, 1986.

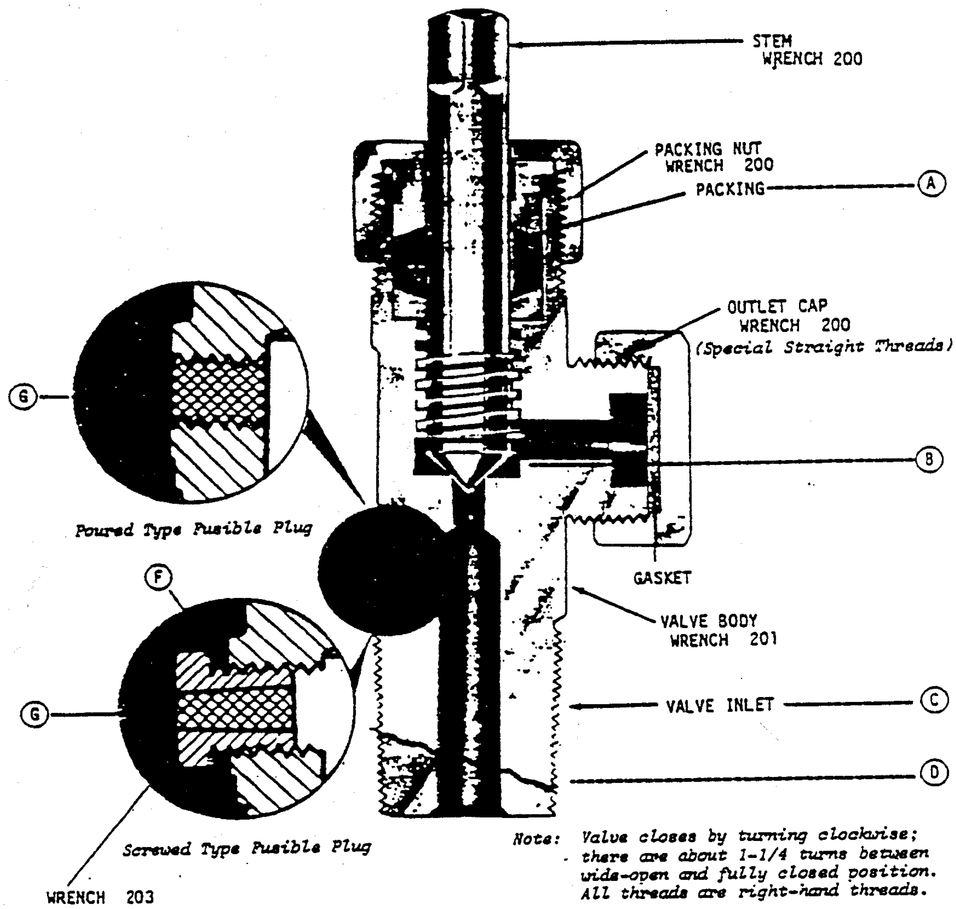
1.10 Revisions

Suggestions for revisions of the kit or the kit instruction booklet should be directed to the Secretary of the Institute.

2. Identifying and Stopping Leaks

CHLORINE LEAKS			
OCCURRING THROUGH		**ARE CORRECTED BY**	**REFER TO SEC.**
A.	**VALVE PACKING GLAND**	**TIGHTENING PACKING NUT with Wrench 200**	
B.	**VALVE SEAR (will not close tight)**	**GENTLY OPENING AND CLOSING VALVE (to dislodge scale from valve seat), or** **APPLYING OUTLET CAP AND GASKET 2B with Wrench 200**	
C.	**VALVE INLET THREADS**	**TIGHTENING VALVE INTO CYLINDER SLOWLY AND WITH STEADY PRESSURE with Wrench 201 <u>or</u>** **APPLYING DEVICE 1 FIG 3.1 (HOOD)**	**3**
D.	**BROKEN OFF VALVE**	**DRIVING SMALL DRIFT PIN A-3 INTO VALVE SHANK <u>and</u> APPLYING DEVICE 1 (HOOD)**	**3**
E.	**VALVE BLOWN OUT (due to stripped threads)**	**DRIVING LARGE DRIFT PIN A-4 INTO VALVE OPENING <u>and</u> APPLYING DEVICE 1 (HOOD)**	**3**
F.	**FUSIBLE PLUG THREADS**	**TIGHTENING FUSIBLE PLUG, SLOWLY USING STEADY PRESSURE with appropriate end of wrench 203** **<u>or</u>** **SAWING FUSIBLE FLUSH WITH VALVE BODY, FILING THIS SURFACE SMOOTH <u>and</u> APPLYING DEVICE 2 (CLAMP)**	**4**
G.	**FUSIBLE METAL OF PLUG**	**APPLYING DEVICE 2 (CLAMP)** ***<u>NOTE</u>: DEVICE 1 (HOOD) WILL PROBABLY NOT FIT OVER THE DRIFT PIN. PUT CYLINDER IN AN ISOLATED AREA AND CALL YOUR CHLORINE SUPPLIER***	**4**
H.	**VALVE STEM ASSEMBLY BLOWN OUT**	**DRIVING SMALL DRIFT PIN A-3 INTO BODY**	
I.	**SIDE WALL OF CYLINDER**	**APPLYING DEVICE 8 (PATCH)**	**5**
Note:	**At all times, before and after application of the emergency device, position cylinder so that source of leak is in the gas phase. See section 6.**		

- WEAR RESPIRATORY EQUIPMENT -



TYPICAL VALVE LEAKS OCCUR THROUGH ...

A - VALVE PACKING GLAND

B - VALVE SEAT

C - VALVE INLET THREADS

D - BROKEN OFF VALVE

E - VALVE BLOWN OUT

F - FUSIBLE PLUG THREADS

G - FUSIBLE METAL OF PLUG

H - VALVE STEM BLOWN OUT

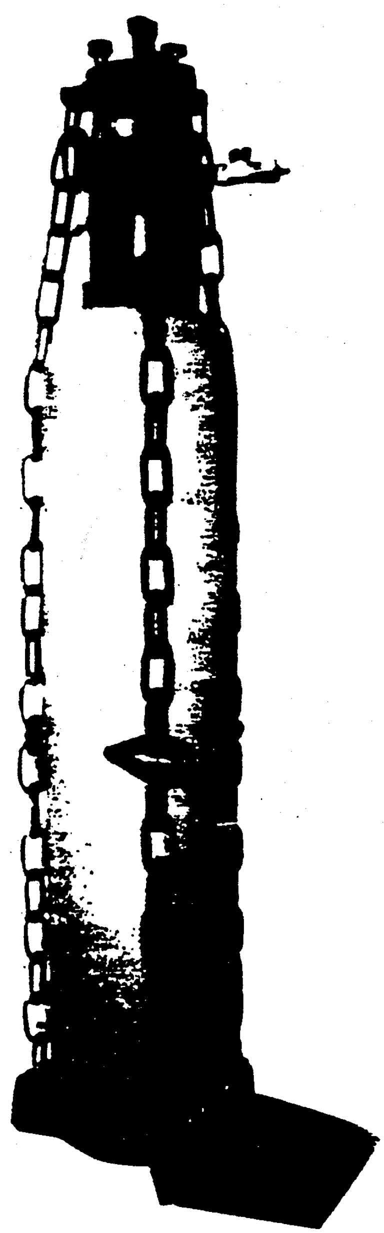
FIG. 2.1 CHLORINE INSTITUTE STANDARD CYLINDER VALVE

3. Hood For Valve - Device 1

STEPS	EQUIPMENT REQUIRED
1. REMOVE VALVE PROTECTION HOOD if in place. POSITION CYLINDER SO THAT VALVE IS IN UPPERMOST POSITION.	
2. REMOVE OUTLET CAP FROM VENT VALVE ON HOOD (1A1) AND OPEN VALVE	WRENCH 200
3. PREPARE BASE ASSEMBLY (1EH) BY PLACING SPACER PLATE (1P) OVER SEGMENTS OF BASE (1E) to insure proper position and stability of base segments. SECURE RAMP (1R) between two base segments by means of hook attacked under base ring to prevent sliding of base assembly while cylinder is being positioned.	
4. ROLL UPRIGHT CYLINDER ON ITS BASE UP RAMP and PLACE IN POSITION ON BASE ASSEMBLY	
5. CLEAN THE SHOULDER OF THE CYLINDER, USE SCRAPER IF PAINT IS LOOSE OR UNEVEN.	SCRAPER A-8
6. PLACE GASKET (1BMV) ON HOOD (1A1). PLACE HOOD WITH GASKET OVER LEAKING VALVE	HOOD 1A1 and GASKET 1BMV
7. ADJUST CAP SCREW (1D1) AND (1K1) IN YOKE (1C1) so that point of screw extends only slightly below yoke	CAP SCREWS 1D1, 3 CAPS SCREWS 1K1, YOKE 1C1 WRENCH 201
8. PLACE YOKE (1C1) IN POSITION ON TOP OF HOOD (1A1). WITH CHAINS (1F) <u>taut and not twisted</u>, FASTEN ON YOKE (1C) using appropriate link to avoid slack. <u>CAUTION</u>: YOKE MUST BE CLOSE TO TOP OF HOOD. Thus, before next step, TAKE UP SLACK IN EACH CHAIN BY TURNING DIAMOND LINKS (1G) TO SHORT POSITION	YOKE 1C1 HOOD 1A1 CHAINS 1F
9. HAND TIGHTEN THE 1D1 AND 1K1 SCREWS. It may be necessary to shorten one or two chains by twisting one half turn on the diamond link to correct vertical alignment of the hood and yoke. TIGHTEN 1K1 SCREWS EQUALLY FORCING THE 1A1 HOOD AND 1BMV GASKET AGAINST SHOULDER OF CYLINDER. KEEP THE 1D1 SCREW HAND TIGHT AGAINST WITH CENTER OF HOOD. If LEAK PERSISTS, TIGHTEN 1K1 SCREW FURTHER IN AREA OF LEAK. *CAUTION - CHECK THE FOOT RING ON BASE OF CYLINDER FOR POSSIBLE DETERIORATION UNDER EXTREME PRESSURE CONDITIONS.*	WRENCH 201
10. CLOSE VENT VALVE ON HOOD LEAKS AROUND GASKET. TIGHTEN SCREW 1K1 FURTHER IF NECESSARY.	WRENCH 20011. TEST FOR WRENCH 201

<u>Device 1 includes</u>:

HOOD (1A1)	CAP SCREW (1D1)	SPACER PLATE (1P1)
YOKE (1C1)	BASE ASSEMBLY (1EH)	GASKET (1BMV)
3 CAP SCREWS (1K1)	RAMP (1R)	



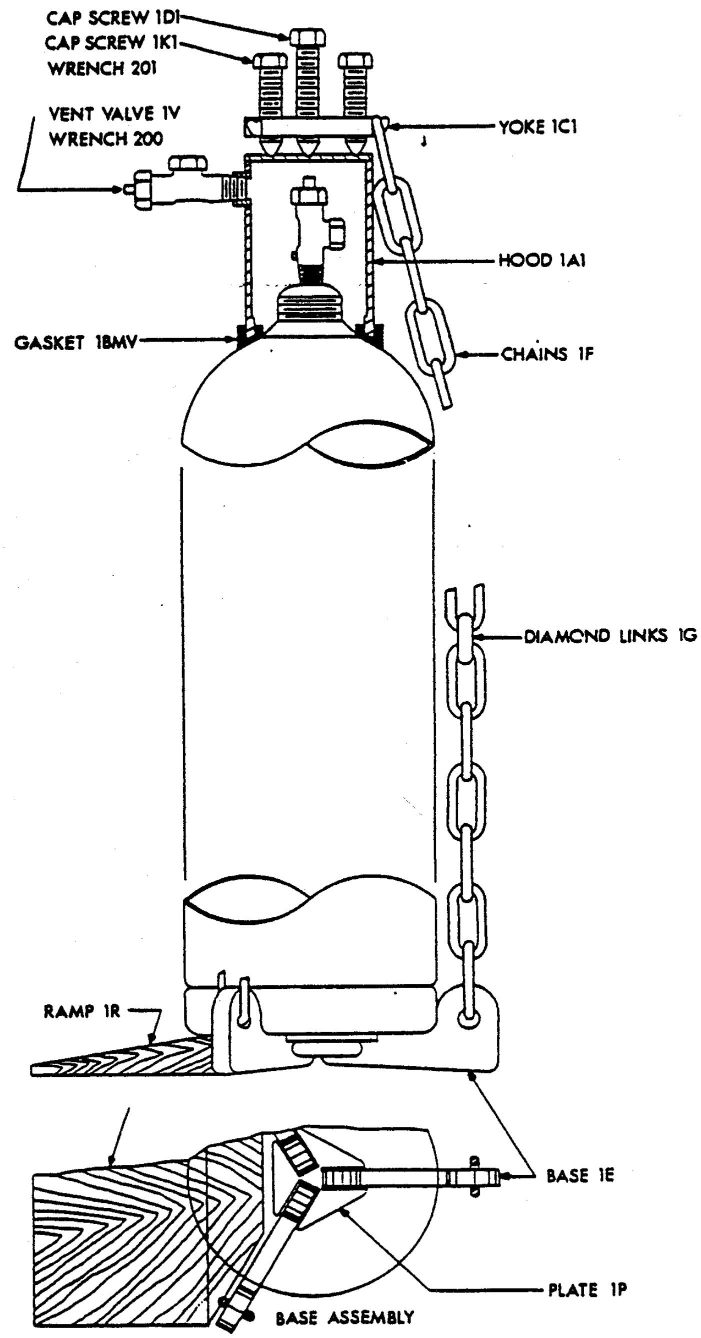


FIG. 3.1 DEVICE NO. 1

4. Clamp for Fusible Plus - Device 2

STEPS		EQUIPMENT REQUIRED
1.	REMOVE VALVE PROTECTION HOOD if in place. POSITION CYLINDER SO VALVE IS IN UPPERMOST POSITION.	
If leak is in threads of fusible plug:		
1.	SAW OFF* FUSIBLE PLUG FLUSH WITH VALVE BODY. **Some valves have the fusible metal cast directly into the valve body; in such cases, be sure gasket seating surface is clan and free from pitting.*	HACKSAW A-2
2.	LOOSEN SET SCREW (2D) AND PLACE CLAMP (2C) OVER LEAKING VALVE. *(Note: It is not necessary to remove hexagonal cap on valve).*	WRENCH 200 & CLAMP 2C
3.	PLACE GASKET (2B) BETWEEN LEAKING FUSIBLE PLUG AND BLOCK (2A).	GASKET 2B
4.	TIGHTEN SET SCREWS (2D) UNTIL LEAK STOPS	WRENCH 200
5.	TEST FOR LEAKS. TIGHTEN SCREW (2D) further IF NECESSARY.	
If leak is in the fusible metal:		
1.	If face of fusible plug is badly pitted or corroded, SAW OFF PLUG FLUSH WITH VALVE BODY.	HACKSAW A-2
2.	LOOSEN SET SCREW (2D) AND PLACE CLAMP (2C) OVER LEAKING VALVE. *(Note: It is not necessary to remove hexagonal cap on valve.)*	WRENCH 200
3.	PLACE GASKET (2B) BETWEEN LEAKING FUSIBLE PLUG AND BLOCK (2A).	GASKET 2B
4.	TIGHTEN SET SCREW (2D) UNTIL LEAK STOPS.	WRENCH 200
5.	TEST FOR LEAKS. TIGHTEN SCREW (2D) further IF NECESSARY.	WRENCH 200
	Device 2 includes: CLAMP ASSEMBLY - BLOCK (2A) CLAMP (2C) SCREW (2D) GASKET (2B)	

-WEAR RESPIRATORY EQUIPMENT-

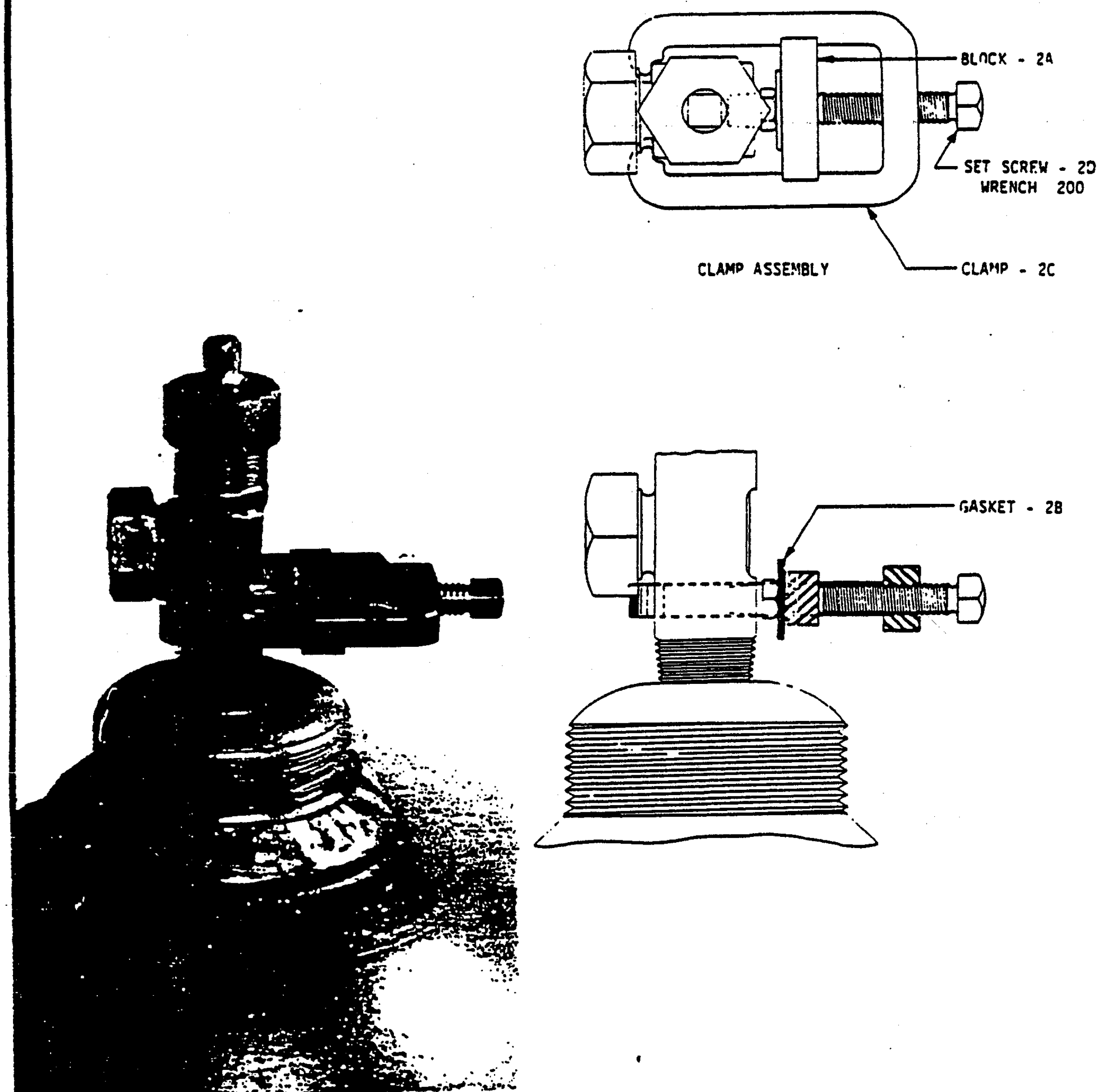


FIG. 4.1 DEVICE NO. 2

5. Patch for Side Leaks - Device 8

STEPS		EQUIPMENT REQUIRED
1.	ROLL CYLINDER SO THAT LEAK IS IN UPPERMOST POSITION. BE SURE CYLINDER WALL AROUND LEAK IS SOUND BEFORE PROCEEDING WITH APPLICATION OF DEVICE.	
2.	ADJUST CAP SCREW (8C) IN YOKE (8B) UNTIL POINT OF SCREW EXTENDS ONLY SIGHTLY BELOW YOKE.	YOKE 8B & CAP SCREW 8C
3.	SLIP ONE END OF CHAIN (8A) UNDER CYLINDER AND PULL IT THROUGH UNTIL IT REACHES LEAK.	CHAIN 8A
4.	CENTER CAP SCREW (8C) IN YOKE 8B) IN PATCH DEPRESSION (8D).	PATCH 8D
5.	ATTACH FREE ENDS OF CHAIN (8A) TO EACH SIDE OF YOKE (8B) (keeping chain as short as possible).	
6.	PLACE GASKET (8EV)* AND PATCH (8D) OVER LEAK. USE SCRAPER (A-8) IF PAINT IS LOOSE OR UNEVEN. **Use two gaskets on slender cylinders (about 8 inch diameter).*	GASKET IEV, PATCH 8D & SCRAPER A-8
7.	TIGHTEN CAP SCREW 98C) CAUTION: IF THERE IS ANY EVIDENCE OF WEAKENING OF CYLINDER WALL, IMMEDIATELY DISCONTINUE TIGHTENING SCREW.	WRENCH 201
8.	TEST FOR LEAKS. TIGHTEN SCREW further, IF NECESSARY	WRENCH 201

DEVICE 8 includes:

CHAIN (8A)	PATCH (8D)
YOKE (8B)	GASKET (8EV)
CAP SCREW (8C)	

- WEAR RESPIRATORY EQUIPMENT_

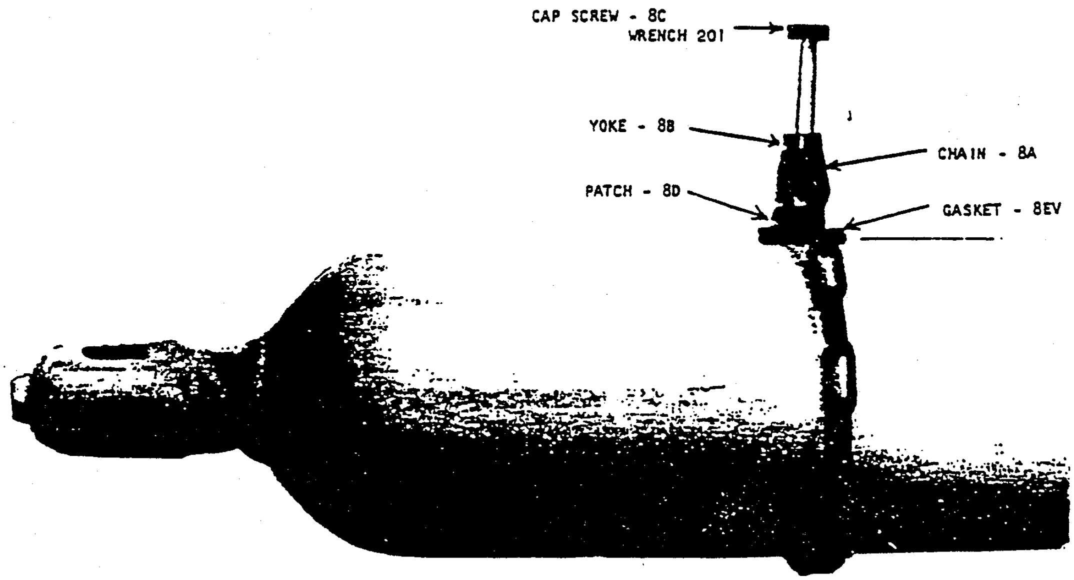


FIG. 5.1 DEVICE NO. 8

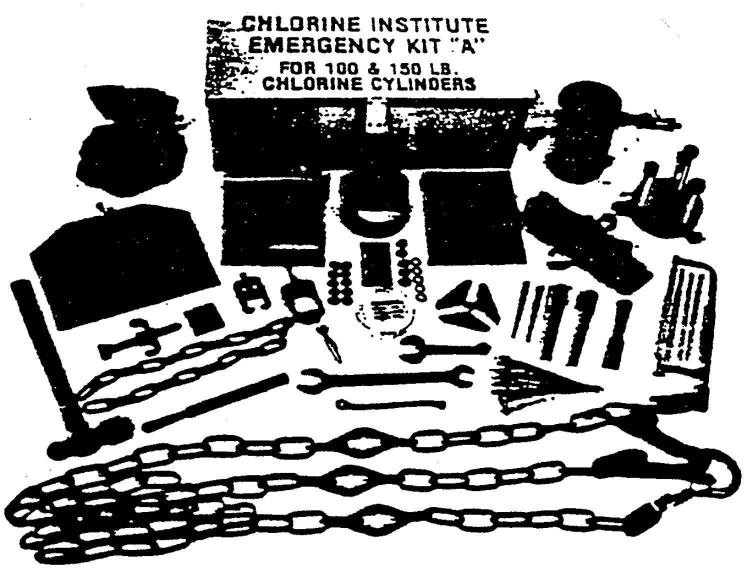


FIG. 5.2 CHLORINE INSTITUTE EMERGENCY KIT "A"

6. Disposal of Chlorine Remaining in Container

The stopping of leaks by the emergency devices is only an interim measure; <u>the cylinder must be emptied as soon as possible</u>. Chlorine may be passed into and absorbed by a solution of caustic soda or soda ash. Each 100 pounds of chlorine to be absorbed requires either at least 135 pounds of caustic soda dissolved in about 65 gallons of water or 350 pounds of soda ash dissolved in about 390 gallons of water.

If the chlorine cannot be consumed or absorbed, the capped or plugged container should be removed to a remote area. Consult with the chlorine supplier immediately and arrange for ultimate disposal.

***NOTE: This needs revision in accord with data in revised CHLORINE MANUAL**

7. Kit Maintenance

7.1 After Use

When the emergency device is removed from the cylinder, all metal parts should be thoroughly cleaned with a dilute alkaline solution, rinsed thoroughly, dried, and lightly oiled to prevent corrosion. Return the device, all wrenches and other tools to the box, check the contents list,l and reseal the box so that it will again be ready for an emergency.

7.2 Routine

<u>The kit should be frequently inspected</u> by the person responsible for the equipment and checked with the contents list to insure that equipment is complete and ready for use. <u>The box should be sealed after each inspection</u> and such seals should be broken only by authorized persons or in case of accidents. Many owners coordinate routine inspection with training drills.

7.3 Spare Parts

Spare parts may be purchased by owners of this kit or the Solvay Emergency Kit 'A' provided that the kit serial number accompanies the order. The serial number is steel-stamped on the inside, upper right corner of the cover of the steel box in 3/8" numbers and decaled on the front in 1" numbers. For information on ordering procedures, consult the institute.

8. Kit Limitations

Some 100-lb. and 150-lb. chlorine cylinders in current use are of such design that application of Kit 'A' devices might be difficult or impossible. Among these are included those having larger than normal (4" O.D.) neck rings (precluding proper placement of device 1). The kit devices also are unsuitable for stopping leaks around the cylinder neck, base and foot-ring areas.

CHLORINE INSTITUTE EMERGENCY KIT 'A'

PARTS LIST

Part Number	Description	Quantity Per Kit
1Aa	Hood Assembly (with 1V Vent Valve)	1
1BMV	Gasket, molded Viton®	2
1C1	Yoke	1
1D1	Cap Screw	1
1K1	Cap Screw	3
1EH	Base Assembly with Chains	1
1R	Ramp	1
1P	Spacer Plate	1
2B	Gasket, Garlock 951, 15/16 dia. x 1/16	10
2	Clamp Assembly	1
8A	Chain	1
8B	Yoke	1
8C	Cap Screw	1
8D	Patch	1
8EV	Gasket, Viton®, 2-1/2 square x 1/8	2
200	Wrench, 3/8 sq. box, 1-1/4 open end x 7-1/4	1
201	Wrench, straight open end, 1-1/4 x 1-1/8 x 12-3/8	1
203	Wrench, double box, 7/16 x 9/16 x 8-3/4	1
A-1	Hammer, machinist, 48 oz.	1
A-2	Hacksaw, 10" and 3 blades	1
A-3	Drift Pin, 9/32 x 1/2 x 6	2
A-4	Drift Pin, 7/8 x 1-1/4 x 8	2
A-5	Ring, vent valve packing 7/8 OD x 15/32 ID x 1/4 sq.	5
A-6	Metal Railroad Car Seal	15
A-7	Gasket Sack	1
A-8	Paint Scraper, 1-1/4 blade	1
A-9	Valve Yoke	1
A-10	Valve Adapter (820-Hose)	1
A-12	Washer, valve outlet, 9/16 ID x 15/16 OD x 1/16	5
A-13	Plastic Box	1
A-14	File	1
144	Tool Roll	1
151A	Steel Box	1
	Instruction Booklet	2
	Chlorine Manual	1

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EMERGENCY CONTACTS

CHLORINE SUPPLIER: ________________________________

Address: ________________________________

Phone: _______

NEAREST CHLORINE PRODUCER: ________________________________

Address: ________________________________

Phone: _______

POLICE DEPARTMENT: ________________________________

FIRE DEPARTMENT: ________________________________

FIRST AID: ______

CHEMTREC *: 800-424-9300
CANUTEC **: 613-996-6666

: ________________________________

: ________________________________

: ________________________________

* **In the UNITED STATES, summon help through CHEMTREC, the Chemical Transportation Emergency Center at the Chemical Manufacturers Assn. in Washington, D.C.**

48 contiguous state (toll free) 800-424-9300
if "800" number cannot be reached from your phone, call the "202" number instead.
Alaska and Hawaii 202-483-7616
(telephone advice only)
District of Columbia 483-7616

** **In CANADA, summon help through CANUTEC, the Canadian Transport Emergency Centre in Ottawa:**

All provinces (toll free) 613-996-6666

3. <u>Absorbents</u>

Absorbent are used primarily in spill control whereby they provide a large surface area for the absorption of liquids. The absorbent are normally solid material which absorb liquids at levels several times their own weight (ten to twenty-five times). The absorbed solids are then disposed of in accordance with their degree of hazard, and in accordance with the local, state, and federal regulations. (In some cases the absorbed material is removed and recovered and the absorbent or absorbed material is recycled). Absorbent can usually be classified in the following manner:

General Properties

(1) Hydrophobic--Repels water and absorbs most petroleum based liquids, oils, and hydrocarbons.

(2) Hydrophilic---Absorbs most water based chemicals including acids and bases.

(3) Universal------Absorbs water based chemicals, solvents, and oils.

(4) Special---------Absorbent designed for specific chemicals (acids, mercury, etc.)

(5) Reactive-------Solidifiers, neutralizers, etc.

Absorbent Materials

Specific chemicals are used to neutralize acids and bases while many types of materials are used as non reactive absorbants, such as: Polypropylene, Cellulose based, Silicas, clays, Activated Carbon, etc., or chemicals which promote solidification or polymerization of the contaminant.

Absorbent Forms

Includes the following common types:

(1)	**Powders**	**(6)**	**Booms**
(2)	**Pigs**	**(7)**	**Socks**
(3)	**Pillows**	**(8)**	**Rolls**
(4)	**Pads**	**(9)**	**Specialized Kits for Specific Chemicals (See neutral chemicals)**
(5)	**Blankets/Sheets**		

4. <u>Vapor Suppressors/Foams</u>

Vapor suppression techniques can be used offensively in conjunction with defensive spill control to reduce the surface area exposed to the atmosphere. For example, a hazmat can be diverted into a low-lying area by building a diversion barrier and then applying a vapor suppression agent.

In addition to the traditional firefighting foams used for hydrocarbon or polar solvent liquid ires, new type of vapor suppression foams are being marketed specifically for hazardous materials. Vapors from materials such as chlorine, ammonia, sulfuric and nitric acids have been suppressed with some success during field tests and actual emergencies. As these new products enter the market place, they will become effective tools for the IC.[12]

Fire Fighting Foams

Fire fighting foam is a mass of gas-filled bubbles formed by various methods from aqueous solutions of especially formulated foaming agents. Since foam is lighter than the aqueous solutions from which it is formed and lighter than flammable liquids, it floats on all flammable or combustible liquids, producing an air-excluding, cooling, continuous layer of vapor-sealing, water bearing material for purposes of halting or preventing combustion.

Fire fighting foams are formulated in several ways for fire extinguishing action. Some foams are thick and viscous, forming tough heat-resistant blankets over burning liquid surfaces and vertical areas. Some foams are thinner and more rapidly spreading. Some are capable of producing a vapor-sealing film of surface-active water solution on a liquid surface. Some are meant to be used as large volumes of wet gas cells for inundating surfaces and filling cavities.

There are various methods of generating and applying foams. This section covers the basic characteristics of various foaming agents and the methods for producing fire fighting foams.

The us of foam for fire protection requires attention to its general characteristics. Foam breaks down and vaporizes its water content under attack by heat and flame. It, therefore, must be applied to a burning surface in sufficient volume and rate to compensate for this loss, and to provide an additional amount to guarantee a residual foam layer over the extinguished portion of the burning liquid. Foam is an unstable "air-water emulsion" and may be easily broken down by physical or mechanical forces. Certain chemical vapors or fluids may also quickly destroy foam. When certain other extinguishing agents are used in conjunction with foam, severe breakdown of the foam may occur. Turbulent air or violently uprising combustion gases from fires may divert light foam from the burning area.

In general, foam is especially useful wherever a very light, cohesive, blanketing and cooling, fire controlling or extinguishing agent is needed. Certain special types of foam are required for special situations such as cavity filling and water-miscible solvent fire protection. very definite engineering design requirements and application methods are needed for successful use of foams.

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12 **Noll, et.al. 1988. Pg. 166.**

A. Types and Characteristics of Fire fighting Foams

The various types of fire fighting foams that are available and the characteristics of each are covered in this part of the section.

Protein Foaming Agents

Protein type air foams utilize aqueous liquid concentrates proportioned with water for their generation. These concentrates contain high molecular weight natural protein-aceous polymers derived from a chemical digestion and hydrolysis of natural protein solids. The polymers give elasticity, mechanical strength, and water retention capability to foams generated from them. The concentrates also contain dissolved polyvalent metallic salts, which aid the protein polymers in their bubble strengthening capability while the foam is exposed to heat and flame. Organic solvents are added to the concentrates to improve their foamability and foam uniformity as well as to control their viscosity at lowered temperatures. Protein type concentrates are available for proportioning to a final concentration of either 3 percent or 6 percent by volume using either fresh water or sea water. In general, these concentrates produce dense, viscous foams of high stability, high heat resistance, and better resistance to burnback than many other foaming agents. They are nontoxic and biodegradable after dilution. Normal use ambient temperature range for these concentrates is 20^{o}F (-6.7^{o}C) to 120^{o}F (48.9^{o}C).

Fluoroprotein Foaming Agents

The concentrates utilized for generating fluoroprotein foams are similar in composition to protein foam concentrates, but, in addition to protein polymers, they contain fluorinated surface active agents that confer a "fuel shedding" property to the foam generated. This makes these particularly effective for fire fighting conditions where foam becomes coated with fuel, such as in the method of subsurface injection of foam for tank fire fighting, and nozzle or monitor foam applications where the foam may often be plunged into the fuel. Fluoroprotein foams are more effective for in-depth petroleum or hydrocarbon fuelled fires than other agents because of this property of "fuel shedding." In addition, these foams demonstrate better compatibility with dry chemical agents than do the protein type foams. They also possess superior vapor securing and burnback resistance characteristics. Fluoroprotein type concentrates are available for proportioning to a final concentration of either 3 percent or 6 percent by volume using either fresh water or sea water. They are nontoxic and biodegradable after dilution. The normal use temperature range for these agents is 20^{o}F (-6.7^{o}C) to 120^{o}F (48.9^{o}C).

Low Temperature (Cold) Foaming Agents

This type of foam concentrate is similar to the protein type foaming agents, but it is protected for storage and kept at low temperature by the inclusion of non-flammable freezing point depressants. Fluoroprotein foaming agents for use at low temperatures are also available. Low temperature foaming agents may be used at ambient temperatures as low as -20^{o}F (-28.7^{o}C). They are available for use with either 3 percent or 6 percent by volume concentration using either fresh or sea water.

Aqueous Film-forming Foaming Agents (AFFF)

Aqueous film-forming foam agents are composed of synthetically produced materials that form air foams similar to those produced by the protein-based materials. In addition these foaming agents are capable of forming water solution films on the surface of flammable liquids; hence the term "aqueous film-forming foam" (AFFF). AFFF concentrates are available for proportioning to a final concentration of either 3 percent or 6 percent by volume with either fresh or sea water.

The air foams generated from AFFF solutions possess low viscosity, have fast spreading and leveling characteristics, and act as surface barriers to exclude air and halt fuel vaporization just as other foams do. These foams also develop a continuous aqueous layer of solution under the foam with surface activity which maintains a floating film on hydrocarbon fuel surfaces to help suppress combustible vapors and cool the fuel substrate. This film which can also spread over fuel surfaces not fully covered with foam, is self-healing following mechanical disruption and continues as long as there remains a reservoir of nearby foam for its production. However, to insure fire extinction, an AFFF blanket, as with other types of foam, should entirely cover the fuel surface.

The result of the double action of aqueous film-forming foams is to yield a highly efficient foam extinguishing agent, in terms of water and concentrate needed and the rapidity with which it acts on fuel spills.

AFFF concentrates contain fluorinated, long-chain hydrocarbons with particular surface-active properties. Various water soluble high molecular polymers are added to aid in strengthening the bubble wall and to retard breakdown. They are nontoxic and biodegradable after dilution. The shelf life of AFFF concentrates containing no naturally occurring substances that might change with time.

AFFF can be used as a foam cover and protecting material for flammable liquids which have not become ignited. It may be used under certain circumstances for extinguishment of certain water soluble polar solvents. Because of the extremely low surface tension of the solutions draining from AFFF, these foams may be useful under mixed class fire situations (Class A and Class B) where deep penetration of water is needed in addition to the surface spreading action of foam itself.

Foam generating devices yielding stable, homogeneous foams are not necessarily needed in the employment of AFFF. Less sophisticated foaming devices may be used because of the inherent rapid and easy foaming capability of AFFF solutions. Water spray devices may be used in some situations. AFFF also may be used in conjunction with dry chemical agents without compatibility problems. Although AFFF concentrates must not be mixed with other types of foam concentrates, foams made from them do not break down other foams in fire fighting operations.

Synthetic Hydrocarbon Surfactant Foaming Agents

There are many synthetically produced surface active compounds which foam copiously in water solution. When these are properly formulated, they may be used as fire fighting foams and employed in much the same manner as other types of foam.

Hydrocarbon surfactant foam liquid concentrates are employed in 1 to 6 percent proportions in water. When these solutions are used in conventional foam making devices, the resulting air foam possesses low viscosity and fast spreading qualities over liquid surfaces. Its fire fighting characteristics depend on the volume of the foam layer on the burning surface, which halts access to air and controls combustible vapor production, and the minor cooling effect of the water in the foam, which becomes available due to a relatively rapid breakdown of the foam mass. This water solution does not possess film forming characteristics on the flammable liquid surface, although under some conditions it may produce a temporary water emulsion due to its wetting agent or "detergent type" properties. because of the low surface tension and wetting properties of the water solutions of these foams, they may also be used as extinguishing agents for Class A fires.

Synthetic hydrocarbon surfactant foams are generally less stable than other types of fire fighting foams. Their water solution content drains away rapidly to leave a bubble mass which is highly vulnerable to heat or mechanical disruption. Usually they must be applied at higher rates than other fire fighting foams to achieve extinction. Many formulations of this type of foam concentrate break down other foams if used simultaneously or sequentially.

"Alcohol-type" Foaming Agents

Air foams generated from ordinary agents are subject to rapid breakdown and loss of effectiveness when they are used on fires that involve fuels which are water soluble, water miscible, or of a "polar solvent" type. Examples of this type of liquid are the alcohols, enamel and lacquer thinners, methyl ethyl ketone, acetone, isopropyl ether, acrylonitrile, ethyl and butyl acetate, and the amines and anhydrides. Even small amount of these substances mixed with the common hydrocarbon fuels will cause the rapid breakdown of ordinary fire fighting foams.

Certain special foaming agents have, therefore, been developed, called "alcohol-type" concentrates. Some of these concentrates must be foamed and applied to the burning surface almost immediately after they are proportioned into water. Solutions of this type cannot be pumped long distances because their "transit times" (the time required for foam solutions to travel from the eductor or foam generator to the discharge outlet) before foam production are short. They would be ineffective if this time was to be exceeded.

"Alcohol-type" foaming agents fall into three general categories:

1. Protein-base concentrates containing heavy metal soaps made soluble by ammoniacal or solvent solutions. Foams produced from these agents require gentle application to the burning surface and may have solution transit time limitations.

2. Two component concentrates consisting of a polymeric system in one part which is further polymerized by a catalyst solution in the second part to render solvent stability to the produced alcohol-resistant foam. This type may be used in devices which may not apply the foam gently to the surface and it has not transit time limitations.

3. Synthetic base concentrates in a single-component system to produce foams for application to either ordinary flammable liquids or polar type solvents by any device. Agents of this type have no transit time limitations.

Normal use temperatures for any of the "Alcohol-type" agents are 35°F (1.7°C) to 120°F (48.9°C).

High Expansion Foaming Agents

"High expansion" foam is an agent for control and extinguishment of Class A and Class B fires and is particularly suited as a flooding agent for use in confined spaces. The foam is an aggregation of bubbles mechanically generated by the passage of air or other gases through a net, screen or other porous medium that is wetted by an aqueous solution of surface active foaming agents. Under proper conditions, fire fighting foams of expansions from 100 to 1 (100X) up to 1,000 to 1 (1,000X) can be generated.

High expansion foam is a unique vehicle for transporting wet foam masses to inaccessible places, for total flooding of confined spaces, and for volumetric displacement of vapor, heat, and smoke. Tests have shown that under certain circumstances high expansion foam when used in conjunction with water from automatic sprinklers will provide more positive control and extinguishment than either extinguishing agent by itself. (High-piled storage of rolled paper stock is an example.) Optimum efficiency in any one type of hazard is dependent on the rate of application and the foam expansion and stability.

Liquid concentrates for producing high expansion foams consist of synthetic hydrocarbon surfactants of a type that will foam copiously with a small input of turbulent action. They are used in about 2 percent proportion in water solution.

High expansion foam is particularly suited for indoor fires in confined spaces. Its use outdoors may be limited because of the effects of weather. High expansion foam has several effects on fires:

1. **When generated in sufficient volume, it can prevent air, necessary for continued combustion, from reaching the fire.**

2. **When forced into the heat of a fire, the water in the foam is converted to steam, reducing the oxygen concentration by dilution of the air.**

3. **The conversion of the water to steam absorbs heat from the burning fuel. Any hot object exposed to the foam will continue the process of breaking down the foam, converting the water to a steam, and of being cooled.**

4. **Because of its relatively low surface tension, solution from the foam, which is not converted to steam, will tend to penetrate Class A materials. However, deep-seated fires may require overhaul.**
5. **When accumulated in depth, high expansion foam can provide an insulating barrier for protection of exposed materials or structures not involved in a fire, thereby preventing fire spread.**

Research has shown that using air from inside a burning building for generating high expansion foam has an adverse effect on the volume and stability of the foam produced. Combustion and pyrolysis products can reduce the volume of foam produced and increase the drainage rate when they react chemically with the foaming agent. The high temperature of the air breaks down the foam as it is being generated. Physical disruption also takes place apparently caused by vapor and solid particles from the combustion process. These factors which cause foam breakdown may be compensated for by higher rates of foam generation.

When foam is generated from the gases of combustion it becomes toxic, and entry to a foam-filled passage must not be attempted without self-contained breathing apparatus. The foam mass also obscures vision, and life lines must be used if entering into it.

Chemical Foam Agents and Powders

These foam producing materials have become obsolete because of the superior economics and ease of handling of the liquid foam-forming concentrates previously discussed. Chemical foam is formed from the temperature sensitive chemical reaction in aqueous solution between aluminum sulfate ("A") (acidic) and sodium bicarbonate ("B") (basic) which also contains proteinaceous foam stabilizers. In "wet systems," these chemicals are stored in solution in large separate tanks. In powder systems, and in all portable methods for its use, the chemicals are added through "hoppers," into flowing water streams. The foam is formed by the generating of carbon dioxide gas from the chemical reaction of the two solutions of compounds. Chemical foam is quite stable and heat resistant, but generally it is very stiff and slow-moving. It "bakes" under flame attack and will form open fissures in the foam layer which expose the underlying fuel.

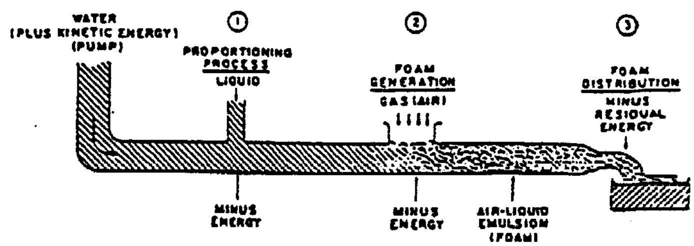


Fig. 13-2A. A generalized flow diagram of air foam generation.

Chemical foam "fixed" systems require constant maintenance, and portable devices for its use are very difficult to operate at a fire.

B. Air Foam Generating Methods

The process of producing and applying fire fighting air foams to hazards requires three separate operations, each of which consumes energy. They are the proportioning process, the foam generation phase, and the method of distribution. A flow diagram illustrating the relationship of the three operations in given in Figure 13-2A.

In general practice, the functions of air foam generation and distribution take place nearly simultaneously within the same device. There are also many types of proportioning and foam generating equipment.

In certain portable devices all three functions are combined into one device. The design and performance requirements of foam systems dictate the choice of types of proportioning, generating, and distributing equipment for the protection of specific hazards.

Foam Concentrate Proportioners

In order that a predetermined volume of liquid foam concentrate may be taken from its source and placed into a water stream to form a foam solution of fixed concentration, the following two general method classifications are made:

1. Methods which utilize the pressure energy of the water stream by venturi action and orifices to induct concentrate. (In general, such devices impose a 35 percent pressure drop on the water stream.)

2. Methods which utilize external pumps or pressure heads to inject concentrate into the water stream at a fixed ratio to flow.

Figures 13-2B and 13-2C illustrate the general principles of the two different methods of proportioning.

These (and other) foam concentrate proportioning methods may be easily arranged to produce foam solutions in concentrations of 3 percent or 6 percent by volume of the liquid foam concentrate in the water stream.

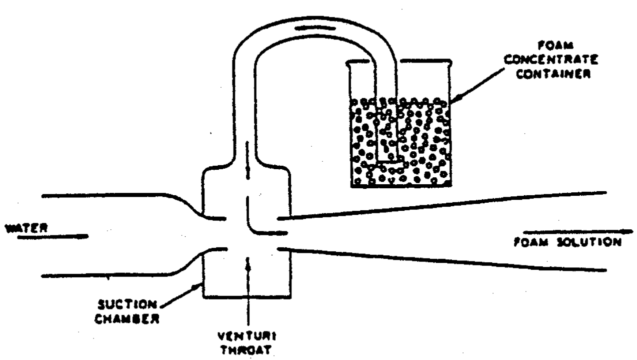


Fig. 13-2B. Venturi induction (in-line) proportioner.

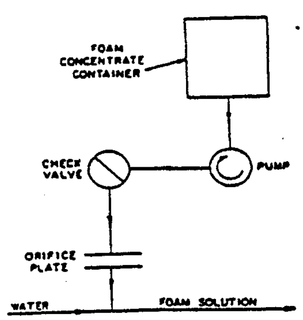


Fig. 13-2C. Concentrate pump proportioner.

Air Foam Generating Methods

Air foam nozzles, foam tubes, and foam makers are the devices that mix air with proportioned foam solution to form finished air foam for application to a hazard. The most widely used type of foam makers are those in which the foam is generated by inspiration of air into the device using a venturi nozzle.

Air foam generators can be put into five general categories depending on the amount of energy that is used in the foam-making process. They are:

Nonaspirating Methods: Devices such as water sprinklers or water spray nozzles produce a watery foam-froth. Use of such devices for foam production is confined to special applications because of the poor quality, sloppy foam that results. They do not actually inspirate air for foam production but rely on droplet collision and air turbulence for foam-froth production. The resulting froth is relatively unstable. Very little energy is required for this method of foam making. AFFF foams may be produced in these devices.

Air Aspirating Foam Nozzles, Foam Tubes, and Ordinary Foam Makers: These constitute the majority of commercial foam-making devices for portable use or fixed installation. They generate foam by venturi action and aspiration of air into a turbulent foam solution stream.

Figure 13-2D illustrates the basic principles of the air aspirating method of foam production.

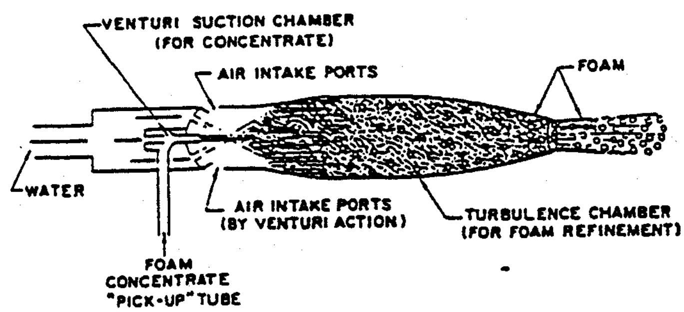


Fig. 13-2D. Cross section of an aspirating type foam maker with a concentrate "pick-up" tube.

Approximately 90 percent of the kinetic energy of the incoming foam solution is exhausted in this type of device and the air foam issuing from it may be distributed only in ways which do not require large pressure differentials.

"*High Back-Pressure*" *Foam Makers*: These modified venturi devices are especially designed to conserve foam pressure energy. They operate at relatively high back-pressures for purposes of discharging foam through extended lengths of pipe of hose and for subsurface injection of foam for fuel tank fire fighting. They are also useful for converting old chemical foam systems to air foam systems. They operate at higher pressures than ordinary venturi devices but the foam produced retains some (25 percent) residual pressure.

Pumped Foam Devices: In these systems compressed air is injected or pumped into the foam solutio under pressure. They are inherently more expensive and find rather limited commercial or industrial application. They require additional increments of power to inject air but the resulting homogeneous foam retains some kinetic energy.

High Expansion Foam Generating Devices: **There are two principal methods used for the generation of this type of fire fighting foam. One of these utilizes a modified venturi action with very turbulent flow and the other requires input of energy to form the finished foam. The latter system results in high expansion foam containing enough residual kinetic energy to enable it to be forced through large tubes and passageways.**

Figures 13-2F and 13-2G illustrate the operating principles of high expansion foam generating devices.

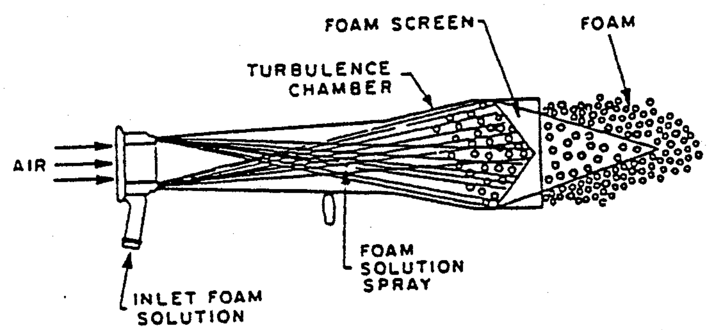


Fig. 13-2F. Aspirating type high expansion foam generator.

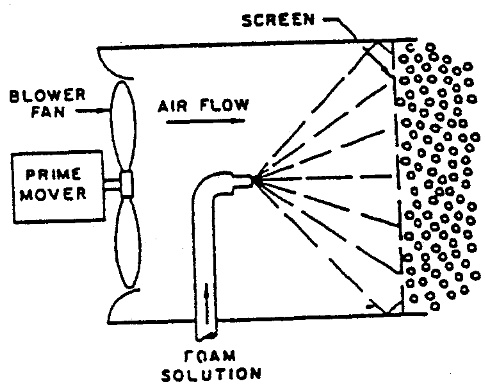


Fig. 13-2G. Fan-blower type high expansion foam generator.

C. Chemical Foam Generating Methods

Except for the generation of chemical foam from "we systems" where the simple mixing of the two solutions ("A" and "B" solutions) will produce foam, it is necessary to pour two chemical powders into a water stream in a fixed ratio to produce the foam. The "A" and "B" chemicals may be mixed previously and stored together in tightly sealed containers. Figure 13-2H illustrates the equipment used to generate foam using previously mixed "A" and "B" powders.

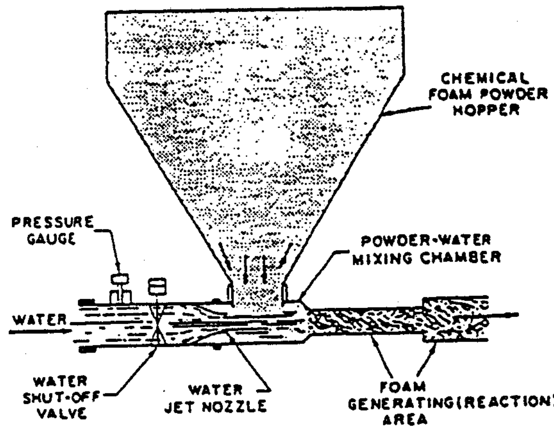


Fig. 13-2H. A chemical foam hopper generator for a single (previously mixed "A" and "B") powder system. When dual powders are used, two hoppers are piped in parallel to a single water source. Dual piping is used from their outlets.

The admixture of solids into water must be very carefully done so that clogging of the mixing throat does not occur. Back-up of water into the cone prevents free flow of the powders into the apex of the cone. If this should occur, which has often happened during fire fighting, the operation must be stopped and all moisture removed from the walls of the device.

D. Some Requirements Governing Fire Protection with Foams

Foams are primarily used for control and extinguishment of fires involving flammable or combustible liquids. In general, the following criteria for the hazardous liquid must be met for a foam to be effective:

1. The liquid must be below its boiling point at the ambient conditions of temperature and pressure.

2. Care must be taken in application of foam to liquids with a bulk temperature higher than 212°F (100°C). At these fuel temperatures and above, foam forms an emulsion of steam, air, and fuel. This may produce a fourfold increase in volume.

3. The liquid must not be unduly destructive to the foam used, or the foam must not be highly soluble in the hazard to be protected.

4. The liquid must not be water-reactive.

5. The fire must be a horizontal surface fire. Three-dimensional (falling fuel) fires cannot be extinguished by foam unless the hazard has a relatively high flashpoint and can be cooled to extinguishment by the water in the foam. However, some foams are capable of "following" a flowing fuel fire.

The following general rules apply to the application and use of ordinary air foams.

1. The more gently the foam is applied, the more rapid the extinguishment and the lower the total amount of agent required.

2. Successful use of foam is also dependent on the rate at which it is applied. Application rates are described in terms of the amount (in gallons or litres) of foam solution reaching the fuel surface (in terms of total square footage of square meters) every minute. An application rate of 0.1 gpm/sq.ft (4.17 litres/min.m^2) means one-tenth of a gallon of foam solution is being applied every minute for each square foot of fuel surface. (If the foam has a 10 expansion, the means a gallon (3.8 litres) of finished foam is being applied every minute per square foot (0.09 m^2).) Increasing foam application rate over the minimum recommended will generally reduce the time required for extinguishment. However, little time advantage is gained if application rates are increased more than three times the minimum recommended. If application rates are less than the minimum recommended, extinguishment time will be prolonged or may not be accomplished at all. If application rates are so low that the rate of foam loss by heat or fuel attack equals or exceeds the rate at which foam is being applied, the fire will not be controlled or extinguished.

3. The critical application rate is the lowest rate at which a foam will extinguish a given fire under a particular set of conditions.

4. The minimum recommended application rate is the rate found by test to be the most practical in terms of speed of control and amount of agent required. The general curve in Figure 13-2I illustrates the rate-time relationship for foam application to a hazard. The curve may be displaced right or left depending on fuel and method of application; hence the need for carefully engineered systems based on actual test information.

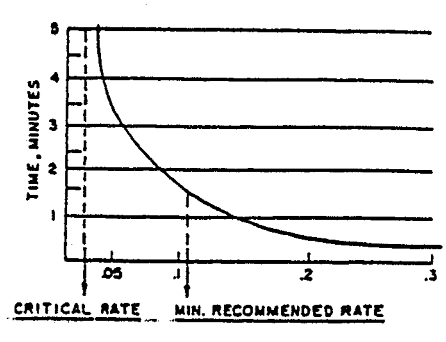


Fig. 13-2I. General relationship of foam application rate to time of application necessary for extinction.

5. In general, air foams will be more stable when they are generated with lower temperature water. Preferred water temperatures range from 35°F (1.7°C) to 80°F (26.7°C). Either fresh or sea water may be used. Water containing known foam

contaminants such as detergents, oil residues, or certain corrosion inhibitors may adversely affect foam quality.

6. Foams are adversely affected by air containing certain combustion products. While the effect is minor with ordinary air foam and ordinary hydrocarbon fuels, it is desirable to locate fixed foam makers on the sides of, rather than directly over, the hazard.

7. Recommended pressure ranges should be observed for all devices. Foam quality will deteriorate if these limits, both high and low, are exceeded.

8. Most air foams are adversely affected by contact with vaporizing liquid extinguishing agents or their vapors and by many dry chemical agents. Unless information to the contrary is available, these materials should not be used simultaneously with air foams. Gases from decomposing plastic materials have a similar breakdown effect on foams.

9. Foam solutions are conductive and, therefore, are not recommended for use on electrical fires. If foam is used, a spray is less conductive than a straight stream. However, because foam is cohesive, and contains materials that allow water to conduct electricity, a spray foam stream is more conductive than a water fog.

E. Important Uses for Fire Fighting Foams

Fire fighting foams are useful on surfaces wherever the cooling effect of water is needed and wherever continuous film-coating characteristics of a light, opaque form of water, capable of sealing vapors, are needed.

The most important use of foams is in fighting fires in flammable or combustible liquids. Foam is the only permanent extinguishing agent used for fires of this type. Its application allows fire fighters to extinguish fires progressively. A foam blanket covering a liquid surface is capable of preventing vapor transmission for some time, depending on its stability and depth. Fuel spills are quickly rendered safe by foam blanketing. The blanket may be removed after a suitable period of time; often it has no detrimental effect on the product with which it comes into contact.

Foams may be used to diminish or halt the generation of flammable vapors from nonburning liquids or solids. They may be used to fill to fill cavities or enclosures where toxic or flammable gases may collect.

Foam is of great importance where aircraft are fueled and in operation. Sudden large fuel spills resulting from aircraft accidents or malfunction require rapid foam application. Hangar fire protection is best accomplished by foam-water sprinkler systems and portable foam equipment.

Foams of the high expansion type (100X to 1,000X) may be used to inundate or fill enclosures such as basement room areas or holds of shops where fires are difficult or impossible to reach. Here foams act to halt convection and access to air for combustion. Their water content also cools and diminishes oxygen by steam displacement.

Many foams are generated from solutions with very low surface tension and penetrating characteristics. Foams of this type are useful where Class A combustible materials are present.

The water solution draining from the foam cools and wets the solid combustible in such instances.

SI Units

The following conversion factors are given as a convenience in converting to SI units the English units used in this chapter.

1 sq ft = 0.0929 m^2
5/9 (^oF-32) = ^oC
1 gpm/ft^2 = 40.746 litres/min m^2

5. **Neutralizing Chemicals**

"Neutralization

Some hazmats can be neutralized by applying another material to the spill which will react chemically with it to form a less harmful substance. The major advantage of neutralization operations is the significant reduction of harmful vapors they provide. In some cases, the hazmat can be rendered harmless and disposed of at much less cost and effort. Examples include acids neutralized by bases.

Before initiating any neutralization techniques, the following conditions must be satisfied.

1. **The Hazardous material has been positively identified.**

2. **Its physical and chemical characteristics have been properly researched.**

3. **The spill has been controlled and confined to prevent runoff after application of the neutralizing agent.**

Sufficient neutralizing agent should be on hand to complete the process once it is begun. This enables ERP to receive minimum exposure.

Spills should be covered by shovelling from the outermost edge inward, thereby protecting the workers first. Avoid walking through un-neutralized materials, even when wearing proper protective clothing. This is particularly important when dealing with corrosives.

Most neutralizing agents, such as sodium bicarbonate and soda ash should be purchased in bulk quantities and stored at key locations. Several neutralizing kits are available commercially for handling small spills. They are normally packaged for smaller laboratory or workshop-type spills of one to five gallons and are usually ineffective for spills larger than 50 gallons."[13]

[13] Noll, et. al. 1988. Pg. 166.

6. <u>Fire Extinguishers</u>

2 Portable Extinguishers

Portable fire extinguishers are classifies according to their intended use on the four classes of fires (A, B, C, D,) discussed in the previous chapter. All portable extinguishers display a rating which indicates the appropriate extinguisher to use on a certain class of fire.

The rating system is based on physical tests conducted by the Underwriter's Laboratories, Inc., and Underwriter's Laboratories of Canada, and are designed to determine the extinguishing potential for each size and type of extinguisher.

These ratings may consist of a LETTER, NUMERAL and LETTER, or a combination thereof and they appear on labels affixed to the extinguisher. The LETTER refers to the class of fire on which the use of the particular extinguishing agent is most effective. The NUMERAL, used in conjunction with Class A and B extinguishers only, indicates the relative effectiveness of the extinguisher. Multiple letters or numeral-letter ratings are used on extinguishers which are effective on more than one class of fire. (Figure 2.1)

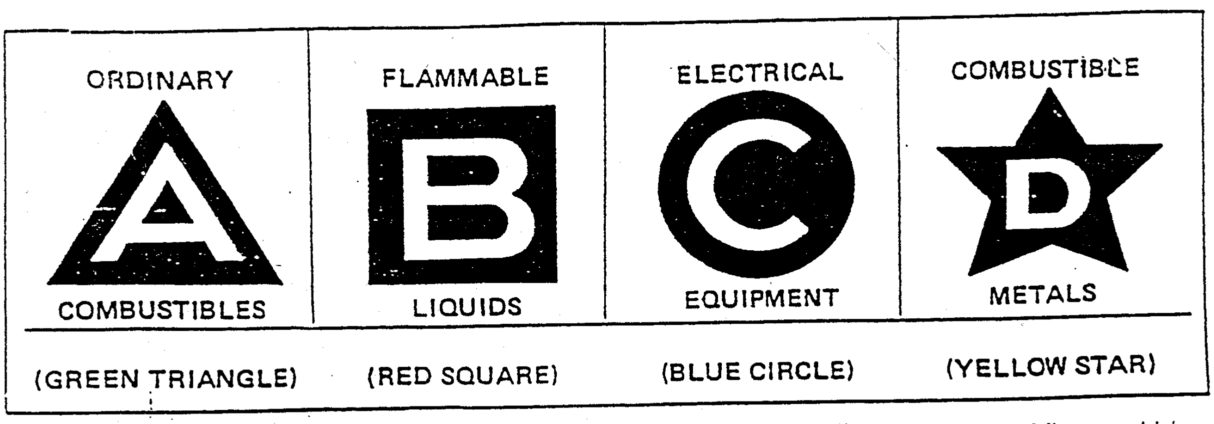


Figure 2.1 Distinctive letters, shapes and colors help to mark extinguishers according to the classes of fires on which they should be used.

CLASS A RATINGS

Extinguishers for use on Class A fires are classified with the following ratings:

1-A, 2-A, 3-A, 4-A, 6-A, 10-A, 20-A, 30-A, and 40-A. The NUMERAL is indicative of the relative fire extinguishing potential of various sizes of the different types extinguishers suitable for use on Class A fires. For example, a 4-A extinguisher can be expected to extinguish approximately twice as much fire as a 2-A extinguisher.

CLASS B RATINGS

Extinguishers for use on Class B fires are classified with the following ratings:

1-B, 2-B, 5-B, 10-B, 20-B, 30-B, 40-B...ranging up to 640-B. The NUMERAL serves two purposes.

1. It is indicative of the relative fire extinguishing potential of various sizes of the different types of extinguishers suitable for Class B fires.

2. It is also an approximate indication of the square-foot area of deep-layer flammable liquid fire which an average operator can extinguish.

For example, a 10-B unit can be expected to extinguish 10 times as much fire as a 1-B unit and should successfully extinguish 10 square feet of a flammable liquid fire when used by a trained operator.

CLASS C RATINGS

No NUMERAL is used since Class C fires are essentially either Class A or B fires involving energized electrical wiring and equipment. the size of the different suitable extinguishers installed should be commensurate with the size and extent of the area involving the electrical hazard or containing equipment being protected.

Example 1 - Dry Chemical Extinguisher, Rated 5-B, C

This extinguisher should extinguish approximately five times as much Class B fire as a 1-B unit and should successfully extinguish a flammable liquid fire of 5 square foot area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

Example 2 - Multi-Purpose Extinguishers, Rated 4-A, 20-B, C.

This extinguisher should extinguish approximately four times as much Class A fire as a 1-A extinguisher, 20 times as much Class B fire as a 1-B extinguisher, and a flammable liquid fire of a 20 square foot area when used by a trained operator. It is also safe to use on fires involving energized electrical equipment.

CLASS D RATINGS

No NUMERAL is used since there are so many metals which would each require extremely different ratings. The relative effectiveness of those extinguishers for use on specific combustible metal fires is detailed on the extinguisher faceplate.

MULTIPLE MARKINGS

Extinguishers suitable for more than one class of fire should be identified by multiples of the symbols previously pictured. If a new extinguisher is not properly marked, the seller should be requested to supply the proper decals. (Figure 2.2)

MULTIPLE MARKINGS FOR EXTINGUISHERS*

1. Dry Chemical

A. ABC (ammonium phosphate base)

2-1/4 lb.	1-A, 10-B:C
2-3/4	2-A, 10-B:C
5-1/2 lb.	2-A, 20-B:C
6	2-A, 40-B:C
5-1/2	3-A, 20-B:C
6	3-A, 40-B:C
8	4-A, 40-B:C
9	4-A, 60-B:C
18	10-A, 40-B:C
18	10-A, 60-B:C
20	10-A, 80-B:C
18	20-A, 80-B:C

B. Purple K (potassium bicarbonate base)

2 lbs.	5-B:C
2-3/8	10-B:C
4-3/4	20-B:C
5-3/4	30-B:C
9	40-B:C
9	60-B:C
18	80-B:C
30	120-B:C

C. Ordinary (sodium bicarbonate base)

1 lbs.	2-B:C
2	5-B:C
2-3/4	10-B:C
10	30-B:C
7-1/2	40-B:C
10	60-B:C
20	80-B:C

D. Monex (ures-potassium bicarbonate base)

9 lbs.	80-B:C
19	120-B:C
23	160-B:C

II. Carbon Dioxide

2-1/2 lbs.	2-B:C
5	5-B:C
10	10-B:C

III. Halon 1211

2-1/2 lbs.	5-B:C
5	10-B:C
10	1-A, 10-B:C
16	1-A, 20-B:C
16	2-A, 40-B:C
22	2-A, 60-B:C

IV. Water

2-1/2 gals.	2-A, 1-B
2-1/2	2-A
4	3-A
5	4-A

V. Wet Chemical

1-1/2 gals.	2-A

VI. Antifreeze Solution

2-1/2 gals	2-A
2-1/2	2-A, 1-B
2-1/2	3-A, 1-B

Figure 2.2 Some fire extinguishers are suitable for more than one type of fire. Multiple marking of the different letter classes, along with numerals for denoting relative effectiveness, allow the user to see at a glance the application of an extinguisher. *For more information on rating tests for determining numeral classifications, see NFPA HANDBOOK, 14th Edition, pages 16-4 and 16-5.

USING PORTABLE EXTINGUISHERS

Portable fire extinguishers, available in many types and designs, are not intended to be a substitute for sprinkler systems, hose streams, or other fire fighting devices. They are, however, considered necessary even though the property is equipped with automatic fire protection devices and each type should be used according to its designated purpose. Portable extinguishers contain a limited supply of extinguishing agent; their discharge range and time is limited; they require periodic inspection; and some must be recharges periodically.

Portable extinguishing equipment should be relied upon only to the extent of their intended use, and when that limit has been reached, larger fire fighting devices and equipment should be provided to extinguish the anticipated fire. The operating principle, classification and suitability, servicing, and method of operating portable extinguishers available to the fire service and for private fire protection are described for each extinguisher on the following pages.

WATER TYPE EXTINGUISHERS (Pump Tanks)

Sizes: 1½ to 5 gallons
Applicable To: Class A Fires.
Operating Principle: Hand pump operated.
Method of Operation: There are several kinds of pump tank extinguishers equipped with a double action pump which delivers a continuous stream of water. Carry the extinguisher to the fire by the handle. Operate the pump with an up and down stroke. Short continuous strokes of the pump handle may provide a better stream than long strokes. The filler cap is provided with a tiny vent which must be kept clear so that air may replace the water as it is discharged from the tank. Some nozzles are provided with two tips, one for straight stream and the other for a spray stream. It may be desirable to place one finger into the discharge stream at the nozzle to break the solid stream up into a broken stream. (Figure 2.4 and 2.5)

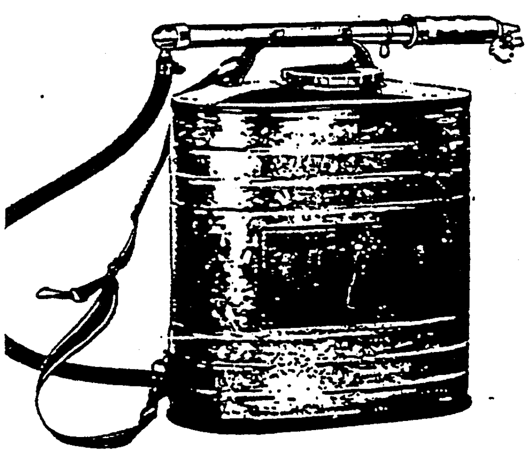
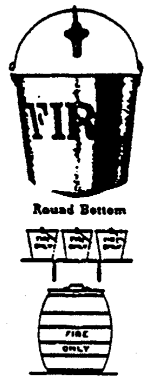
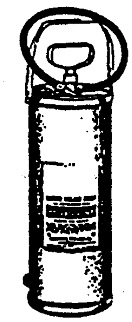
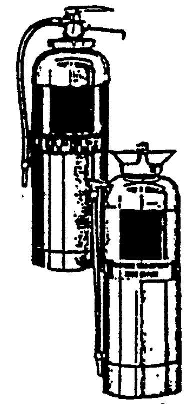


Figure 2.4 A hand-pumped water type extinguisher with straps for carrying on the back. Pump handle is part of the nozzle mechanism.

Figure 2.5 One of several kinds of water pump tanks.

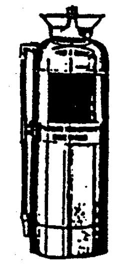
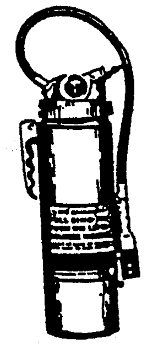
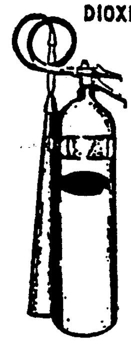
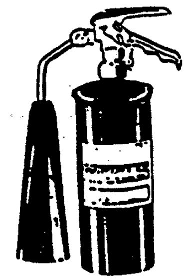
	WATER		
Use The PROPER Extinguisher *Classification & Use*	 pails and cask or drum	 pump tanks	 pressurized
CLASS A Ordinary Combustibles	YES	YES	YES
CLASS B Flammable Liquids	NO	NO	NO
CLASS C Electrical Equipment	NO †	NO †	NO †
CLASS D Combustible Metals	NO	NO	NO
EXTINGUISHING AGENT	WATER With or Without Calcium Chloride	WATER With or Without Calcium Chloride	WATER
HOW TO OPERATE	THROW OR PITCH	HAND PUMP	Pull trigger or invert and bump on floor.
RANGE OF STREAM	5 to 10 feet	30 to 40 feet	30 to 40 feet
DURATION OF DISCHARGE (at room temperature)	VARIABLE	2½ gal. - 1 min. 5 gal. - 2 min.	2½ gal. - 1 min.
APPROXIMATE WEIGHT FULLY CHARGED	25 to 30 pounds	2½ gal. - 35 pounds 5 gal. - 65 pounds	2½ gal. - 35 pounds
REQUIRES PROTECTION FROM FREEZING	YES, Unless calcium chloride solution is used.	YES, Unless calcium chloride solution is used.	YES

† Fires in electrical equipment can be safely attacked with extinguishers of this type ONLY AFTER electric current has been cut off.

* A special type foam charge should be used for "Polar Solvents." (alcohol, acetone, ketone, etc.)

‡ Effective for initial attack on fires in combustible fibers but should be followed up with a fine water spray.

Should not be used where open low voltage contacts are employed.

ANTI-FREEZE			LIQUEFIED GAS	
Loaded Stream	Calcium Chloride	DRY CHEMICAL ‡	CARBON DIOXIDE	BROMOTRIFLUORO METHANE
				 Halon 1301
YES	YES	ONLY with ABC powders	NO, except very small fires.	NO, except very small fires.
NO	YES	YES	YES	YES
NO †	NO †	YES	YES	YES
NO	NO	SPECIAL POWDERS	NO	NO
Water with dissolved potassium carbonate and special salts.	Water with dissolved calcium chloride and a corrosion inhibitor.	Usually powdered compounds of sodium or potassium bicarbonate or ammonium phosphate base. Other formulations available for special hazards.	Carbon dioxide as gas and snow.	Monobromotrifloromethane as a gas.
Pull lock pin and pull or squeeze trigger.	Invert and bump plunger on floor.	Pull lock pin and squeeze trigger.	Pull lock pin and squeeze trigger.	Pull lock pin and squeeze trigger
30 to 40 feet	30 to 40 feet	5 to 20 feet	3 to 8 feet	4 to 6 feet
2½ gal. - 1 min.	2 ½ gal. - 1 min.	10 to 20 seconds	10 to 20 seconds	10 seconds
2½ gal. - 35 lbs.	2½ gal. - 35 lbs.	12 lbs. - 40 lbs. 20 lbs. - 55 lbs.	7½ lbs. - 35 lbs. 15 lbs. - 50-60 lbs. 20 lbs. - 55-75 lbs.	7 pounds
NO	NO	NO	NO	NO

‡‡ Extinguishers of this type should not be used in the vicinity of equipment which may be affected by the highly corrosive vapors resulting from their use.

Due to the toxic effect of gases or vapors generated by the use of this liquid, special precautions MUST BE TAKEN TO AVOID BREATHING THESE VAPORS particularly in confined or unventilated spaces.

STORED-PRESSURE WATER EXTINGUISHERS

Size: **2½ gallons.**
Applicable To: Class A Fires
Operating Principle: **Air pressure stored in the same shell or changer with the water. Average air pressure is 100 psi.**
Method of Operations: **Carry to the fire in an upright position and use in accordance with the instructions on the faceplate of the extinguisher. Hold the hose in hand at all times ready to use. Direct the stream at the base of the fire. (Figure 2.6).**

Figure 2.6 A stored pressure water extinguisher. The gauge at the top registers pressure.

CARBON DIOXIDE EXTINGUISHERS

Sizes: 2, 2½, 4, 5, 6, 10, 12, 15, 18, and 20 pounds.
Applicable To: Class B and C Fires.
Operating Principle: Carbon Dioxide gas stored under pressure and expelled by operating valves.
Method of Operation: Carry to the fire by the handle and operate in accordance with instructions which are prominent on the extinguisher. The discharge expels a cloud of carbon dioxide (CO_2) gas with some "snow" through the nozzle horn. CAUTION: Do not handle the "snow" as frostbite may occur. The discharge horn should be pointed at the base of the fire. The discharge should be applied to the burned surface even after the flames are extinguished. On flammable liquid fires, best results are obtained when the discharge form the extinguisher is employed to sweep the flame off the burning surface. On low voltage electrical contact fires this agent is recommended to reduce costly cleaning operations, as the CO_2 does not leave a residue such as a dry chemical would. (Figure 2.7)

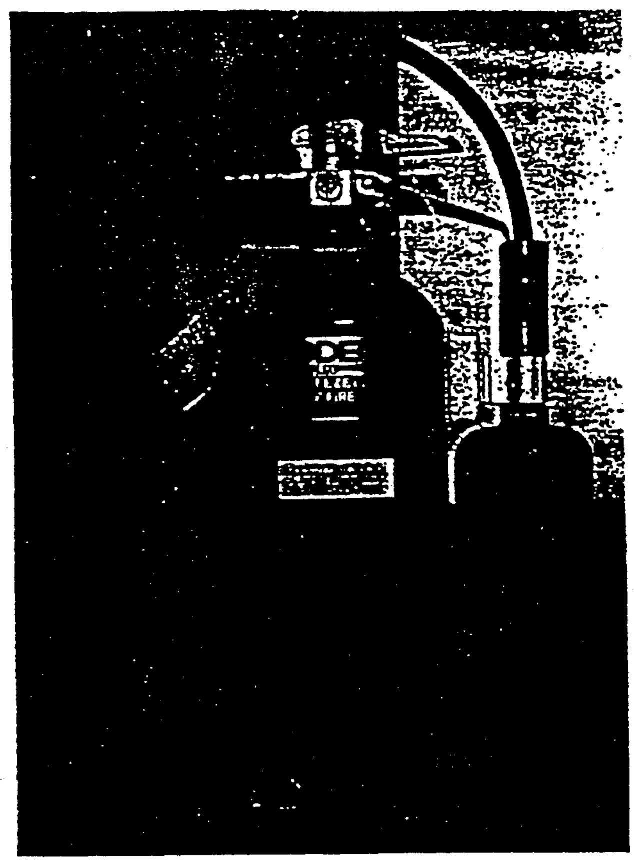


Figure 2.7 Carbon dioxide extinguisher. The CO_2 is stored in a liquid condition at 800 to 900 psi.

HALON EXTINGUISHERS

Sizes: 1 gallon to 10 gallon wheeled units.
Applicable To: Class B and C Fires.
Operating Principle: Liquefied compressed gas.
Method of Operation: Carry to the fire and operate in accordance with instructions on extinguisher label. Discharge is controlled by trigger type handle. Discharged liquid readily vaporizes to a gas. Direct stream to base of flames. Extinguishment is by inhibition of the chain reaction of the combustion process.

ORDINARY BASE DRY CHEMICAL EXTINGUISHERS

Sizes: 2½ to 30 pounds.
Applicable To: Class B and C Fires.
Operating Principle: Alkaline base chemical expelled by either gas cartridge or store-pressure within the same container.
Method of Operation: Carry to the fire and operate in accordance with instructions which are prominent on the extinguisher. Both cartridge-oriented and pressurized dry chemical extinguishers control the discharge of the dry chemical by a nozzle shut-off valve. On fires in flammable liquids, the discharge should be directed at the base of the flames. Best results are obtained by attacking the near edge of the fire and progressing forward moving the nozzle rapidly with a side-to-side sweeping motion. When it is used on electrical fires, care should be taken around open low voltage contacts to prevent costly cleaning. It may be better to use other agents in such cases. (Figure 2.8).

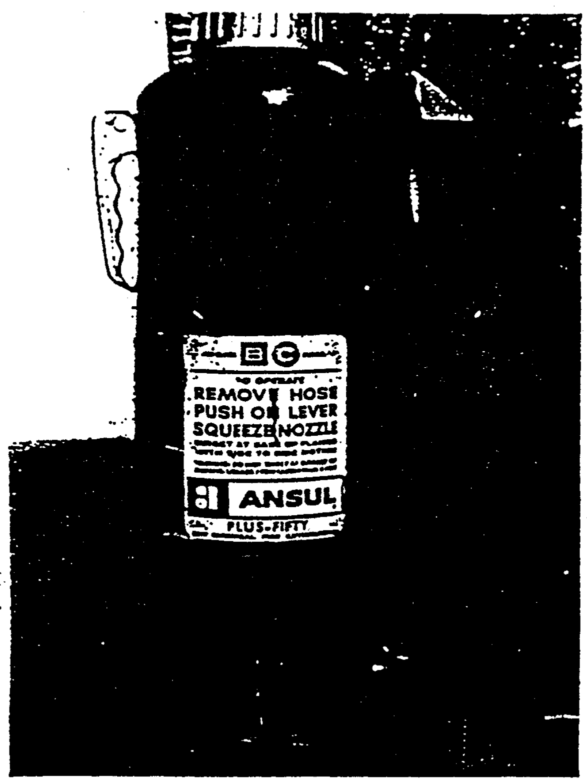


Figure 2.8 Ordinary base dry chemical extinguisher. A gas cartridge behind the cover on the right provides the pressure to expel the chemical.

MULTI-PURPOSE BASE DRY CHEMICAL EXTINGUISHERS (Figure 2.9)

Sizes: 2½ to 20 pounds.
Applicable To: Class A, B, and C Fires.
Operating Principle: Same as Ordinary Base Dry Chemical Extinguishers except that the chemicals are a mixture suitable for use on ordinary combustible materials.
Method of Operation: Same as Ordinary Base Dry Chemical Extinguishers except that on fires in ordinary (Class A) combustibles, the discharge should be directed at the burning surfaces to cover them with chemical. When the flames have been extinguished, the chemical discharge should be directed on any glowing areas. Careful watch should be maintained for hot spots that may develop and additional agent applied to those surfaces as required to coat them thoroughly with the extinguishing medium.
CAUTION: Care should be taken to avoid contamination of any type of dry chemical with multi-purpose type.

Intermixing types of dry chemical agent can result in a chemical reaction which can cause the extinguisher to malfunction and corrode the interior of the extinguisher itself. Under certain conditions, the reaction will create enough pressure to cause the extinguisher to rupture.

OBSOLETE EXTINGUISHERS

In 1969, the manufacture of all inverting type extinguishers was discontinued in the United States. These include soda-acid, foam, and cartridge-operated water and loaded stream extinguishers. It is estimated that there are still several million inverting type extinguishers in use. Some of the disadvantages associated with these extinguishers are:

1. They are extremely good conductors of electricity.

2. They cannot be turned off once activated.

3. The agent is more corrosive than plain water.

4. They are potentially dangerous to the operator during use. If the discharge hose becomes blocked, they can build up pressures in excess of 300 psi and explode causing serious injury or death to the operator. (Figures 2.10 & 2.11)

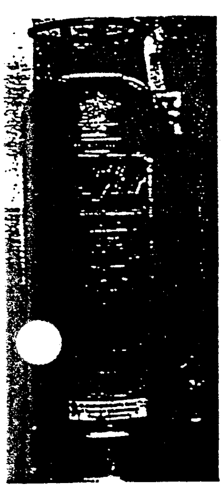


Figure 2.10 Inverting extinguishers like this soda-acid type are considered to be obsolete, although millions are still in use.

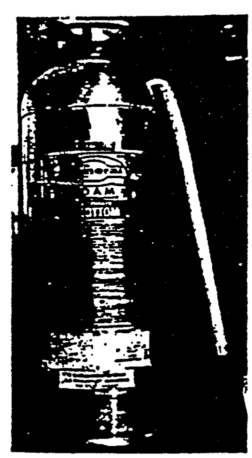


Figure 2.11 An obsolete

NEW MARKING SYSTEM

A new extinguisher marking system based on the International "Picture-Symbol" labeling system is now in limited use. The system is designed to make the operation of fire extinguishers more effective and safe to use through the use of the less confusing pictorial labels. The new system also emphasizes when NOT to use an extinguisher on certain types of fires. Examples of this labeling system are shown in Figures 2.12-2.15.

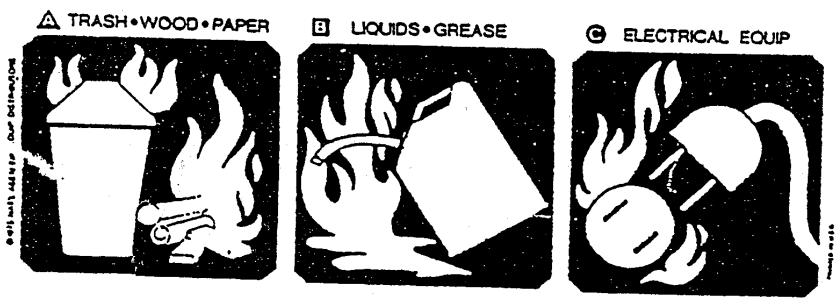


Figure 2.12 The new type markin_ for an extinguisher suitable for Class A, B, and C Fires.

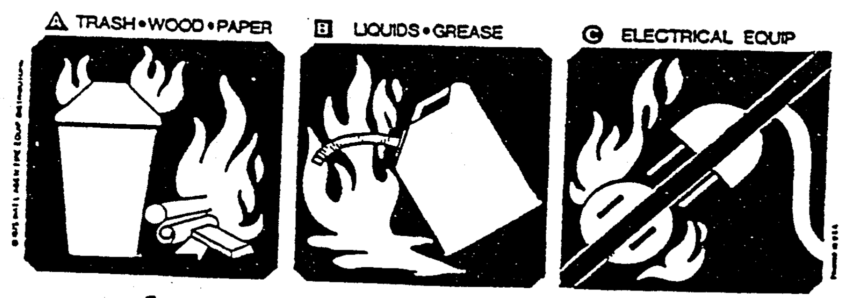


Figure 2.13 A red line across a black background denotes on extinguisher not suited for electrical fires, but suitable for A and B fires.

Courtesy of National Association of Fire Equipment Distributors Inc.

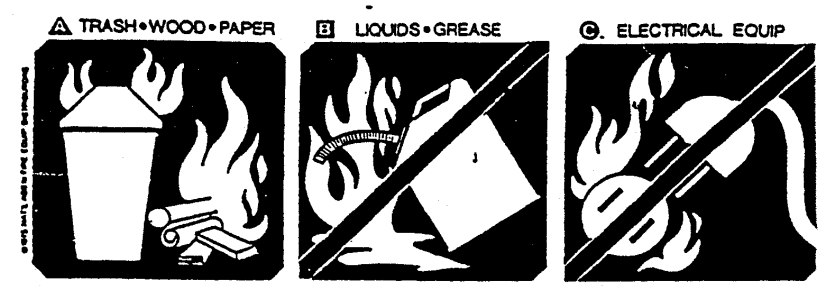


Figure 2.14 New marking system for an extinguisher suitable only for Class A fires.

Figure 2.15 An extinguisher with this decal can be used on either flammable liquids or electrical equipment but not on ordinary combustibles.

Figure 2.16 Extinguisher locations should be marked with a separate sign located high on a wall or pole for better visibility in a large room.

7. Disposal

"Disposal techniques include absorption or packaging the spilled material on-site. then the hazmat and all contaminated equipment and supplies can be transported to the proper facility by approved haulers.

Absorption differs from neutralization since the hazmat does not change chemically; in other words, you have the same material you started with. This may be either an advantage or disadvantage, depending on the situation.

Practically, absorbents are effective when dealing with a liquid spill of less than 55 gallons. Larger spills are more difficult to absorb and often the cost and time exceeds the benefit. Examples include clay, sand, absorbent pads and pillows, and other commercially available kits.

Disposal involves overpacking the leaking container and its contents and then transporting it to a waste disposal facility where it will be chemically treated, buried, or incinerated. Disposal may be necessary when:

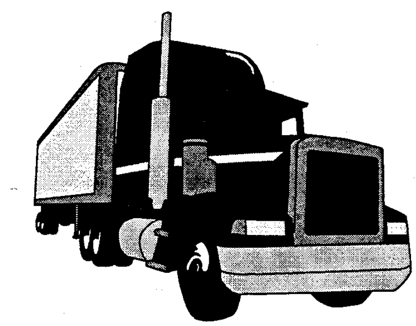
- **Highly toxic materials which cannot be rendered harmless are involved.**
- **On-site treatment requires unacceptable risks to ERP.**
- **On-site treatment costs exceed disposal costs. For example, neutralizing a spill and decontaminating emergency equipment may cost more than pumping the material into a drum and having it transported to a waste dump."[14]**

[14] Noll, et. al. 1988. Pg. 166-167.

TRAINING FOR SAFE TRANSPORTATION OF HAZARDOUS MATERIALS (HM 126F)

STUDENT MANUAL - PART II

◆ FUNCTION-SPECIFIC TRAINING ◆



ARIZONA STATE UNIVERSITY-- EAST
OFFICE OF ENVIRONMENTAL TECHNOLOGY

TABLE of CONTENTS

SUGGESTED TABBING OF 49-CFR (BNA Parts 171 thru 178)
HAZARDOUS MATERIALS, SUBSTANCE, and WASTE

SUBJECT	49-CFR REFERENCE	SUGGESTED TAB
GENERAL		
Definitions/Abbreviations	171.8	DEF/ABB
COMMUNICATION REQUIREMENTS		
Hazardous Material Table (Info)	172.101	HMT (Info)
Hazardous Material Table (Entries)	172.101	HMT(Entry)
Hazardous Substance Table	Appendix A	HAZ SUB
Marine Pollutants Table	Appendix B	MARINE POL.
Special Provisions	172.102	SPEC PRO
Shipping Papers	172.200	SHP PAP
Marking	172.300	MARKING
Labeling	172.400	LABELS
Placarding	172.500	PLACARDS
Emergency Response Info	172.602	EMERG INFO
Emergency Contact: Phone Number	172.604	EMERG PHONE
Training Requirements	172.700	TRAINING
CLASSIFYING and GENERAL PACKAGING (Exceptions) REQUIREMENTS		
Classifying Haz. Materials	173.2	CLASS INDEX
Percedence Table	173.2a	PER TABLE
"Salvage Drums"	173.3	SAL DRUMS
Small Quantities	173.4	SMALL QUNT
Exceptions for Waste Shipments	173.12	WASTE EXP
Exceptions for Class 3,4,5,6,&8	173.13	EXP 3,4,&8
Generator's Responsibility	173.22	GENERATOR
General Packaging Req.	173.24	GEN PACK
Additional Package Non Bulk	173.24a	ADD NON BLK

CLASSIFYING and GENERAL PACKAGING (Exceptions) REQUIREMENTS		
Overpacks	173.25	OVERPACKS
Reuse of Packagings	173.28	REUSE
HAZARDOUS CLASS DEFINITIONS and SPECIFIC (Exceptions) PACKAGE REQUIREMENTS		
Class 1 Definition (Explosives)	173.50	CLASS 1
Class 2 Definition (Comp. Gas)	173.115	CLASS 2
Class 3 Definition (Flm. Liquid)	173.120	CLASS 3
Class 4 Definition (Flm. Solids)	173.124	CLASS 4
Class 5 Definition (Oxidizers)	173.127	CLASS 5
Class 6 Definition (Poison)	173.132	CLASS 6
Class 7 Definition (Radioactive)	173.403	CLASS 7
Class 8 Definition (Corrosive)	173.136	CLASS 8
Class 9 Definition (Miscelaneous)	173.140	CLASS 9
(ORM-D)	173.144	ORM-D
Packaging Exceptions for Classes 3, 4, 5,1, 6, & 8 (Ltd Qty, ect.)	173.150 thru 156	PACKAGE EXCEPTIONS
Non Bulk Packaging	173.201 thru 213	NON BULK
Bulk Packaging	173.240 thru 249	BULK
CARRIER REQUIREMENTS		
Rail	174	RAIL
Air	175	AIR
Water	176	WATER
Highway	177	HIGHWAY
PERFORMANCE-ORIENTED NON-BULK PACKAGING		
Performance-oriented Standards	178.500	POP STAND
Performance-oriented Testing	173.600	POP TEST

YOUR COMPANY or ORGANIZATIONS D.O.T. EXERCISE

1. WHAT HAZARDOUS MATERIALS ARE HANDLED BY YOUR ORGIZATION

Name	Size and Type of Container	Virgin (V) Waste (W)	HMTA Regulation Required(Y or N)

2. For each chemical above, that are regulated by 49CFR, prepare the following Analysis:

   A. WHY IS THE MATERIAL REGULATED BY 49CFR?

   B. WHAT IS THE D.O.T. DESCRIPTION?

      (1) Proper Shipping Name -
      (2) Hazard Class -
      (3) I.D. Number -
      (4) Packing Group -

   C. WHAT MARKING IS ON THE CONTAINER?

      (1) Description of the Marking
         (a) Regulation Reference Section = ________________

   D. WHAT LABEL(s) ARE ON THE CONTAINER?

      (1) Description of the Label(s)
         (a) Regulation Reference Section = ________________

E. WHAT IS THE CONTAINER SPECIFICATION

(1) Description of the Container Specification Marking

(a) Regulation Reference Section = ________________

F. WHAT IS THE D.O.T. SHIPPING PAPER/MANIFEST DESCRIPTION?

(1) Proper Shipping Name -
(2) Hazard Class -
(3) I.D. Number -
(4) Packing Group -
(5) Weight -
(6) Certification Signed -
(7) Emergency Response Telephone Number -
(8) Emergence Response Information i.e. MSDS or ERG reference -

(a) Regulation Reference Section(s) = ________________

G. WHAT PLACARD(s) WOULD YOU OFFER?

(1) Description of the Placard(s)

(a) Regulation Reference Section = ________________

DEFINITIONS

HAZARDOUS MATERIALS

Definitions

A hazardous material, as defined by the U.S. Department of Transportation (DOT), is a substance or material, including a hazardous substance, in a quantity or form which may pose an unreasonable risk to health, safety, or property when transported in commerce.

Classification

Hazardous materials are classified according to their chemical and/or physical properties or their relative hazard to health. The Department of Transportation has adopted the United Nations (UN) system of identifying hazardous materials by class number. The regulations in 49 CFR will show both the UN hazard class number and, in parentheses, the name of that hazard class. For example, under the UN system, flammable liquids will be "Class 3." This will be shown in 49 CFR as "**Class 3 (flammable liquid)**." Some materials are identified with a "Division number." For example, compressed gases could be Division 2.1 (flammable gas), Division 2.2 (nonflammable gas), or Division 2.3 (poisonous gas).

Also, most hazardous materials are assigned a Packing Group according to the degree of danger. There are three Packing Groups: I, II, and III. Group I packages are for the greater danger, Group II for medium danger, and Group III for minor danger. Materials in the same hazard class may require different Packing Groups. For example, Class 3 (flammable liquid) may be assigned Packing Group I, II, or III depending on the characteristics of the material, such as flash point and boiling point. Packing Groups are not assigned to Class 2 (gases), Class 7 (radioactive), combustible liquids or ORM materials. Section 173.2 contains a table listing the hazard classes, their names, and those sections which contain definitions for classifying materials.

Multi-Class Materials

Frequently materials will have properties which meet the definition of more than one hazard class. In such cases, the shipper must classify the material according to the Precedence of Hazardous Table in §173.2a. The Table in that section determines which is the "**primary hazard class (or division)**," or "how the material is classed." The primary hazard class (or division) is shown on shipping papers and is used to determine placarding (warning signs on vehicles) and other operating requirements for the carrier. Other hazards a materials may have are called "**subsidiary hazards**" and will be communicated through additional shipping paper entries and/or hazard warning labels on the packages. As an example, Crotonaldehyde, stabilized, is a material that is Class 3 (flammable liquid), Packing Group II, and also Division 6.1 (poisonous). According to the table in §173.2a, this material would have a primary hazard of Class 3 and would be identified on the shipping paper as having a subsidiary hazard of Class 6.1.

DEFINITIONS

Definitions of Terms

You will be learning many new terms during this course so it is important that you know what these terms mean.

General Definitions: These apply throughout the regulations and are found in §171.8.

Specific Definitions: These apply to a specific subject and are found in the section(s) dealing with that subject. (See 173.403 for Radioactive Materials definitions.)

Turn to §171.8. Locate the following general definitions, read them carefully, and highlight the subject for future reference.

Bag	Hazardous Waste	Package
Box	Inner Packaging	Packaging
Bulk Packaging	Inner Receptac'~	Packing Group
Cargo Tank	Limited Quantity	Person
Class	Manufacturer	Portable Tank
Combination Packaging	Marking	Primary Hazard
Compatibility Group	Mixture	Proper Shipping Name
Composite Packaging	Mode	Reportable Quantity
Consumer Commodity	Non-Bulk Packaging	Shipping Paper
Division	NOS	Solution
Flash Point	NRC	Strong Outside Container
Freight Container	ORM	Subsidiary Hazard
Hazardous Material	Outer Packaging	Technical Name
Hazardous Substance	Overpack	Transport Vehicle

Definitions of Hazard Classes

The hazard class definitions are not found in §171.8. Each class (or Division) is referenced to another section containing the specific hazard class (or Division) definition. The following pages contain work projects to help you become acquainted with the specific hazard class definitions. Remember these are definitions of hazard classes for Department of Transportation purposes.

49CFR CLASS/DIVISION REFERENCE TABLE

Class or Division	Definition Name	Ref.	Examples **	Type of Hazard **
1.1	Explosive *2	173.50	Black powder	Mass explosive
1.2	Explosive *2	173.50	Rocket motors	Projection hazard
1.3	Explosive *2	173.50	Fireworks Type C	Fire w/minor blast or projection
1.4	Explosive *2	173.50	Squibs	Small hazard, normally kept to package
1.5	Explosive *2	173.50	Water gels	Insensitive but mass explosion
1.6	Explosive *2	173.50		Insensitive articular mass explosion
2.1	Flammable Gas	173.115(a)	Propane	Contents under pressure and flammable
2.2	Non-Flammable Gas	173.115(b)	Nitrogen	Contents under pressure (300kPa/44PSIA)
2.3	Poisonous Gas	173.115(c)	Chlorine	Contents under pressure and poisonous
3	Flammable Liquid	173.120(a)	Benzene	Flash point equal to or less than 141°F (60.5°C)
	Combustible Liquid	173.120(b)	Diesel fuel	Flash point equal to or more than 100°F can be reclassified for highway or rail
4.1	Flammable Solid	173.124(a)	Matches, Safety	Cause fire by friction, readily combustible
4.2	Flammable Solid	173.124(b)	Fibers, Animal	Spontaneous combustion

4.3	Flammable Solid	173.124(c)	Calcium Carbide	Reacts with water and spontaneously combustible/give off flammable gas
5.1	Oxidizer	173.127(a)	Potassium Bromate	Yields oxygen readily
5.2	Organic Peroxide	173.128(a)	Acetyl Benzoyl Peroxide	Thermally unstable
6.1	Poisonous	173.132(a)	Parathion Liquid	Poison based on LD50 or LC50 i.e. Oral LD50 500mg/kg (liquid)
6.2	Infectious Substances	173.134(a)	AIDS virus	Viable micro-organisms causing disease in humans/animals
7	Radioactive Material	173.403(y)	Uranium-234	Activity greater than 0.002 uCi/g (74k Bg/kg)
8	Corrosive	173.136(a)	Muriatic Acid	Destroys skin when exposed ≤ 4 hours or corrosion rate ≥ .25 IPY
9	Miscellaneous	173.140(a) 173.140(b)	Dry-ice Haz. Substance/ Waste	Oxygen deprivation Effect on environment
ORM-D	Consumer Commodity	173.144	Drugs	Regulated domestically only

* Also have compatibility groups for explosives (Table 1, 173.52(b)).

** Summary only, check definition sections for specific.

CLASSIFYING HAZARDOUS MATERIALS USING 49CFR

A. STEP 1

1. Hazard Class

For a material to be regulated as a Hazardous Material under 49CFR it must meet the definition of one of the classes contained in Section 173 of 49CFR. The first step is to determine IF THE MATERIAL BEING SHIPPED is regulated as a hazardous material meeting the criteria of one or more of the classes and packing groups contained in Section 173 of 49CFR. If the material being shipped does NOT meet any of the criteria of one or more of the classes contained in Section 173 of 49CFR, it is not regulated as a hazardous material. If the material being shipped meets the criteria of one or more of the hazard classes contained in Section 173, the material is regulated as a hazardous material. The next step would be to find the most appropriate PSN listed in Column 2 of the Hazardous Material Table (HMT) with Column 3 and 5 entries that are the same **Class** and **Packing Group** as the hazardous material being shipped. The class or division and packing group if applicable, governs the selection of the PSN and other information related to it.

ILLUSTRATION:

A **paint** that has a flash point of 68°F (20°C) and an initial boiling point of over 95°F (35°C) would be regulated as a Class 3 with a Packing Group of II. The Hazardous Material Table contains two potential entries for the PSN paint, illustrated in Figure 2. The entry that must be used is the first one because the hazard class (Column 3) **3** and the Packing Group (Column 5) **II** agree with the class and packing group of the material.

HAZARDOUS MATERIALS TABLE (HMT) 172.101

							Packaging Authorizations (173.***)			Quantity Limit		Vessel Storage	
Symbols (1)	Name & Description (2)	Class or Division (3)	Identification Numbers (4)	Package Group (5)	Label(s) (6)	Spec. Instr. (7)	Exception (8A)	Non-Bulk Packing (8B)	Bulk Packaging (8C)	PAX Aircraft (9A)	Cargo Aircraft (9B)	Vessel Stowage (10A)	Other Storage Provisions (10B)
	Paint	3	UN1263	II	Flammable Liquid	B52, T7 T30	150	173	242	5L	60L	B	
	....	.....	....	III	Flammable Liquid	B1, B52, T7, T30	150	173	242	60L	220L	A	

Classification Terminology (Class numbered 1 through 9).

Each has its own definition which will be found in Subparts C and D, corresponding to the class "number" within Section 173 of 49CFR. The first paragraph within the section will contain the **Class Definition.** illustrates Subsection 173.120 which contains the definition paragraph for "Class 3 Flammable Liquids." A complete listing of the definition, references, and a summary of the hazards related to each class will be found in Figure 4 on pages III-7 and III-8.

Divisions. Hazardous Material Classes 1, 4, 5, and 6 are broken down into divisions which are indicated by a decimal number after the primary class number. Reference to the Figure 4 Hazard Class: definition reference, division, and packing group indicates that Class 4 has three divisions. The number to the left of the period is the class and the number to the right of the period is the division. Division 4.3 is Division 3 of Class 4.

2. **Packing Group**, or the degree of hazard. The class or division represents the type of hazard associated with the hazardous material. The packing group represents the degree of that type of hazard within the transportation system. Where applicable the packing group will be an upper case Roman numeral I, II, III.(172.101(f). The lower the packing group number, the greater the degree of risk and the more it will be regulated. Among other things, the packing group dictates the entries in Column 5 of the Hazardous Materials Table (HMT) to be used, governs the drop test for UN packaging, is a code marked on UN specification packaging, and is a required entry on the shipping paper for hazardous material.

Packing Group I	-	Greatest degree of risk - Most regulated.
Packing Group II	-	Moderate degree of risk - Moderately regulated.
Packing Group III	-	Least degree of risk - Least regulated, but still regulated.

For materials specifically identified by their technical name in the HMT, the packing group if applicable, will be found in Column 5 of the entry. In addition, certain classes and divisions such as 3, 4.1, 4.2, 4.3, 5.1, 6.1 and 8 have packing group criteria which must be considered in classifying hazardous materials not specifically identified in the HMT by their chemical (technical) name (173.2a). The packing group if applicable, will be found in Column 5 of the HMT for the entry. In addition, Classes 3, 6, and 8 have packing group criteria which must be considered in classifying hazardous material not specifically identified in the HMT by their chemical (technical name) (173.2).

The packing group criteria will usually be found in a paragraph or paragraphs which closely follow the definition paragraph. illustrates this point for "Class 3 flammable liquids". The packing group criteria is found in Paragraph 173.121(a) which comes immediately after the Definition Paragraph 173.120.

173.120 Class 3 = FLAMMABLE LIQUIDS
Definition of Class 3 Hazardous Material

173.120(a) Means any liquid having a flash point of not more than 60.5°C (141°F) with the following exceptions:

- Any liquid meeting one of the definitions specified in 173.115.
- Any mixture having one or more components with a flash point greater than 60.5°C (141°F) or higher making up at least 99% of the total volume of the mixture.

PACKING GROUP CRITERIA - 173.121

Packing Group	Flash Point (Closed Cup)	Initial Boiling Point
I		≤ 95°F (35°C)
II	< 73°F (23°C)	> 95°F (35°C)
III	≥ 73°F (23°C) but ≤ 141°F (60.5°C)	> 95°F (35°C)

Technical Name. Recognized chemical name currently used in technical and scientific texts, formulas, and handbooks (171.8).

Technically Pure. As used in this text the term **Technically Pure** means a material (chemical) as it is commonly manufactured without the addition of any outside ingredients which would cause it to become a mixture or solution. It includes those impurities which are a natural result of the manufacturing process.

a. The Classification of Hazardous Materials

(1) Technically Pure Materials Specifically Identified by Their Technical Name. As a general rule, technically pure materials specifically identified in Column 2 of the HMT with a PSN that is their specific chemical or technical name will be regulated under the class specified in Column 3, and the packing group shown in Column 5 for the entry. Reference to Columns 2, 3, and 5 in Figure 5 for "technically pure acetone" indicates its PSN is acetone, it is regulated as a Class 3, and has a Packing Group of II.

b. Mixtures and Materials not Specifically Identified Technical Names. Mixtures and materials NOT specifically identified in Column 2 of the HMT by a PSN that is their specific chemical or technical name must be classified by:

(1) Comparing their characteristics against the criteria listed in the appropriate Section 173.XXX to determine the class or classes under which the material is regulated, if any. A complete list of the classes, definitions, references, and a summary of the hazards involved will be found in Figure 4 on Page III-7 and III-8.

For Classes 3, 4, or 8 and Divisions 5.1 and 6.1, classify by:

(2) Comparing their characteristics against the packing group criteria to determine the packing group.

(a) **Technically Pure Chemicals.** Technically pure Ethyl Cyclohexane has a flash point of 95°F (35°C) and an initial boiling point over 95°F (35°C) and is not listed by its chemical name in Column 2 of the HMT. A comparison of the characteristics with the different hazard class definitions in Section 173.XXX of 49CFR leads to the possibility of the material being regulated as a "3" flammable liquid. Information from Section 173.120 of 49CFR is contained in Figure 3. A comparison of the characteristics of Ethyl Cyclohexane against the Definition Paragraph 173.120 indicates that Ethyl Cyclohexane is regulated as a Class 3 flammable liquid because its flash point is less than 141°F (60.5°C). Further, a comparison of the flash point and initial boiling point of Ethyl Cyclohexane would be in Packing Group III because the flash point is above 73.4°F (23°C) and the initial boiling point is above 95°F (35°C). The PSN, class, UN number, and packing group would be: Flammable Liquid, n.o.s. (contains Ethyl Cyclohexane), 3, UN 1993, PG III.

(b) **Single Class Mixture.** A mixture of Acetone and Benzene having a flash point of 76°F (24.4°C) and an initial boiling point of more than 95°F (35°C) and is not specifically identified in Column 2 of the HMT by its chemical name would be classified as follows. Although both Acetone and Benzene are listed separately, their mixture is not. A comparison of the characteristics of the mixture against Class 3 definition and packing group criteria illustrated in Figure 4 indicates that the mixture of Acetone and Benzene would be classed as a "3" and have a Packing Group of "III", because the initial boiling point is above 95°F (35°C) and the flash point of 76°F (24°C). The PSN, class, UN number, and packing group would be:

Flammable Liquid, n.o.s. (contains Acetone/Benzene), 3, UN 1993, PG III.

(c) **Multiple Class Materials or Mixtures**. If a material that is not specifically identified in Column 2 of the HMT by its technical name or a mixture of materials that meets the definition of more than one class must be classed in accordance with the precedence indicated in Section 173.2a of 49CFR. For hazardous materials Classed as 3, 4.1, 6.1, or 8, the precedence is determined by the table in 173.2(b). Reference to the table will show that a mixture of Menthanol and Potassium Hydroxide meeting the definitions of a Class 3, Packing Group II and a Class 8, Packing Group II would be classed as a Class 3, Packing Group II because that is the class and packing group which appears at the point in the table where the two classes and packing groups of the material cross each other. The subsidiary risk of the mixture would be Class 8, Packing Group II. The PSN, class, UN number, packing group would be:

Flammable Liquid, Corrosive, n.o.s. (contains Methanol/Potassium Hydroxide), 3, UN2924, PG II.

(d) **Subsidiary Risk Under 49CFR**. In addition to the determination of the primary hazard class, a determination must also be made as to the applicability of the subsidiary risk, if any. In general, the term **Subsidiary Risk** is an international term for additional labeling and **Will Most Often** apply to materials meeting the definition of more than one hazard class.

- For materials being shipped in their technically pure form that are specifically identified in the HMT Column 6 as an additional label to the class label.

  Reference to Column 6 for the entry **Allyl Acetate** shows a second label of **Poison** in addition to the Class Label "Flammable Liquid."

- For materials or mixtures not specifically identified in the HMT by their chemical or technical names, the subsidiary risk determination is an extension of the classification process requiring a determination as to the additional hazard class definitions a given material meets. Once this information is obtained, reference to the Section 172.402 Table as illustrated in the section will give the subsidiary hazard.

<u>DISCUSSION</u>. The Methanol/Potassium Hydroxide Mixture discussed on page III-7 under Item 1 (c) meeting the definitions of a Class 3, Packing Group II and a Class 8, Packing Group II would be classed as a Class 3, Packing Group II because that is the class and packing group which appears at the point in the table where the two classes and packing groups of the materials cross each other. The subsidiary risk of the mixture would be "8" and require a "Corrosive" label in addition the "Flammable Liquid" label.

3. Proper Shipping Name (PSN)

Importance of the **Proper Shipping Name**. The PSN determines the entry or line in the HMT (172.101) that is used to make many other determinations such as mode exceptions, hazard class, UN/ID number, labeling, UN packing groups, special provisions, packaging instructions, passenger and cargo aircraft quantities, and vessel storage requirements. The PSN is the key to regulatory compliance and safety. It is a required mark on the package and a required entry on the shipping paper. If a material has the wrong PSN the shipment cannot be considered neither safe nor in compliance.

a. How to determine the most appropriate PSN, hazard class, identification number, and packing group:

(1) General Rule, the most specific Column 2 entry in Roman print, the PSN is obtained from Column 2 of the HMT 172.101. The name in Column 2 of the HMT 172.101 in Roman print that MOST appropriately (specifically) describes the hazardous material being shipped **MUST** be used. In determining the most appropriate PSN from Column 2, the most specific information available, chemical name used, product use, etc., should be used in the following order:

- **Chemical Name**. If a material or mixture is specifically identified by its chemical (technical) name in Column 2 of the HMT 172.101 the most appropriate PSN will generally be that entry. This is most applicable when shipping material in **technically pure form** and normal commercial mixtures for solutions of such materials as Acetone or dry Calcium Hypochlorite mixtures.

- **Generic Chemical or Usage Name**. If a material or mixture is not identified in the HMT 172.101 by its chemical name, the next most appropriate PSN would be the generic chemical or usage name listed in Column 2 of the HMT 172.101 that best describes the hazardous material being shipped. Examples of such PSNs would be Alcohol, n.o.s.; Organophosphorus pesticides, liquid, toxic, n.o.s.; Paint.

- **General Hazard Class Entry**. If the hazardous material is not more appropriately (specifically) identified in Column 2 of the HMT by any of the above it must be identified by the most appropriate **General Hazard Class Entry** in Column 2 such as Flammable Liquid, n.o.s; Corrosive Liquid, n.o.s.; Flammable Liquid, Poisonous, n.o.s.; etc.

(2) Using Column 2 of the HMT 172.101 the PSN for a shipment of technically pure Acetone is Acetone. This is determined as follows:

- Is the chemical name listed in Column 2 of the HMT in Roman print? The PSN MUST be Acetone. Flammable liquid, n.o.s. would not be an appropriate PSN even though Acetone is a flammable liquid because there is a more specific name in Column 2. In most cases the chemical or technical name listed in Column 2 will be the PSN.

(3) Technically pure Ethyl Cyclohexane with a flash point of 95°F (35°C) meets the DOT definition of a flammable liquid and is used in organic synthesis. Using Column 2 of the HMT, the PSN for this material in its technically pure form would be determined as follows:

- Is the chemical name listed in Column 2 of the HMT in Roman print? No.
- Is a generic chemical or usage name listed in the HMT? No.
- Select the general hazard class entry from Column 2 of the HMT 172.101 that is most appropriate for the hazardous material being shipped: Flammable Liquid, n.o.s. (Ethyl Cyclohexane)

(4) Specifically Listed Materials Mixture Rule. Generally, if a hazardous material that is listed in the HMT 172.101 by its chemical (technical) name is MIXED with other materials that are not regulated as a hazardous material the PSN Must Be the chemical name of the listed material. The PSN for Acetone in its technical pure form, and in a mixture is the same - Acetone. The words "Mixture" or "Solution" as appropriate shall be added to the PSN in Column 2 (172.101(c)(10).

PERFORMANCE-ORIENTED PACKAGING

PACKAGING MUST MEET PERFORMANCE-ORIENTED STANDARDS

The U.S. DOT non-bulk specification packaging requirements are replaced by a system of performance-oriented packaging (POP) standards. This system helps shippers and manufacturers design packages suitable for the environments in which the shipment is transported. The UN "package performance" system provides a more rational and uniform basis for making packaging assignments. The POP system and standards emphasize risk avoidance and incident prevention.

PACKAGING MUST FIRST BE TESTED AND MARKED

Successful passage of the UN drop, leakproofness, hydrostatic pressure, and stacking test determines the UN marking of the package. This UN marking certifies that in transportation, the packaging is appropriate for the level of hazard contained.

PERFORMANCE-ORIENTED PACKAGING AND INTERNATIONAL STANDARDS

The performance-oriented packaging system is not a verbatim repetition of the international standards. Deviations have been made based on public comments and on U.S. DOT's own initiative. Some of these deviations include:

- For liquids and gases poisonous by inhalation, the new rules in HM-181 **go beyond the UN system**. Bulk and non-bulk packaging are upgraded for these high-hazard materials.

- A vibration standard has been added to ensure an acceptable level of safety because the international standards were believed inadequate. Packagings must be capable of passing this test.

- Domestic packaging exceptions are provided to account for transportation stresses unique to the U.S. distribution system.

MANUFACTURER/CERTIFIER/SHIPPER RESPONSIBILITY - GENERAL

Packaging manufacturers or others that certify that package design types meet HM 181 and shippers who prepare packagings for shipment, **SHARE THE RESPONSIBILITY FOR MAINTAINING THE STRUCTURAL INTEGRITY OF PACKAGES** when they are transported under normal transportation conditions.

Manufacturers/Certifiers

- Packagings are developed, tested, and marked by manufacturers or other persons who certify that the resulting design types perform to the hazard levels of the materials they are intended to contain.

- Shippers ensure that hazardous materials are properly certified to have met Part 178 requirements and are in proper condition for transportation.

MANUFACTURER/CERTIFIER/SHIPPER RESPONSIBILITY - SPECIFIC

Any person who certifies that a package complies with a DOT or UN standard:

- Applies the mark or directs another to apply it.
- Produces single or composite packagings, and applies the certifying mark before distribution.
- Assembles and closes a design type combination packaging, tests the completed package, and applies the certifying mark. (178.2(b))

THE CERTIFYING MARK SHOWS THAT:

- All requirements and performance tests of a DOT or UN standard have been met, and
- Everything the manufacturer does to establish a certified packaging, complies with the HM 181 requirements.

WRITTEN INSTRUCTIONS

The person who certifies a design type not in "full" compliance must provide written instructions to users on "how to bring a package into full compliance with the HM 181," before it is offered for transportation. (178.2(c))

FOR EXAMPLE: A drum manufacturer may not have provided a required closing device with the unit he sold to a shipper. The manufacturer must notify the shipper of the types of closure required to meet the performance requirements in Subpart B of Part 173.

SHIPPER RESPONSIBILITIES - SPECIFIC

BEFORE OFFERING A PACKAGE FOR TRANSPORTATION, a shipper must make sure the package complies with HM 181 packaging requirements; i.e., the shipper must:

- Complete all functions needed to bring a package into compliance (Part 178 - certifier's notification requirements).
- Ensure that under normal transportation conditions, the package maintains structural integrity (designed, built, filled, and closed properly).
- Packagings are compatible with lading.
- Packagings marked "USA" are capable of withstanding vibration test.
- Ensure compliance with packaging standards (Subpart L) and performance test requirements (Subpart M) of Part 178.

TESTING OF NON-BULK PACKAGINGS AND PACKAGES

Subpart M of Part 178 prescribes certain testing requirements for performance-oriented packagings identified in Subpart L of Part 178.

The test procedures are intended to ensure that packages containing hazardous materials can withstand normal conditions of transportation and are considered minimum requirements.

Each packaging must be manufactured and assembled so as to be capable of successfully passing the prescribed tests and conform to the requirements of 173.24 (General requirements for packagings and packages) at all times while in transportation. (178.600(a))

RESPONSIBILITY

It is the responsibility of the packaging manufacturer and the person who offers a hazardous material for transportation (dual responsibility), to the extent that assembly functions including final closure are performed by the person who offers the hazardous material, to assure that each package is capable of passing the prescribed tests.

A. Design Package

The non-bulk performance-oriented packaging standards for packaging design are listed in Subpart L of Part 178. These standards are summarized in the following charts.

CHART 11 - GENERIC UN Packaging Standards

§178.504	1A Steel Drums	§178.516	4G Fiberboard Boxes
§178.505	1B Aluminum Drums	§178.517	4H Plastic Boxes
§178.506	1N Other Metal Drums	§178.518	5H Woven Plastic Boxes
§178.507	1D Plywood Drums	§178.519	5H4 Plastic Film Bag
§178.508	1G Fiber Drums	§178.520	5L Textile Bag
§178.509	1H Plastic Drums and Jerricans	§178.521	5M Paper Bag
§178.510	2C Wooden Barrels	§178.522	6HA Composite Packaging (inner plastic receptacle)
§178.511	3A Steel Jerricans		
§178.512	4A Steel/Aluminum Boxes	§178.523	6PA Composite Packaging (inner glass or stoneware receptacle)
§178.513	4C Wooden Boxes		
§178.514	4D Plywood Boxes		

<u>CERTIFICATION (ID CODES) §178.502</u>

TYPES OF PACKAGES

Number = type of package

1 = drum	4 = box
2 = wooden barrel	5 = bag
3 = jerrican	6 = composite packaging

7 = pressure receptacle

Capital Letter = construction material

A = steel	G = fiberboard
B = aluminum	H = plastic
C = natural wood	L = textile
D = plywood	M = paper, multi-wall
F = reconstituted wood	N = other metal

P = glass, porcelain, stoneware

Number = category of packaging

1 = non-removable head	2 = removable head

Number = type of package

1 = drum	4 = box
2 = wooden barrel	5 = bag
3 = jerrican	6 = composite packaging

7 = pressure receptacle

Capital Letter = construction material

A = steel	G = fiberboard
B = aluminum	H = plastic
C = natural wood	L = textile
D = plywood	M = paper, multi-wall
F = reconstituted wood	N = other metal

P = glass, porcelain, stoneware

Number = category of packaging

e.g., drum:

1 = non-removable head	2 = removable head

e.g. bags:

5M1 = multi-wall bag	5M2 = multi-walled <u>water resistant</u> bag

B. Test Package

General

For liquid or solid hazardous materials required to be shipped in DOT or UN specification packaging, each "design type" package must:

- Conform to the appropriate standard in Subpart L;
- Pass the design qualification tests in Subpart M.

For specific details on testing, review §178.601 - §178.608.

Design qualification tests may be conducted by any person who certifies the design type, that is:

- Manufacturer,
- DOT-certified third-party laboratory, or
- Non-certified testing agency to self-certify. (see 49 CFR 107.403)

Under performance standards, there are no detailed package specification requirements. Instead, "manufacturers" must maintain their own sets of detailed package test results. In effect, full detain documentation of "what was successfully tested" establishes the design type of the package. Test reports should contain enough detail to prove that the design type:

- Withstood the appropriate tests, and
- Meets all applicable UN standards

A summary of the design qualification tests is shown in the following chart.

DESIGN QUALIFICATION TESTS

TESTING OF DESIGN TYPES: Samples of package design types containing the hazardous (*or equivalent substitute*) materials they are intended to carry are tested according to:

- The hazard level of the materials (expected by Packing Groups I, II, III)
- The vapor pressure or density of the material
- The nature of the material, liquid, or solid

DROP TEST (§178.603)

- Required for all packagings for both liquids and solids
- Required for all Packing Groups
- Drop height varies depending on the Packing Group
- Within a Packing Group, drop height increases with increasing specific gravities above 1.2

LEAKPROOF TEST (§178.604)

- Required for all packagings intended for liquids (except for inner packagings of combination packagings)
- Required for all Packings Groups
- Pressure required varies, and depends upon the Packing Group

HYDROSTATIC PRESSURE TEST (§178.605)

- Required for all packagings intended for liquids (except for inner packagings of combination packagings)
- Pressure applied to the test sample depends upon the vapor pressure of the hazardous material
- Minimum test pressure for Packing Group I is 250 kPa

STACKING TEST (§178.606)

- Required for all packagings for both liquids and solids

COOPERAGE TEST (§178.607)

- Required ONLY for bung-type wooden barrels

VIBRATION STANDARD (§178.608)

- All non-bulk packagings marked "USA" must be capable of withstanding vibration test

COMBINATION PACKAGING TESTS

- Completely assembled combination packaging design types must undergo the drop and stacking tests.
- Inner packagings of combination package design types are not subject to leakproof or hydrostatic tests.

NOTE: For air transport, inner packagings must be capable of withstanding hydrostatic pressure tests to accommodate changes in altitude and temperature.

2. Retain Testing Documentation

- For as long as packages are produced PLUS an additional TWO YEARS,
- For each successfully tested design type,
- At each location where manufactured, and
- At each location where tested. (178.601(k)(1), (2))

3. Selective Testing - Variations to Packagings

"Selective" testing is an *allowable design change* without design qualification testing. HM-181 offers two variations: additional variations will soon be authorized.

SELECTIVE TESTING VARIATIONS (178.601(g))

A.. variations must offer an equal or greater level of pe...ance.

	Variation	Condition
I.	Inner packaging	Variation offers equal or greater level of performance.
II.	Inner packaging of different design	Original design type withstands PG I drop test with the most fragile (glass) inner packaging.

Future Variations (Published as Competent Authority Notice)

III.	Up to 25% variation in outer dimension	Single or composite packaging
IV.	Reduced dimension of outer packaging	Combination packagings
V.	Different closure and/or gasket device	Replacement closures and gasketing must be qualified through a test procedure.

4. Periodic Design Requalification, Production Testing §178.601

Periodic design requalification tests provide quality control in the production of packages built to design (tested/passed) types. The package "manufacturer" must requalify★ design types, as shown in Chart 15.

THE "UN" CERTIFICATION MARK IS THE KEY TO THE PERFORMANCE-ORIENTED SYSTEM ADOPTED BY DOT UNDER HM-181. The following chart lists identification codes for the certification mark.

Manufacturer Marking Requirement §178.503

By October 1, 1996, every package is required to conform to the prescribed U.N. Standards. The required markings must be made in the sequence shown.

CERTIFICATION (Marking)

EXAMPLE		MARKING DEFINITION
u n	1.	The United Nations symbol
(1A1)	2.	Type of packagings (i.e., a nonremovable head steel drum)
X,Y,Z	3.	Letter (X, Y, or Z) indicating packaging performance standard appropropriate to the hazardous material contained. "X" = PG I, II, III; "Y" = PG II, III; and "Z" = PG III.
(145)	4.	A designation of the specific gravity or gross mass which the package design type was tested.
(kPa) OR (S)	5.	Single and composite packages (for liquids) give test pressure in "kilopascals," or packages (for solids or inner packages) the letter "S."
(91)	6.	Last two digits of year of manufacture of package. Plastic drums and herricans must be marked with a month of manufacture.
(USA)	7.	The letters "USA" indicate the packaging was marked in accordance with U.S. requirements.
(M1004)	8.	Name and address or symbol of the manufacturer or the approval agency certifying compliance with the UN standard. (Note: Do not have to register beforehand with U.S. DOT, if using name and address of manufacturer.)
(SP)	9.	The letter "V" indicates a combination package — selective testing variation #2. "V" signifies that a combination packaging has passed PG I drop test with the most fragile inner packaging.
(0.9mm)	10.	For metal or plastic drums or jerricans, intended for reuse, express the minimum thickness in millimeters, abbreviated "mm."
(RL)	11.	Reconditioned packaging marking.

The mark must be accessible, permanent, legible, durable, and clearly visible. Minimum letter size is 12.0 mm (0.5 inch) or 6.0 mm (0.25 inch) depending on package size.

Manufacturer Marking Requirement Examples

EXAMPLE 1

u n	4G/Y145/S/90	Fiberboard box/PG II-145/Solid/1990
	USA/RA	Correctly marked/manufacturer's name and address or registered symbol

EXAMPLE 2

u n	1A1/Y1.4/150/90	Removable head steel drum/PG-11 and specific gravity/test pressure/year
	USA/VL824	USA (correct marking)/manufactuer's name and address or registered symbol
	1mm	Thickness in mm

D. Non-Bulk Package Reuse and Reconditioning

Basic package reuse and reconditioning requirements are retained in HM-181. Section 173.28 is revised in HM-181 for clarity, simplicity, and application to a broader spectrum of packages.

Permitted drum reuse is based on requirements in Part 173 for maintaining original design type integrity of packages under normal transportation conditions.

1. Before reuse, packages must:

   - Pass a leakproofness test of internal air pressure:

     - 7 psi for PG I liquids
     - 3 psi for PG II liquids
     - 3 psi for PG III liquids

   - Comply with the required minimum thickness permanently marked in millimeters (mm) on the packaging (drums and jerricans only)

2. If reused without reconditioning, packages must be marked with:

   - The name and address or symbol of the person who conducted the successful leakproofness test;
   - The month and last two digits of the year of the test; and
   - The letter "L" — indicates successful passage of test.

3. If reconditioned, packages must be marked with:

- ♦ The name and address or symbol of the reconditioner, and
- ♦ Th letter "L" (passed leakproofness test).

A reconditioned package is marked near the original design-type certification mark.

CERTIFICATION (RECONDITIONING) §178.503

Where?	Country where reconditioning was performed
Who?	Reconditioner's name, address, or DOT-registered symbol
When?	Month/two-digit-year reconditioned, e.g., 4/90
What?	The letter "R" (reconditioned); the letter "L" (leakproofness tested/passed)

Non-Bulk Package Reuse and Reconditioning Examples

EXAMPLE 1

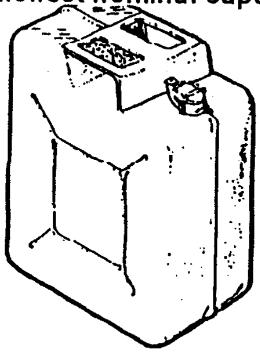
u n	1A2/Y1/4/150/88	Removable head steel drum/PG II and specific gravity/test pressure/year
	USA/VL824/1mm	Country authorizing/manufacturer's name and address or registered symbol/thickness in mm
	USA/M-1002/07/91/RL	USA (correct marking)/reconditioner's name and address or registered symbol/date reconditioned/leakproofness tested

EXAMPLE 2

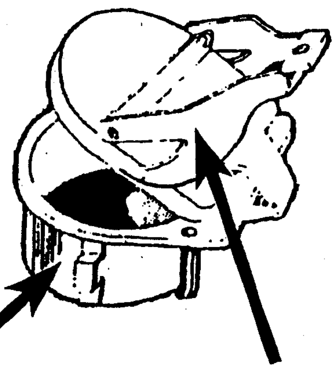
u n	1A2/Y1.4/150/88	Removable head steel drum/PG-II and specific gravity/test pressure/year
	USA/VL824/1 mm	Country authorizing/manufacturer's name and address or registered symbol/thickness in mm
	USA/RB/10-90/RL	USA (correct marking)/reconditioner's symbol/date reconditioned/leakproofness tested

METAL JERRICANS

(Commonest nominal capacity range: 5-25 L)



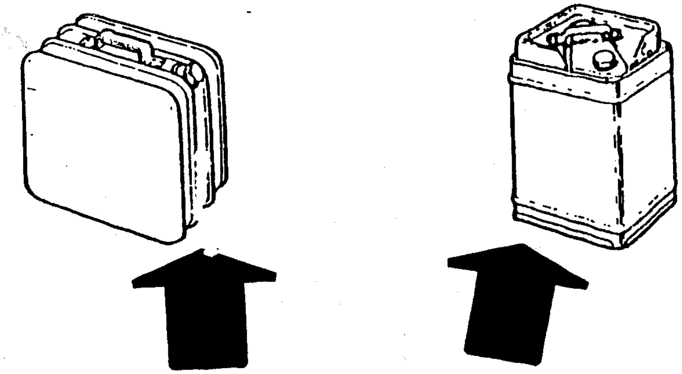
Recessed Handle



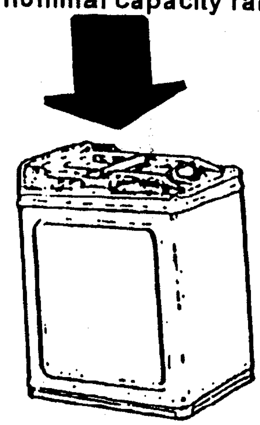
DETAIL OF CLOSURE

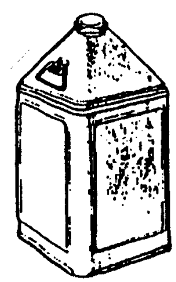
Flanged spout

Locking device



(Commonest nominal capacity range: 5-60 L)





Customary name: "Square taper neck drum"

(Commonest nominal capacity range: 25-60 L)

ARIZONA STATE UNIVERSITY
and
Rice Services Institute, Inc., 2240 East El Moro Avenue
Mesa, Arizona 85204-4523, (602) 507-5217

GENERATOR'S PROCEDURE
(Using 40/49CFR)

	Reference
Step 1	
1. Determine the hazardous waste number for the material. <u>(Once a Waste Number is assigned you have a Hazardous Material)</u>	40CFR, Part 261, Subpart C & D
**** Note **** ALL "HAZMAT" EMPLOYEES MUST BE TRAINED IN THEIR FUNCTIONS AS TO THE REQUIREMENTS OF 49CFR, (EITHER AWARENESS/FAMILIARIZATION or FUNCTION-SPECIFIC)	49CFR, Subpart H, (172.704)
2. Determine the Hazard Class or Division, and the Packing Group. If the material meets any of the Hazard Class Definitions listed in Part 173 "You Have A Hazardous Material."	GENERATOR'S knowledge of the material being shipped (MSDS's, Test)
a. <u>Items Listed by Name:</u> (technical grade, or pure go to the Hazardous Material Table to find the required information)	
b. <u>Items Not Listed by Name:</u> (generic chemicals, generic use, hazard description, mixtures, solutions, and multiple hazards) Determine the Hazard Class or Division and Packing Group. Hazard Class or Division _____ Packing Group _____	
3. Using the Hazardous Material Table Determine the a. Proper Shipping Name b. Hazard Class c. Identification Number d. Packing Group	172.101 (HMT) Column 2 Column 3 Column 4 Column 5
4. Modes or Types of Transportation the material is regulated by, unless Excepted in the Packaging Section for the material. (Air or Water, Domestic, International, or Plus Sign "+")	172.101 (HMT) Column 1

Step 2	
Hazardous Substance	**Appendix A**
1. Determine IF you have a Hazardous Substance two (2) things are needed.	Appendix "A" to 172.101 & 171.8
a. The material must be listed by name in Column 1 of the Appendix to 172.101.	Column 1
b. You must have equal to or Greater than the amount listed in Column 3 of the Appendix to 172.101.	Column 3
Marine Pollutants	**Appendix B**
2. Determine IF you have a Marine Pollutants	Appendix "B" to 172.101 & 171.8
a. Transportation by water, bulk and non bulk	172.322(a),(b)
1. Marine pollutant 10% by weight	171.8
2. Severe marine pollutant 1% by weight	171.8
b. Transportation by other than water, bulk	172.322(b)
1. Marine pollutant 10% by weight	171.8
2. Severe marine pollutant 1% by weight	171.8
(Any material meeting this definition is regulated by all Modes of Transportation)	171.8
3. Special Provisions; Check the special provisions in Column 7 for the material as packaged. 172.102.	Column 7 and 172.102

Step 3	Reference
1. Determine if an exception is authorized for the material being shipped. (Must have a reference in Column 8A of the Hazardous Materials Table) Are you going to use it? yes___ no___, none___	172.101 Column 8A
2. No exception authorized or not using one, then the item must be in UN Specific packaging referenced in Column 8B.	172.101 (HMT) Column 8B
3. Insure completed waste package meets the requirements as appropriate	173.12
4. Insure completed package meets standard packaging requirements PIUS the General packaging requirements for the Hazard Class. Make sure "Performance Oriented Packaging" Test are done.	173.24, 24a,

Step 4 Marking the Package	
1. Mark the Proper Shipping Name on your package (for n.o.s. entries give technical name(s)) (the word "WASTE" not required if marked under EPA)	172.301(a) 172.301(a)(2) 40 CFR 262.32
2. Mark the Identification Number on your package	172.301(a)(1)
3. Mark consignor, consignee name and address	172.301(d)
4. Additional marking (as required)	
a. Exception packaging	172.301(c)
b. Previous marked packagings	172.301(e)
c. ORM-D materials	172.316(a)
d. Explosives	172.320
e. Orientation marking	172.312
f. Radioactive materials	172.310
g. Hazardous Substance (Add RQ & the name or waste number that makes it a RQ)	172.203(c)
h. Poison Inhalation Hazard	172.313
i. Ovepacks	172.301 & 173.25
j. Hazardous Waste in non-bulk packages (Sticker (Label) may be used) (a) Statement (b) Generators Name and Address (c) Manifest Document number	172.300's & 40CFR,262.32(b)
k. Specification Packaging	178 Subpart L & M

Reference

Step 5 Labeling the Package	
1. Label the Package using the label(s) required in Column 6 (unless excepted from labeling such as "Limited Quantity" or small quantity.	172.400(a) 172.400a
2. With an appropriate additional label or multiple as may be required.	172.402

Step 6 Shipping Paper Requirements	
1. Uniform Hazardous Waste Manifest Entries	Appendix to Part 262
a. Key 1 thru 10	
b. Key 11 thur 16	
(1) Proper Shipping Name (and Technical names if required)(preceded by word Waste)	172.201(a)(1)
(2) Hazard Class or Division	(2)
(3) Identification Number	(3)
(4) Packing Group (PG)	(4)
(5) Waste Number	172.203(c)
(6) Number and Type of containers	
(7) Total Quantity	172.201(c)
(8) Unit (Wt/Vol)show G,P,T,Y,L,K,M or N	
(9) Emergency Response	172.600's
(a) EMERGENCY CONTACT phone number in key 4 or 15	172.604(a)
(b) Emergency Response Information must be provided	172.602(a),(b)
(10) Key 16	
(a) Name must be printed or typed	172.205(d)
(b) Signature hand written	
(c) Dated	
c. Additional Description (If required)	172.203
(1) D.O.T. Exemptions	172.203(a)
(2) Limited Quantity	172.203(b)
(3) Hazardous Substance (Add RQ & the name or waste number that makes it a RQ)	172.203(c)
(4) Radioactive Materials	172.203(d)
(5) Empty packaging	172.203(e)
(6) Transportation by Air	172.203(f)
(7) Transportation by Rail	172.203(g)
(8) Transportation by Highway	172.203(h)
(9) Transportation by Water	172.203(i)
(10) Dangerous when wet	172.203(j)
(11) Technical names	172.203(k)
(12) Marine Pollutants	172.203(l)
(13) Poisonous Materials	172.203(m)

Step 7 Placarding Requirements	Reference
1. Placarding	172.500's
a. Shipper's requirements to provide.	172.500(a) 172.504(e)
b. Carrier's requirements for affixing	172.504(b),(c)

WORK PROJECT
SHIPPER'S REQUIREMENTS

The following work project is to help you understand the shipper's requirements, and how to determine what is required for shipping hazardous materials. (**TO BE DONE BY THE INSTRUCTOR**)

One glass bottle with 5 pounds of Kepone (solid) in one box

1. What is the Proper Shipping Name?______________________________

2. What is the Class or Division?_______________

3. What is the Identification Number?___________________________

4. What is the Packing Group?__________________________________

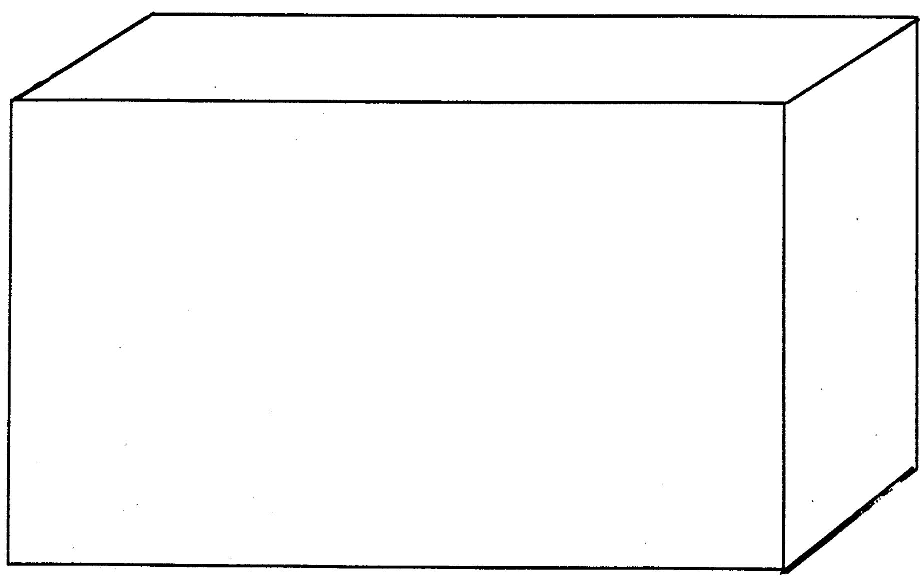
5. Is this material a Hazardous Substance? yes_____ no_____

6. How must this commodity be packaged? **Name only one method**, and list the reference.____

Markings 172.300's
Labeling 172.400's

What Marking are required on the outside of the package?
What labels are required on the outside of the package?

Please mark and label the package below appropriately



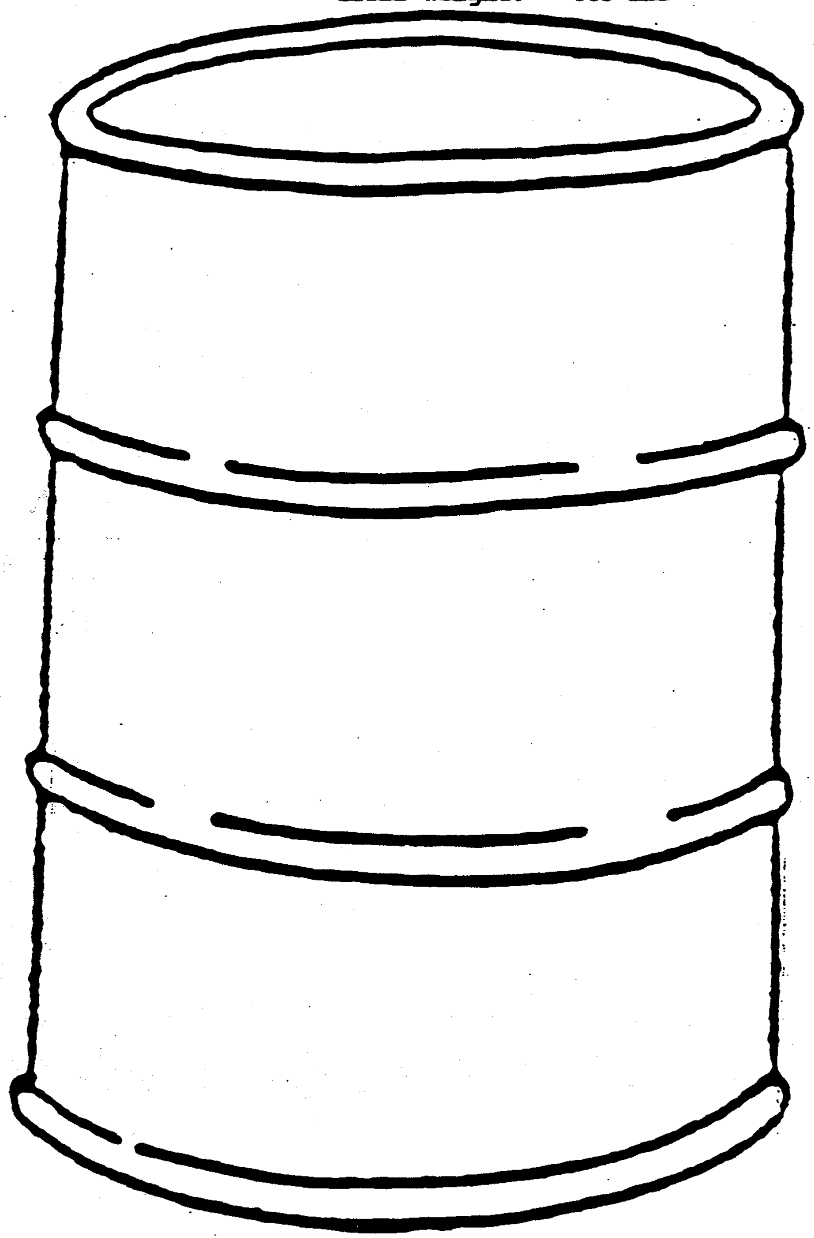
"NONCOMPLIANCE MAY BE HAZARDOUS TO OUR WORLD"

EXERCISE (#1)

You are asked by your boss to ship a 55 Gallon metal drum with 52 gallons of Paint and Paint Thinner which has a flashpoint of 78 degrees F and a boiling point of 268 degrees F, it has no other waste characteristics.

Using a copy of Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided.(show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway
Gross weight: 440 lbs



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND CONTACT THE NEAREST POLICE PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME ______________________________

ADDRESS ______________________________

CITY ____________ STATE ________ ZIP ________

EPA ID NO. ____________ EPA WASTE NO. ____________

ACCUMULATION START DATE ____________ MANIFEST DOCUMENT NO. ____________

____

____

____

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

State of California—Environmental Protection Agency
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Please print or type. Form designed for use on elite (12-pitch) typewriter.

See Instructions on back of page

Department of Toxic Substances Control
Sacramento, California

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. | Manifest Document No. | 2. Page 1 of | Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address | A. State Manifest Document Number [redacted]

B. State Generator's ID

4. Generator's Phone ( )

5. Transporter 1 Company Name | 6. US EPA ID Number | C. State Transporter's ID

D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number | E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number | G. State Facility's ID

H. Facility's Phone

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a.					State
					EPA/Other
b.					State
					EPA/Other
c.					State
					EPA/Other
d.					State
					EPA/Other

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above
a. b.
c. d.

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Year

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year

GENERATOR

TRANSPORTER

FACILITY

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-852-

DO NOT WRITE BELOW THIS LINE.

39

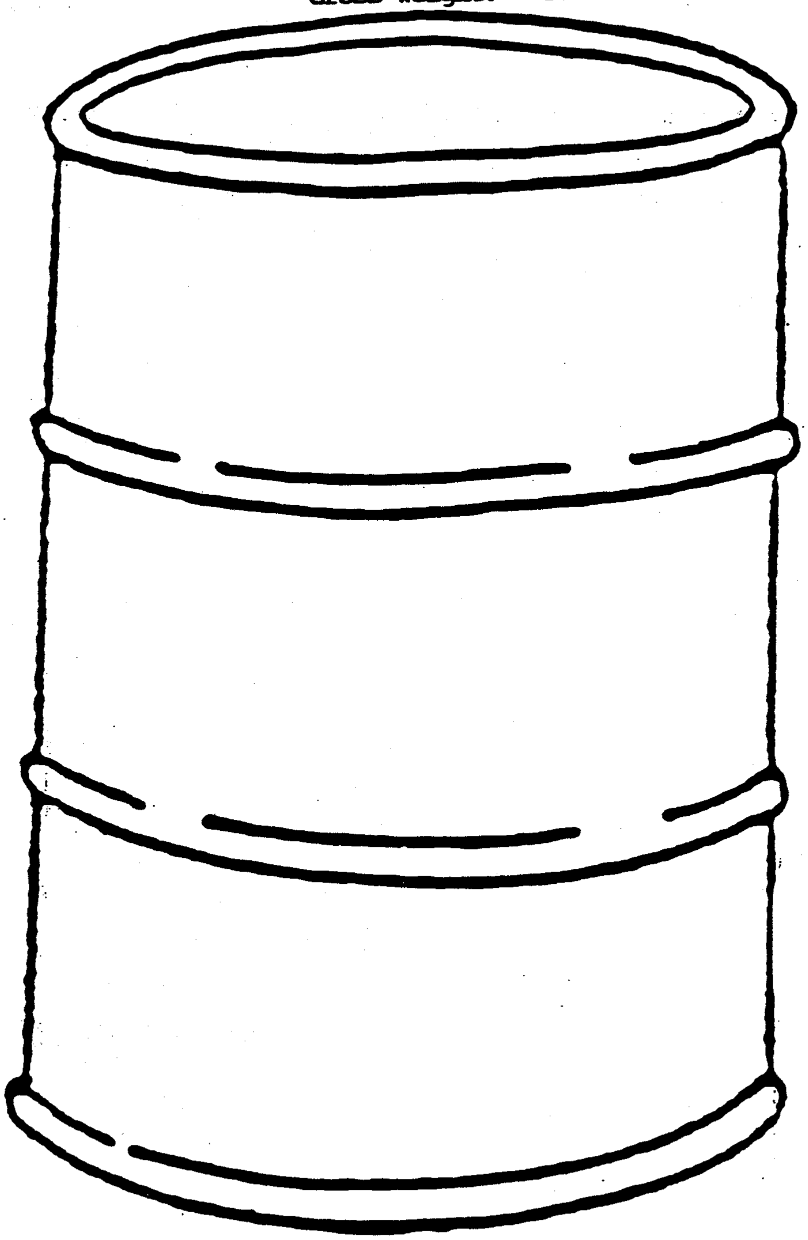
DTSC 8022A (9/94)
EPA 8700—22

EXERCISE (#2)

You are asked by your boss to ship a 55 Gallon metal drum with 52 gallons of Acetone (Spent) solvents (30%), Xylene (30%), Toluene (30%), and Water (10%) which has a flashpoint of 70 degrees F and a boiling point of 118 degrees F.

Using a copy of Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided.(show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway
Gross weight: 360 lbs



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND CONTACT THE NEAREST POLICE PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME ______________________________

ADDRESS ______________________________

CITY ____________ ____________ STATE ____________ ZIP ____________

EPA ID NO. ____________ EPA WASTE NO. ____________

ACCUMULATION START DATE ____________ MANIFEST DOCUMENT NO. ____________

[______________________________

____

____

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX]

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3. Generator's Name and Mailing Address		A. State Manifest Document Number [redacted]
		B. State Generator's ID
4. Generator's Phone ( )		
5. Transporter 1 Company Name	6. US EPA ID Number	C. State Transporter's ID
		D. Transporter's Phone
7. Transporter 2 Company Name	8. US EPA ID Number	E. State Transporter's ID
		F. Transporter's Phone
9. Designated Facility Name and Site Address	10. US EPA ID Number	G. State Facility's ID
		H. Facility's Phone

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a.					State / EPA/Other
b.					State / EPA/Other
c.					State / EPA/Other
d.					State / EPA/Other

J. Additional Descriptions for Materials Listed Above	K. Handling Codes for Wastes Listed Above a. b. c. d.

15. Special Handling Instructions and Additional Information

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Year

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year

G E N E R A T O R — T R A N S P O R T E R — F A C I L I T Y

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-85

DO NOT WRITE BELOW THIS LINE.

39

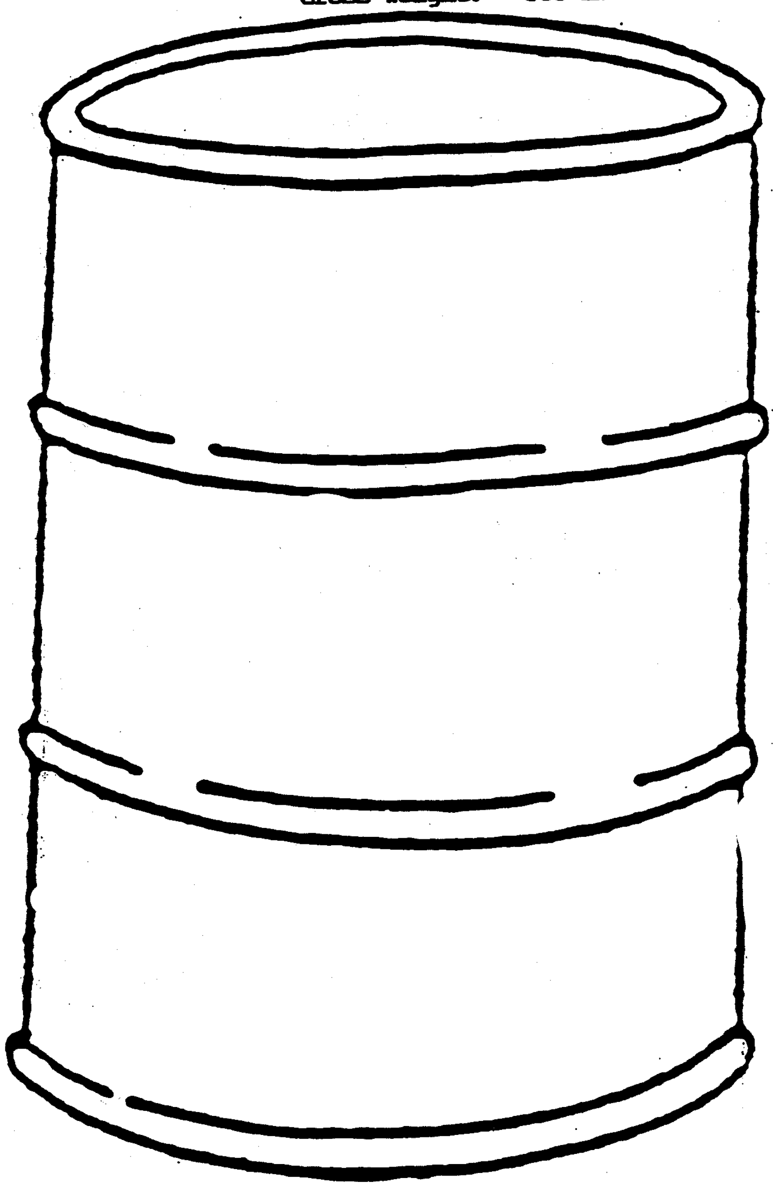
DTSC 8022A (9/94)
EPA 8700—22

EXERCISE (#3)

You are asked by your boss to ship a 55 Gallon metal drum with 52 gallons of Acetone 60% and rain water 40%, (it contains no other regulated material) it has a flashpoint of 70 degrees F and a boiling point of 118 degrees F.

Using a copy of Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided.(show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway
Gross weight: 360 lbs



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND CONTACT THE NEAREST POLICE PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME ______________________________

ADDRESS ______________________________

CITY ____________ STATE ____________ ZIP ____________

EPA ID NO. ____________ EPA WASTE NO. ____________

ACCUMULATION START DATE ____________ MANIFEST DOCUMENT NO. ____________

[______________________________

____

____

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX]

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3. Generator's Name and Mailing Address

A. State Manifest Document Number [redacted]

B. State Generator's ID

4. Generator's Phone ( )

5. Transporter 1 Company Name | 6. US EPA ID Number

C. State Transporter's ID

D. Transporter's Phone

7. Transporter 2 Company Name | 8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone

9. Designated Facility Name and Site Address | 10. US EPA ID Number

G. State Facility's ID

H. Facility's Phone

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a.					State EPA/Other
b.					State EPA/Other
c.					State EPA/Other
d.					State EPA/Other

J. Additional Descriptions for Materials Listed Above

K. Handling Codes for Wastes Listed Above
a. b.
c. d.

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

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Printed/Typed Name | Signature | Month Day Year

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name | Signature | Month Day Year

GENERATOR — TRANSPORTER — FACILITY

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-852-

DO NOT WRITE BELOW THIS LINE.

39

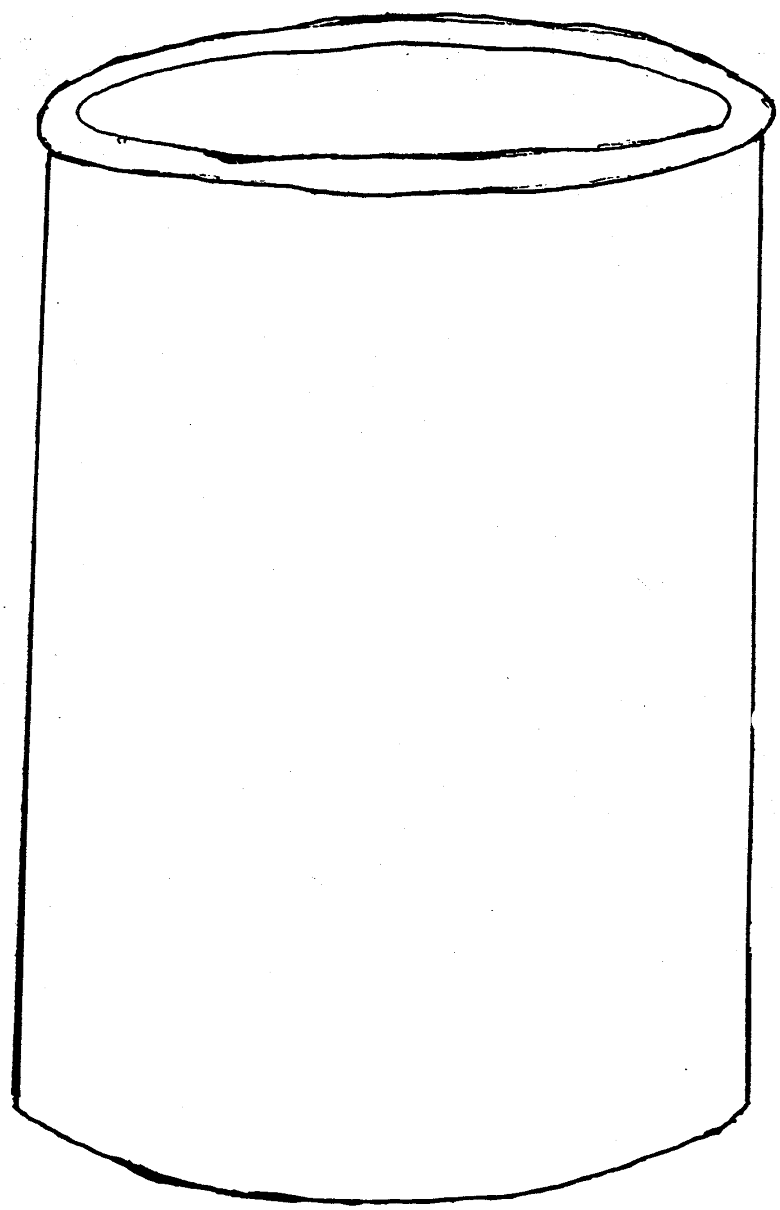
DTSC 8022A (9/94)
EPA 8700—22

EXERCISE (#4)

You are asked by your boss to ship a 20 gallon fiberboard drum with 4 each, 1 gallon cans (net weight of each can is 4 lbs.) of Lindane crystalline powder, that is Lab packed.

Using a copy of Code of Federal Regulations 40/49-CFR, complete a Hazardous Waste Manifest, Marking, and Labeling of the package. Using the information provided.(show where the Hazard Label & EPA sticker goes)

Mode of Transportation: Highway
Gross weight: 35 lbs



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

**IF FOUND CONTACT THE NEAREST POLICE
PUBLIC SAFETY AUTHORITY OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY.**

GENERATOR INFORMATION:

NAME ____________________

ADDRESS ____________________

CITY ____________________ STATE __________ ZIP __________

EPA ID NO. ____________________ EPA WASTE NO. ____________________

ACCUMULATION START DATE ____________________ MANIFEST DOCUMENT NO. __________

[____________________

____

____

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX]

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Sacramento, California

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UNIFORM HAZARDOUS WASTE MANIFEST

GENERATOR

1. Generator's US EPA ID No.
Manifest Document No.
2. Page 1 of
Information in the shaded areas is not required by Federal law.

3. Generator's Name and Mailing Address
A. State Manifest Document Number [redacted]
B. State Generator's ID
4. Generator's Phone ( )
5. Transporter 1 Company Name
6. US EPA ID Number
C. State Transporter's ID
D. Transporter's Phone
7. Transporter 2 Company Name
8. US EPA ID Number
E. State Transporter's ID
F. Transporter's Phone
9. Designated Facility Name and Site Address
10. US EPA ID Number
G. State Facility's ID
H. Facility's Phone

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a.					State EPA/Other
b.					State EPA/Other
c.					State EPA/Other
d.					State EPA/Other

J. Additional Descriptions for Materials Listed Above
K. Handling Codes for Wastes Listed Above
a. b.
c. d.

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year

DO NOT WRITE BELOW THIS LINE.

39

DTSC 8022A (9/94)
EPA 8700—22

ARIZONA STATE UNIVERSITY
and
Rice Services Institute, Inc., 2240 East El Moro Avenue
Mesa, Arizona 85204-4523, (602) 507-5217

GENERATOR'S HAZARDOUS WASTE SHIPMENT CHECKLIST
(Non-Radioactive)
Using 49CFR

1. Determine the hazardous waste number(s) for the material using 40CFR, Part 261, Subpart C, and D. <u>(Once a Waste Number is assigned you have a Hazardous Material)</u>

2. Determine which Hazard Class or Division, and the Packing Group fits your material, using Part 173 definitions.

   What is the Hazard Class or Division, Packing Group for <u>your</u> material? _____,____

3. Determine the Proper Shipping Name and other information that is to be used for this shipment from the Hazardous Materials Table (HMT) (172.101):

   a. <u>Items Listed by Name:</u> (technical grade, or pure).

   b. <u>Items Not Listed by Name:</u> (generic chemicals, generic use, hazard description, mixtures, solutions, and multiple hazards).

   c. The following information will be used for this Shipment:

      (1) Proper Shipping Name:____
      (2) Hazard Class or Division: _________
      (3) Identification Number: ____________
      (4) Packing Group number: ____________
      (5) Label(s) Required: ____________________, ____________________

4. Do you have a Hazardous Substance or Marine Pollutant?
   a. Hazardous Substance; yes:_____ or n/a:_____
   (Listed in Appendix A to 172.101 + RQ per package = Hazardous Substance)(171.8)
   b. Marine Pollutants yes:_____ or n/a:_____
      (1) (Listed in Appendix B to 172.101 + being transported by Water
      (a) With a "PP" <u>BULK & NON-BULK</u> packaging 1%, with-out 10%.
      (2) (Listed in Appendix B to 172.101 + <u>NOT</u> being transported by Water
      (a) With a "PP" <u>BULK</u> packaging 1%, with-out 10%.

5. Do any of the Special Provisions (in Column 7) apply to what is being shipped?
   yes:_____ or n/a:_____

6. Which Packaging Sections are you using?

   a. Exception (Col.8A) (Spec. packaging not required "IF" material fits one of the listed packaging exceptions) yes:_____ or n/a:_____
   b. Non Bulk (Col.8B) (as required by packaging Section. "UN" packaging is required by Air or Vessel (1 Oct 1996 for Highway)
   yes:_____ or n/a:_____
   c. Bulk (Col.8C) (May be UN or DOT spec. packaging) yes:_____ or n/a:_____

d. Or are you using one of the following?

(1). Packaging and Exceptions (173.3) yes:____ or n/a:____
(Salvage Drum)

(2). Exceptions for Waste materials
yes:____ or n/a:____ (173.12)

e. All UN Packaging must meet the Marking and Testing requirements of Part 178, does yours? yes:____ or no:____

f. Are you using an Overpack (173.25) yes:____ or n/a:___

COMPLETING THE UNIFORM HAZARDOUS WASTE MANIFEST (CHECKLIST)

Checks made

yes	no	n/a	
___	___		Key (1) Generator's US EPA number & Manifest Document No.
___	___		Key (2) Page of Pages
___	___		Key (3) Generator's Name & Mailing Address
___	___		Key (4) Generator's Phone No. (May be the "EMERGENCY CONTACT Telephone number required by DOT", (49CFR,172.604(a))
___	___		Key (5) Transporter 1, Company Name
___	___		Key (6) Transporter 1, US EPA ID number
___	___	___	Key (7) Transporter 2, Company Name
___	___	___	Key (8) Transporter 2, US EPA ID Number
___	___		Key (9) Designated Facility Name & Site Address
___	___		Key (10) Designated Facility US EPA Number
			Key (11) US D.O.T. Description (a),(b),(c),(d), Including
___	___		(1) Proper Shipping Name; (172.202(a)(1))(The word "WASTE" preceding)
___	___		(2) Hazard Class; (172.202(a)(2))
___	___		(3) UN or NA Number; (172.202(a)(3))
___	___		(4) Packing Group; (172.202(a)(4))
			"Note" These next Items MAY or MAY NOT be required in Key 11
___	___	___	Exemption; "DOT-E-XXXX" Must be entered if app. (172.203(a))
___	___	___	"Limited Quantity" or "Ltd Qty" (172.203(b))
___	___	___	Hazardous Substance; "IF the name does not identify the hazardous substance, then one of the following will be used: Name, Waste Stream number, EPA Characteristic, or corresponding "D", Plus add the letters "RQ" in front of the Proper Shipping Name. (172.203(c)(1),(2))
___	___	___	Empty Packaging; "Residue Last Contained *****" (172.203(e))
___	___	___	"Dangerous When Wet"; (172.203(j))
___	___	___	"Technical names" for N.O.S. & Generic (172.201(d),172.203(k))
___	___	___	Marine Pollutants; "Identify the component in parentheses, add the words <u>MARINE POLLUTANT</u> with the description. (172.203(l)(1),(2))
___	___	___	Poisonous Materials; "Poison", or "Poison-Inhalation Hazard" and the Hazard Zone, A,B,C, & D". (172.203(m))
___	___		Key (12) Containers; No. & Type: (Example 001,DF) one fiberboard Drum
___	___		Key (13) Containers; Total Quantity each Line: (Example 00055)
___	___		Key (14) Unit; By Wt/Vol, "G" gallons, "P" pounds, "T" tons, "Y" Cubic yards, "L" liters, "K" kilograms, "M" metric tons, and "N" Cubic meters.
___	___	___	Key (15) Special Handling Instructions & Additional Information: "The EMERGENCY CONTACT telephone number may be entered here or in Key 9", If carrier has the Emergency Response Guidebook you may reference it in Key 11 or here: (Example for Key 11; Use ERG 26, after the required entries), (for Key 15; Use ERG 26 for Item (a) in key 11), or (See attached Emergency Response Information)
___	___		Key (16) GENERATOR'S CERTIFICATION: (Includes; Printed or typed name, Hand written Signature, Date.

COMPLETING THE HAZARDOUS WASTE MARKING (CHECKLIST)

Checks made

yes	no	n/a	
			Container marked UN or DOT Spec.(check Bottom head)(Part 178)
			Using a Hazardous Waste Sticker for the Marking requirements
			Hazardous Waste Statement as required by (40CFR, 262.32(b))
			Generator's Name and Address as required by (40CFR, 262.32(b))
			Manifest Document Number as required by (40CFR, 262.32(b))
			EPA Waste Number(s) (See Hazardous Substance below for D.O.T. requirements)
			Generator's EPA ID Number
			Accumulation Start Date
			Proper Shipping Name (172.301(a))
			UN/NA number 172.301(a)
			(Technical name for N.O.S. and Generic (172.301(b))
			Exemption "DOT-E-XXXX" (172.301(c))
			Orientation Marking for Liquid in combination packaging (172.312(a))
			Inhalation Hazard (172.313(a))
			Hazardous Substance; "IF the name does not identify the hazardous substance, then one of the following will be used in parentheses and marked near the Proper Shipping Name: Name, Waste Stream number, EPA Characteristic, or corresponding "D" number Plus add the letters "RQ" in front of the Proper Shipping Name.(172.324(a),(b))
			Marine Pollutants; "Identify the component in parentheses, add the MARINE POLLUTANT marking near the hazard warning Label (172.322(e))
			Salvage Drums; for Damaged, Defective, or Leaking containers must be marked "SALVAGE DRUM" (173.3(c))
			Overpacks; Mark the same as the inside packages, except for the Spec. marking, each package subject to the Orientation marking arrows must be so marked on two opposite sides, and must also be marked with a statement "Inner packages comply with prescribed specifications" (173.25(a)(4)
			Packaging containing Poison Inhalation Hazards; must be marked with the words "Inhalation Hazard" (172.313(a))

COMPLETING THE HAZARDOUS WASTE LABELING (CHECKLIST)

checks made

yes	no	n/a	
			Apply the hazard Label that is called for in Column 6 of the Hazardous Materials Table 172.101.
			Overpacks, Label the same as the inside packages(172.400(a)(5))
			Additional Label(s) Subsidiary Hazard (172.402(a))
			Place the Hazard label near the marked Proper Shipping Name (172.406(a))

COMPLETING THE HAZARDOUS WASTE PLACARDING (CHECKLIST)

PLACARDS Requirements (172.500's)
Checks made

yes	no	n/a	
___	___		Generator's Requirement is to "Provide" (172.506(a))
___	___	___	Generator's Requirement is to "Affix" IF you are Loading & closing the Transport Vehicle, Freight Container, Unit Load Device or Bulk Packaging (172.506(a))
___	___	___	Are the proper Placards applied to the Transport vehicle, Freight Container, Unit load Device, or Bulk Packaging (172.504(a))
___	___	___	Any amount of an "Poison Inhalation Hazard" must be placarded "Poison" or Poison Gas. (172.505(a)) ** Note *** "The 1001 pound Exception applies only to Transportation by Highway and Rail"

Comments:

Checked by: Signature:

Place: Date:
Time:

* IF ANY QUESTION IS ANSWERED WITH A "NO" DO NOT OFFER THE SHIPMENT UNTIL THEY ARE CORRECTED. THIS FORM IS TO BE COMPLETED BY THE SHIPPER.

LIST OF AVERAGE WEIGHT PER GALLON OF LIQUIDS AND LIQUIFIED GASES (AT 60°F UNLESS INDICATED OTHERWISE)

Department of Transportation, Transportation Safety Institute

The following list of commodities, while not totally complete, does show the approximate weight per gallon of many hazardous materials. It may be used in estimating weights with regard to the placarding requirements and also may be used in estimating weight with regard to the weight limitations of various specification packages.

Certain factors such as density, chemical properties and temperature are important in determining true weight by volume, therefore, during any investigation it would be necessary to obtain data sheets on the specific commodity or a statement from the shipper as to its factual weight.

Pounds/Gallon	Commodity
6.93	Acetal
6.65	Acetaldehyde
8.65	Acetic Acid - 28% strength
8.94	70% strength
8.94	84% strength
8.75	Glacial strength
9.04	Acetic Anhydride
6.64	Acetone
7.75	Acetone Cyanahydrin
6.87 to 7.19	Acetone Oils (Ketone Oils)
6.51	Acetonitrile
8.6	Acetophenone
8.11	Acetylacetone
9.18	Acetyl Chloride
10.7	Acetylene Dichloride
13.3	Acetylene Tetrachloride
6.97	Acrolein
7.48 to 7.90	Acrylic Esters
6.64	Acrylonitrile
6.6	Alcohol, Anhydrous
6.8	Alcohol
6.9	Aldehol
9.2	Aldol
7.14	Allyl Alcohol
11.6	Allyl Bromide
7.7	Allyl Chloride
8.56	Allyl Mercaptan
11.1	Average - Alum
8.7	Aluminum Subacetate Solution
7.68	Aminoethyl Ethanolamine
5.14	Ammonia, Anhydrous (liquified)

Pounds/Gallon	Commodity
8.0	Ammonia Solution, Diluted (10%)
7.5	Ammonia Solution, Strong (18%)
7.4	Amyl Acetate
6.78	Amyl Alcohol, Normal
6.76	Amyl Alcohol, Refined
6.30	Amyl Amine
7.38	Amyl Chloride
6.7	Amylene Hydrate
7.1	Amyl Mercaptan
7.1	Amyl Nitrite
7.2	Amyl Oleate
8.1	Amyl Phenol
7.7	p-tert-Amyphenol
8.5	Amyl Phthalate
7.3	Amyl Propionate
8.8	Amyl Salicylate
8.2	Anethole
8.5	Aniline
8.2	Anise Oil
9.1	o-Anisidine
8.3	Anisole
7.44	Aqua Ammonia
7.5	Aromatic Ammonia Spirit
	Asphalt - Averages at Tramsport Temperatures
7.8	RC-0
7.9	RC-1
8.0	RC-2
8.1	RC-3
8.2	RC-4
8.3	RC-5
8.6	40-50 Penetration

Pounds/Gallon	Commodity
8.5	60-150 Penetration
8.3	Emulsified
8.3	Balsam Canada
8.1	Bay Oil
10.5	Benzal Chloride
8.7	Benzaldehyde
7.3	Benzene
11.5	Benzotrichloride
10.2	Benzoyl Chloride
8.8	Benzyl Acetate
8.7	Benzyl Alcohol
9.3	Benzyl Benzoate
8.9	Benzyl Cellosolve
9.2	Benzyl Chloride
8.7	Benzyl Ether
7.3	Bergamot Oil
8.7	Bitter Almond Oil
7.1	Bitter Orange Oil
8.2	Bornyl Acetate
26.0	Bromine
12.5	Bromobenzene
11.6	Bromethylbenzene
24.0	Bromoform
11.9	o-Bromotoluene
11.7	p-Bromotoluene
5.16	Butadiene
4.86	Butane
8.06	Butyl Acetoacetate
7.8	Butyl Acetyl Ricinoleate
6.74	Butyl Alcohol, Normal
6.72	Butyl Alcohol, Secondary
6.56	Butyl Alcohol, Tertiary
6.69	Butyl Aldehyde, Normal
6.22	Butylamine
10.6	n-Butyl Butyrate
8.0	Butyl Carbitol
7.5	Butyl Cellosolve
7.4	n-Butyl Chloride
8.7	Butyl Citrate
8.3	1,3 Butyleneglycol
6.4	n-Butyl Ether
6.3	Butyl Ethyl Ether
8.1	Butyl Lactate
7.48	Butyl Methacrylate
8.3	Butyl Oxalate
8.7	n-Butyl Phthalate
7.2	Butyl Propionate
7.2	Butyl Stearate
6.8	n-Butyraldehydge

Pounds/Gallon	Commodity
8.0	Butyric Acid
8.1	Butyric Anhydride
7.32	Butyric Ether (Ethyl Butyrate)
8.83	Calcium Bisulfite Solution
7.7	n-Caproic Acid
7.6	Caprylic Acid
7.5	Caraway Oil
8.2	Carbitol
8.5	Carbitol Acetate
8.88	Carbolic Acid (Phenol)
8.76	Carbon Dioxide (-50°F, Liquified)
10.5	Carbon Disulfide
13.3	Carbon Tetrachloride
7.8	Cardamon Oil
8.31	Carnauba Wax
8.1	Carvacrol
8.0	Carvone
5.5 to 5.8	Casinghead Gasoline
8.01	Castor Oil
12.7	Caustic Soda 50% Strength
14.7	73% Strength
7.8	Cellosolve
8.1	Cellosolve Acetate
8.0	Chenopodium Oil
12.6	Chloral
13.4	Chlordane
12.17	Chlorine (Liquified)
11.37	Chloroacetic Acid
9.65	Chloroacetone
10.1	o-Chloroaniline
9.2	Chlorobenzene
9.6	b-Chloroethyl Acetate
8.7	Chloroethylbenzene
12.3	Chloroform
10.2	Chloronaphalene Oils
9.6	b-Chlorophenetole
10.3	o-Chlorophenol
13.8	Chloropicrin
7.99	Chloroprene
14.7	Chlorosulfonic Acid
9.0	Chlorotoluene
8.8	Cinnamon Oil
7.1	Citronellal
7.5	Citronella Oil
8.7	Clove Oil
7.7	Coconut Oil
7.7	Cod Liver Oil

Pounds/Gallon	Commodity
6.4	Collodion
7.62	Copra Oil
11.82	Corn Syrup
7.68	Cottonseed Oil
8.96	Creosote
8.55	Cresol
8.62 to 8..76	Cresylic Acid
7.15	Crotaldehyde
7.2	Crotonaldehyde
7.3	Crotonyl Alcohol
	Crude Oil
6.76	Pennsylvania
7.21	Wyoming
7.25	Oklahoma
7.3	Texas
7.6	Cubeb Oil
7.2	Cumene
6.5	Cyclohexane
8.0	Cyclohexanol
8.05	Cyclohexanol Acetate
7.9	Cyclohexanone
6.7	Cyclohexene
8.6	Cyclohexyl Glycolate
6.2	Cyclopentane
7.9	Cyclopentanol
7.9	Cyclopentanone
6.4	Cyclopentene
7.2	m-Cymene
7.3	o-Cymene
7.1	p-Cymene
6.92	Decylaldehyde
7.8	Diacetone Alcohol
6.7	Diallyl Ether
6.42	Diamylamine
6.4	Dibutylamine
8.24	Dibutyl Phthalate
7.79	Dibutyl Sebacate
13.1	Diahloroacetic Acid
10.9	o-Dichlorobenzene
10.47	Dichloroethylene
10.2	sym.-Dichloroethyl Ether
9.3	Dichloroisopropyl Ether
9.02	Dichloropentane
7.05	Diesel Fuel (approximate)
9.08	Diethanolamine
5.8	Diethylamine
7.34	Diethyl Benzene
7.2	2-Diethylaminoethanol
7.8	Dithylaniline

Pounds/Gallon	Commodity
6.8	Diethyl Carbinol
7.6	Diethyl Carbitol
8.13	Diethyl Carbonate
8.61	Diethylene Ether (Dioxane)
9.32	Diethylene Glycol
8.24	Diethylene Glycol Diethyl Ether
8.0	Diethylene Glycol Monolaurate
7.5	Diethylformamide
6.8	Diethyl Ketone
9.4	Diethyl Phthalate
9.8	Diethyl Sulfate
9.7	Diglycol Chlorohydrin
8.1	Diglycol Laurate
7.7	Diglycol Oleate
6.7	Diisobutyl Ketone
8.3	Diisopropanolamine
6.0	Diisopropylamine
10.3	Dimercaprol
8.4	Dimethoxytetraglycol
5.7	Dimethylamine
8.0	Dimethylaniline
5.5	Dimethyl Ether
7.9	Dimethylformamide
7.4	Dimethyl Furan
8.3	Dimethyl Glyoxal
9.9	Dimethyl Phthalate
11.1	Dimethyl Sulfate
6.7	Dioctylamine
8.6	1,4-Dioxane
8.9	Dioxolane
9.7	Diphenylamine
6.1	Dipropylamine
8.6	Dipropylene Glycol
6.8	Dipropyl Ketone
7.73	Divinylbenzene
6.32	Dodecene
7.2	Dwarf Pine Needle Oil
9.9	Epichlorohydrin
8.5	Ethanolamine
6.0	Ether (at 20°F)
7.8	Ethohexadiol
7.5	Ethyl Acetate
8.6	Ethyl Acetoacetate
7.62	Ethyl Acrylate
6.53	Ethyl Alcohol (Ethanol)
5.9	Ethylamine
8.0	m-Ethylaniline

Pounds/Gallon	Commodity
8.8	Ethyl Benzoate
11.9	Ethyl Bromide
6.9	2-Ethylbutyl Alcohol
6.8	Ethyl Butyl Ketone
6.8	2-Ethylbutyl Alcohol
7.3	Ethyl n-Butyrate
7.7	2-Ethylbutyric Acid
7.5	Bethyl Caproate
8.1	Ethyl Carbonate
9.7	Ethyl Chloroacetate
9.5	Ethyl Chlorofomate
8.8	Ethyl Cinnamate
9.5	Ethyl Citrate
5.07	Ethylene (32°F)
10.05	Ethylene Chlorohydrin
8.66	Ethylene Cyanohydrin
7.5	Ethylene Diamine
7.5	Ethylene Diamine, Anhydrous
18.2	Ethylene Dibromide
10.5	Ethylene Dichloride
7.68	Ethylene Formate
9.3	Ethylene Glycol
9.2	Ethylene Glycol Diacetate
9.2	Ethylene Glycol Monoacetate
7.7	Ethyl Formate
7.26	Ethyl Hexyl Acetate
6.94	Ethyl Hexyl Alcohol
16.1	Ethyl Iodide
7.2	Ethyl Isobutyrate
6.2	Ethyl Isopropyl Ether
7.2	Ethyl Isovalerate
8.6	Ethyl Lactate
8.9	Ethyl Maleate
8.8	Ethyl Malonate
7.56	Ethyl Methacrylate
6.0	Ethyl Methyl Ether
6.86	Ethyl Methyl Ketone
7.5	Ethyl Nitrite
6.9	Ethyl Nitrite Spirit
9.0	Ethyl Oxalate
8.7	Ethylphenylethanolamine
8.5	Ethyl Phenyl Ketone
9.4	Ethyla Phthalate
7.4	Ethyl Propionate
7.1	2-Ethyl-3-Propylacrolein
6.1	Ethyl-n-Propyl Ether
6.8	Ethyl Propyl Ketone

Pounds/Gallon	Commodity
9.4	Ethyl Salicylate
7.8	Ethyl Silicate
11.0	Ethylsulfuric Acid
11.5	Ethyl Trichloroacetate
8.2	Ethyl Irethan
7.7	Eucalyptol
7.6	Eucalyptus Oil
8.9	Expressed Almond Oil
8.0	Fennel Oil
11.0	Ferric Chloride Solution
12.9	Ferric Subsulfate Solution
11.4	Ferrous Iodide Syrup
10.73	Fluosilicic Acid
9.13	Formaldehyde
9.0	Formaldehyde Solution
9.5	Formamide
10.12	Formic Acid
10.0	Formic Acid, 90%
8.8	Formic Acid, 25%
6.79	Fuel Oil #1
7.01	#2
7.09	#3
7.14	#4
7.38	#5
8.13	#6
8.00	Residual
7.8	Furan
9.7	Furfural
9.4	Furfuryl Alcohol
6.92	Fusel Oil
6.19 average	Gasoline
7.4	Geranial
7.4	Geraniol
10.51	Glycerine
13.2	Glycerophosphoric Acid
8.2	Glyceryl Laurate
9.2	Glycol Diacetate
10.22	Glycol Diformate
7.5 to 8.0	Greases
7.7	Halibut Liver Oil
7.1	Heptadecanol
6.1	2,4-Heptadiene
5.7	n-Heptane
6.8	Heptyl Ether
5.7	1,5-Hexadiene
5.9	2,4-Hexadiene
10.8	Hexaethyltetraphosphate
6.9	n-Hexaldehyde
5.48	Hexane

Pounds/Gallon	Commodity
6.82	Hexyl Alcohol (Hexanol)
6.39	Hexylamine
7.69	Hexyalene Glycol
6.8	n-Hexyl Methyl Ketone
8.4	Hydrazine
12.5	Hydriodic Acid 47%
11.5	Hydrobromic Acid 40%
	Hydrochloric Acid:
9.4	18° Baumé
9.65	20° Baumé
9.89	23° Baumé
9.8	Hydrochloric Acid (36%)
5.8	Hydrocyanic Acid 97%
9.8	Hydrofluoric Acid 55%
10.6	Hydrofluosilicic Acid 30%
12.2	Hydrogen Peroxide, Anhydrous
	Hydrogen Peroxide:
9.19	28% Strength
9.26	30% Strength
9.44	35% Strength
11.6	90% Strength
12.1	100% Strength
9.2	Hydroxybutyraldehyde
9.4	Hypophosphorous Acid, 30%
9.0	Indalone
8.0	Indan
4.81	Industrial Gas (Liquified Hydrocarbon gas)
7.9	b-Ionone
7.3	Isoamyl Acetate
6.8	Isoamyl Alcohol
8.3	Isoamyl Benzoate
10.2	Isoamyl Bromide
7.1	Isoamyl Butyrate
7.4	Isoamyl Chloride
6.5	Isoamyl Ether
7.1	Isoamyl Isovalerate
7.3	Isoamyl Nitrite
8.6	Isoamyl Phthalate
8.9	Isoamyl Salicylate
4.63	Isobutane
7.7	Isobutenyl Chloride
7.3	Isobutyl Acetate
6.8	Isobutyl Alcohol
6.64	Isobutyl Aldehyde
6.09	Isobutyl Amine
8.3	Isobutyl Benzoate

Pounds/Gallon	Commodity
10.5	Isobutyl Bromide
7.2	Isobutyl n-Butyrate
6.78	Isobutyl Carbinol
7.4	Isobutyl Chloride
6.3	Isobutyl Ether
7.3	Isobutyl Formate
7.2	Isobutyl Nitrite
7.4	Isobutyl Propionate
7.9	Isobutyric Acid
9.1	Isoeugenol
5.74	Isoctane
5.19	Isopentane
7.68	Isophorone
5.7	Isoprene
7.3	Isopropyl Acetate
6.5	Isopropyl Alcohol
5.8	Isopropylamine
7.2	Isopropylbenzene
10.9	Isopropyl Bromide
7.2	Isopropyl Chloride
6.0	Isopropyl Ether
7.8	Isovaleric Acid
6.5	Isovaleronitrile
6.06 to 6.87	Jet Fuel
6.79	Kerosene
	Ketones (See by specific type, viz. Methylethyl Keton)
10.38	Lactic Acid
7.61	Lard Oil
8.0 to 8.3	Latix
7.74	Lauryl Alcohol
7.4	Lavender Oil
10.4	Lead Subacetate Solution
7.5	Lemon Grass Oil
7.1	Lemon Oil
7.0	d-Limonene
7.5	Linoleic Acid
7.72	Linseed Oil
4.25 to 4.86	Liquified Petroleum Gas
8.9	Liquified Phenol
7.4	Liquid Petrolatum
7.1	Liquid Petrolatum, Light
7.75	Menhaden Oil
7.4	1-Menthol
112.9	Mercury
7.13	Mesityl Oxide
8.48 to 9.24	Methacrylate Polymers
7.7	Methyl Acetate

Pounds/Gallon	Commodity
8.9	Methyl Acetoacetate
7.9	Methyl Acrylate
7.1	Methylal
6.6	Methyl Alcohol
7.1	Methyl Amyl Acetate
6.7	Methyl Amyl Alcohol
6.8	Methyl Amyl Carbinol
6.8	Methyl n-Amyl Ketone
8.2	n-Methylaniline
6.9	Methyl Butyl Ketone
8.6	Methyl Carbitol
8.0	Methyl Cellosolve
8.4	Methyl Cellosolve Acetate
6.51	Methyl Cyanide
7.7	Methyl Cyclohexanone
20.8	Methylene Bromide
11.07	Methylene Chloride
27.7	Methylene Iodide
6.7	Methyl Ethyl Ketone
8.1	Methyl Formate
6.8	Methyl Hexyl Ketone
8.8	Methyl-3-Hydroxybutyrate
18.8	Methyl Iodide
6.7	Methyl Isobutyl Ketone
7.4	Methyl Isobutyrate
9.0	Methyl Lactate
9.9	Methyl Phthalate
6.75	Methyl Propyl Carbinol
6.1	Methyl Propyl Ether
6.73	Methyl Propyl Ketone
9.9	Methyl Salicylate
8.42 to 8.64	Milk
6.4 to 6.55	Mineral Spirits
11.75	Molasses
10.1	Monacetin
9.26	Monochlorobenzene
11.1	a-Monochlorohydrin
8.2	Monoisopropanolamine
8.3	Morpholine
13.12	Motor Fuel Antiknock Compound
	Muriatic Acid:
9.49	18° Baumé
9.65	20° Baumé
9.89	23° Baumé
7.6	Mustard Oil
7.5	Myristica Oil
6.2 to 7.99	Naphtha
7.16 to 7.46	Naphtha Solvent

Pounds/Gallon	Commodity
7.63	Neatsfoot Oil
5.54	Neohexane
	Nitric Acid:
11.25	38° Baumé
11.7	42° Baumé
11.7	Nitric Acid (68%)
12.5	Nitric Acid, Fuming
10.0	Nitrobenzene
8.74	Nitroethane
7.9	Nitrogen Fertilizer Solutions
13.3	Nitroglycerin
9.4	Nitromethane
9.6	m-Nitrotoluene
9.7	o-Nitrotoluene
5.9	n-Nonane
6.8	Octanal
5.9	Octane
7.3	Octyl Acetate
6.9	Octyl Alcohol
6.87	Octyaldehyde
6.6	Octyl Amine
6.96 to 7.33	Oil, Fuel, #2 or 3
7.5 to 8.5	Oil Fuel, #4, 5, and 6
7.2 to 7.7	Oil, Lubricating
7.4	Oleic Acid
7.6	Olive Oil
7.2	Orange Flower Oil
7.0	Orange Oil
8.0 to 12.0	Paint
7.03	Palmitic Acid
7.92	Palm-Nut Oil
7.98	Paraffin Wax
8.29	Paraldehyde
7.62	Peanut Oil
7.57	Pelargonic Acid
7.8	Pennyroyal Oil, American
14.0	Pentachloroethane
5.2	Pentane
7.5	Peppermint Oil
14.0	Perchloric Acid, 70%
13.39	Perchloroethylene
7.6	Persic Oil
9.7	Peruvian Balsam
5.5	Petroleum Benzin
5.26 to 5.48	Petroleum Ether
8.0	Phenetole
8.88	Phenol
8.6	Phenylacetaldehyde
8.9	Phenyl Acetate

Pounds/Gallon	Commodity
9.2	Phenyl Cellosolve
9.0	Phenylethanolamine
8.6	Phenyl Ethyl Acetate
8.5	Phenylethyl Alcohol
7.31	Phorone
	Phosphoric Acid:
9.2	20% Strength
10.1	35% Strength
11.1	50% Strength
13.1	75% Strength
14.9	85% Strength
13.92	Phosphorus Oxychloride
13.1	Phosphorus Trichloride
11.7	o-Phthalyl Chloride
8.0	3-Picoline
8.6	Pimenta Oil
7.1	dl-Pinene
7.4	Pine Needle Oil
7.8	Pine Oil
7.2	Piperidine
9.4	Polyethylene Glycol 300
9.4	Polyethylene Glycol 400
9.0	Polysorbate 80
9.2	Polyvinyl Acetate Emulsion
10.06	Polyvinyl Alcohol
7.7	Poppy Oil
12.7	Potassium Hydroxide Solution 50%
10.4 to 11.56	Potassium Silicate Solutions
6.7	Propionaldehyde
8.3	Propionic Acid
8.3	Propionie Anhydride
6.5	Propionitrile
7.4	Propyl Acetate
6.7	n-Propyl Alcohol
6.72	Propyl Alcohol
7.4	Propyl Chloride
9.2	Propylene Chlorohydrin
7.3	Propylenediamine
9.7	Propylene Dichloride
8.6	Propylene Glycol
6.9	Propylene Oxide
6.1	Propyl Ether
8.2	Pyridine
9.1	Quinoline
7.6	Rapeseed Oil
7.4	Red Oil
11.0	Refrigerant Gases

Pounds/Gallon	Commodity
9.5 to 10.5	Resins, Synthetic
7.5	Rosemary Oil
7.1	Rose Oil
9.2	Safrol
9.7	Salicylaldehydge
8.1	Santal Oil
8.9	Sassafras Oil
7.6	Sesame Oil
9.1	Sodium Carbonate Solution 10%
12.8	Sodium Hydroxide Solution 50%
10.0	Sodium Silicate
11.0	Sorbitol
10.4	Sorbitol Solution
7.7	Soya Oil
7.68	Soybean Oil
7.7	Spearmint Oil
≤15.3	Spent Acid
7.3	Sperm Oil
7.04	Stearic Acid
6.98	Stoddard Solvent
7.66	Styrene
8.9	Succinaldehyde
16.8	Sulfur (molten)
14.03	Sulfur Chloride
	Sulfuric Acid:
12.54	53° Baumé
14.19	60° Baumé
15.25	66° Baumé
15.92	20% Oleum
15.3	Sulfuric Acid, 96%
8.5	Sulfuric Acid, 6%
7.68	Sunflower Oil
11.0	Syrup
7.99 to 8.31	Tall Oil
7.44	Tallow
9.0 to 10.37	Tar
7.8	Terebene
7.78	Terpineol
13.6	Tetrachloroethylene
7.0	Tetradecanol
9.4	Tetraethylene Glycol
7.4	Tetrahydrofuran
8.8	Tetrahydrofurfuryl Alcohol
8.1	Tetralin
11.0	Thioglycollic Acid
13.6	Thionyl Chloride
8.9	Thiophene

Pounds/Gallon	Commodity
7.7	Thyme Oil
14.66	Titanium Tetrachloride
7.21	Toluene
8.74	Toluidine
9.7	Triacetin
6.5	Tributylamine
8.7	Tributyl Citrate
8.1	Tributyl Phosphate
12.16	Trichlorobenzene
12.0	1,1,2-Trichloroethane
12.2	Trichloroethylene
11.54	Trichlorosilane
9.36	Triethanolamine
6.07	Triethylamine
9.35	Triethylene Glycol
8.9	Triethylphosphate
8.8	Trimethylene Glycol
10.1	Trimethyl Phosphate
7.6	Triolein
7.8	Tung Oil
7.2	Turpentine Oil
7.2	Turpentine Oil, Rectified
6.2	Undecane
6.9	1-Undecanol
7.6	Undecylenic Acid
11.08	Urea Solutions, Average
7.9	Valeric Acid
6.7	Valeronitrile
7.73	Varnish
7.75	Vinyl Acetate
7.57	Vinyl Chloride
6.42	Vinyl Ether
6.22	Vinyl Methyl Either
7.2	Vinyl Toluene
8.1	Vitamin K
8.3	Water
7.7	Whiskey
8.2	Wine
7.2	m-Xylene (Xylol)
7.5	o-Xylene (Xylol)
8.09 to 8.26	Xylidine
7.8	Ylang-Ylang Oil

TABLES OF EQUIVALENCE

WEIGHT CONVERSION TABLES

a. Conversion Factors

MULTIPLY	BY	TO OBTAIN
Grams	0.03527	Ounces
Grams	0.002205	Pounds
Kilograms	35.2736	Ounces
Kilograms	2.2046	Pounds
Ounces	28.3495	Grams
Pounds	16	Ounces
Pounds	453.59	Grams
Pounds	0.45359	Kilograms
Hundredweight	112	Pounds
Hundredweight	50.802	Kilograms

b. Pounds to kilograms and vice versa.

When the central value in any row of these weight conversion tables is taken to be in pounds, its equivalent value in kilograms is shown on the left; when the central value is in kilograms, its equivalent in pounds is shown on the right.

kg	←lb kg→	lb	kg	←lb kg→	lb	kg	←lb kg→	lb
0.227	0.5	1.1	23	50	110	90.7	200	441
0.454	1	2.2	25	55	121	95.3	210	463
0.907	2	4.41	27	60	132	99.8	220	485
1.36	3	6.61	30	65	143	102	225	496
1.81	4	8.82	32	70	154	104	230	507
2.27	5	11	34	75	165	109	240	529
2.72	6	13.2	36	80	176	113	250	551
3.18	7	15.4	39	85	187	118	260	573
3.63	8	17.6	41	90	198	122	270	595
4.08	9	19.8	43	95	209	125	275	606

kg	←lb kg→	lb	kg	←lb kg→	lb	kg	←lb kg→	lb
4.54	10	22	45	100	220	127	280	617
4.99	11	24.3	48	105	231	132	290	639
5.44	12	26.5	50	110	243	136	300	661
5.9	13	28.7	52	115	254	159	350	772
6.35	14	30.9	54	120	265	181	400	882
6.8	15	33.1	57	125	276	204	450	992
7.26	16	35.3	59	130	287	227	500	1102
7.71	17	37.5	61	135	298	247	545	1202
8.16	18	39.7	64	140	309	249	550	1213
8.62	19	41.9	66	145	320	272	600	1323
9.07	20	44.1	68	150	331	318	700	1543
11.3	25	55.1	73	160	353	363	800	1764
13.6	30	66.1	77	170	375	408	900	1984
15.9	35	77.2	79	175	386	454	1000	2205
18.1	40	88.2	82	180	397			
20.4	45	99.2	86	190	419			

LIQUID MEASURE CONVERSION TABLES

(a) Conversion factors

MULTIPLY	BY	TO OBTAIN
Liters	0.2199	Imperial gallons
Liters	1.759	Imperial pints
Liters	0.2643	U.S. gallons
Liters	2.113	U.S. pints
Gallons	8	Pints
Imperial gallons	4.546	Liters
Imperial gallons pints	1.20095	U.S. gallons pints
Imperial pints	0.568	Liters
U.S. gallons	3.7853	Liters
U.S. gallons pints	0.83268	Imperial gallons pints
U.S. pints	0.473	Liters

(b) Imperial pints to liters and vice versa

When the central value in any row of these liquid measure conversion tables is taken to be in pints, its equivalent value in liters is shown on the left; when the central value is in liters, its equivalent in pints is shown on the right.

l	←pt l→	pt
0.28	0.5	0.88
0.57	1	1.76
0.85	1.5	2.64
1.14	2	3.52
1.42	2.5	4.4
1.7	3	5.28
1.99	3.5	6.16
2.27	4	7.04
2.56	4.5	7.92
2.84	5	0.28

l	←pt l→	pt
3.12	5.5	
3.41	6	
3.69	6.5	
3.98	7	
4.26	7.5	
4.55	8	

(c) Imperial gallons to liters and vice versa.

When the central value in any row of these liquid measure conversion tables is taken to be in gallons, its equivalent value in liters is shown on the left; when the central value is in liters, its equivalent in gallons is shown on the right.

l	←gal l→	gal	l	←gal l→	gal
2.27	0.5	0.11	159.11	35	7.7
4.55	1	0.22	163.65	36	7.92
9.09	2	0.44	168.20	37	8.14
13.64	3	0.66	172.75	38	8.36
18.18	4	0.88	177.29	39	8.58
22.73	5	1.10	181.84	40	8.80
27.28	6	1.32	186.38	41	9.02
31.82	7	1.54	190.93	42	9.24
36.37	8	1.76	195.48	43	9.46
40.91	9	1.98	200.02	44	9.68
45.46	10	2.20	204.57	45	9.90
50.01	11	2.42	209.11	46	10.12
54.55	12	2.64	213.66	47	10.34
59.10	13	2.86	218.21	48	10.56
63.64	14	3.08	222.75	49	10.78
68.19	15	3.30	227.30	50	11.00
72.74	16	3.52	250.03	55	12.09

l	←gal l→	gal	l	←gal l→	gal
77.28	17	3.74	272.76	60	13.20
81.83	18	3.96	295.49	65	14.29
86.37	19	4.18	318.22	70	15.40
90.92	20	4.40	340.95	75	16.49
95.47	21	4.62	363.68	80	17.60
100.01	22	4.84	386.41	85	18.69
104.56	23	5.06	409.14	90	19.80
109.10	24	5.28	431.87	95	20.89
113.65	25	5.50	454.60	100	22.00
118.19	26	5.72		135	29.69
122.74	27	5.94		150	32.98
127.29	28	6.16		200	43.99
131.83	29	6.38		225	49.48
136.38	30	6.60		250	54.97
140.92	31	6.82		300	65.99
145.47	32	7.04		350	76.96
150.02	33	7.26		400	87.99
154.56	34	7.48		450	98.95

TEMPERATURE CONVERSION TABLES

Degrees Fahrenheit to degrees Celsius and vice versa.

When the central value in any row of these temperature conversion tables is taken to be in °F, its equivalent value in °C is shown on the left' when the central value is in °C, its equivalent value in °F is shown on the right.

General Formula: °F = (°C × (9/5)) + 32; °C = (°F - 32) × (5/9)

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
-73.3	-100	-148.0	-31.1	-24	-11.2	-18.9	-2	28.4
-67.8	-90	-130.0	-30.6	-23	-9.4	-18.3	-1	30.2
-62.2	-80	-112.0	-30.0	-22	-7.6	-17.8	0	32.0
-56.7	-70	-94.0	-29.4	-21	-5.8	-17.2	1	33.8
-51.1	-60	-76.0	-28.9	-20	-4.0	-16.7	2	35.6
-45.6	-50	-58.0	-28.3	-19	-2.2	-16.1	3	37.4
-40.0	-40	-40.0	-27.8	-18	-0.4	-15.6	4	39.2
-39.4	-39	-38.2	-27.2	-17	1.4	-15.0	5	41.0
-38.9	-38	-36.4	-26.7	-16	3.2	-14.4	6	42.8
-38.3	-37	-34.6	-26.1	-15	5.0	-13.9	7	44.6
-37.8	-36	-32.8	-25.6	-14	6.8	-13.3	8	46.4
-37.2	-35	-31.0	-25.0	-13	8.6	-12.8	9	48.2
-36.7	-34	-29.2	-24.4	-12	10.4	-12.2	10	50.0
-36.1	-33	-27.4	-23.9	-11	12.2	-11.7	11	51.8
-35.6	-32	-25.6	-23.3	-10	14.0	-11.1	12	53.6
-35.0	-31	-23.8	-22.8	-9	15.8	-10.6	13	55.4
-34.4	-30	-22.0	-22.2	-8	17.6	-10.0	14	57.2
-33.9	-29	-20.2	-21.7	-7	19.4	-9.4	15	59.0
-33.3	-28	-18.4	-21.1	-6	21.2	-8.9	16	60.8
-32.8	-27	-16.6	-20.6	-5	23.0	-8.3	17	62.6
-32.2	-26	-14.8	-20.0	-4	24.8	-7.8	18	64.4
-31.7	-25	-13.0	-19.4	-3	26.6	-7.2	19	66.2

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
-6.7	20	68.0	5.6	42	107.6	17.8	64	147.2
-6.1	21	69.8	6.1	43	109.4	18.3	65	149.0
-5.6	22	71.6	6.7	44	111.2	18.9	66	150.8
-5.0	23	73.4	7.2	45	113.0	19.4	67	152.6
-4.4	24	75.2	7.8	46	114.8	20.0	68	154.4
-3.9	25	77.0	8.3	47	116.6	20.6	69	156.2
-3.3	26	78.8	8.9	48	118.4	21.1	70	158.0
-2.8	27	80.6	9.4	49	120.2	21.7	71	159.8
-2.2	28	82.4	10.0	50	122.0	22.2	72	161.6
-1.7	29	84.2	10.6	51	123.8	22.8	73	163.4
-1.1	30	86.0	11.1	52	125.6	23.3	74	165.2
-0.6	31	87.8	11.7	53	127.4	23.9	75	167.0
0.0	32	89.6	12.2	54	129.2	24.4	76	168.8
0.6	33	91.4	12.8	55	131.0	25.0	77	170.6
1.1	34	93.2	13.3	56	132.8	25.6	78	172.4
1.7	35	95.0	13.9	57	134.6	26.1	79	174.2
2.2	36	96.8	14.4	58	136.4	26.7	80	176.0
2.8	37	98.6	15.0	59	138.2	27.2	81	177.8
3.3	38	100.4	15.6	60	140.0	27.8	82	179.6
3.9	39	102.2	16.1	61	141.8	28.3	83	181.4
4.4	40	104.0	16.7	62	143.6	28.9	84	183.2
5.0	41	105.8	17.2	63	145.4	29.4	85	185.0

°C	←°F °C→	°F	°C	←°F °C→	°F	°C	←°F °C→	°F
30.0	86	186.8	45.6	114	237.2	71.1	160	320.0
30.6	87	188.6	46.1	115	239.0	76.7	170	338.0
31.1	88	190.4	46.7	116	240.8	82.2	180	356.0
31.7	89	192.2	47.2	117	242.6	87.8	190	374.0
32.2	90	194.0	47.8	118	244.4	93.3	200	392.0
32.8	91	195.8	48.3	119	246.2	98.9	210	410.0
33.3	92	197.6	48.9	120	248.0	104.4	220	428.0
33.9	93	199.4	49.4	121	249.8	110.0	230	446.0
34.4	94	201.2	50.0	122	251.6	115.6	240	464.0
35.0	95	203.0	50.6	123	253.4	121.1	250	482.0
35.6	96	204.8	51.1	124	255.2			
36.1	97	206.6	51.7	125	257.0			
36.7	98	208.4	52.2	126	258.8			
37.2	99	210.2	52.8	127	260.6			
37.8	100	212.0	53.3	128	262.4			
38.3	101	213.8	53.9	129	264.2			
38.9	102	215.6	54.4	130	266.0			
39.4	103	217.4	55.0	131	267.8			
40.0	104	219.2	55.6	132	269.6			
40.6	105	221.0	56.1	133	271.4			
41.1	106	222.8	56.7	134	273.2			
41.7	107	224.6	57.2	135	275.0			
42.2	108	226.4	57.8	136	276.8			
42.8	109	228.2	58.3	137	278.6			
43.3	110	230.0	58.9	138	280.4			
43.9	111	231.8	59.4	139	282.2			
44.4	112	233.6	60.0	140	284.0			
45.0	113	235.4	65.6	150	302.0			

DOT REGULATIONS

FOR

TRANSPORTATION OF

HAZARDOUS MATERIALS

49 CFR 171 - 178

[CFR] PART 172 - HAZARDOUS MATERIALS TABLE, SPECIAL PROVISIONS, HAZARDOUS MATERIALS COMMUNICATIONS, EMERGENCY RESPONSE INFORMATION, AND TRAINING REQUIREMENTS

TABLE OF CONTENTS

[TITLE 49] [SUBTITLE B] [PART 172]

Subpart A-General

Subpart B-Table of Hazardous Materials and Special Provisions

Subpart C-Shipping Papers

Subpart D-Marking

Subpart E-Labeling

Subpart F-Placarding

Subpart G-Emergency Response Information

Subpart H-Training

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Source: Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, unless otherwise noted.

49 CFR 171

[CFR] PART 171 - GENERAL INFORMATION, REGULATIONS, AND DEFINITIONS

[TITLE 49] [SUBTITLE B] [PART 171]

Sec.

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

§171.1 Purpose and scope.

(a) This subchapter prescribes requirements of the Department of Transportation governing-

(1) The offering of hazardous materials for transportation and transportation of hazardous materials in interstate, intrastate, and foreign commerce by rail car, aircraft, motor vehicle, and vessel (except as delegated at §1.46(t) of this title), (except that until October 1, 1998, this subchapter applies to intrastate carriers by motor vehicle only in so far as this subchapter relates to hazardous waste, hazardous substances, flammable cryogenic liquids in portable tanks and cargo tanks, and marine pollutants).

(2) The representation that a hazardous material is present in a package, container, rail car, aircraft, motor vehicle, or vessel.

(3) The manufacture, fabrication, marking, maintenance, reconditioning, repairing, or testing of a packaging or container which is represented, marked, certified, or sold for

use in transportation of hazardous materials.
(4) The use of terms and symbols prescribed in this subchapter for the marking, labeling, placarding and description of hazardous materials and packagings used in their transport.
(b) Any person who, under contract with any department, agency, or instrumentality of the executive, legislative, or judicial branch of the Federal Government, transports, or causes to be transported or shipped, a hazardous material or manufactures, fabricates, marks, maintains, reconditions, repairs, or tests a package or container which is represented, marked, certified, or sold by such person as qualified for use in the transportation of a hazardous material shall be subject to and comply with all provisions of the Federal hazardous materials transportation law, all orders and regulations issued thereunder, and all other substantive and procedural requirements of Federal, State, and local governments and Indian tribes (except any such requirements that have been preempted by the Federal hazardous materials transportation law or any other Federal law), in the same manner and to the same extent as any person engaged in such activities that are in or affect commerce is subject to such provisions, orders, regulations, and requirements.
(c) Any person who knowingly violates a requirement of the Federal hazardous material transportation law, an order issued thereunder, subchapter A, an exemption issued under subchapter A, of this subchapter, is liable for a civil penalty of not more than $25,000 ($27,500 for a violation that occurs after January 21, 1997) and not less than $250 for each violation. When the violation is a continuing one and involves the transporting of hazardous materials or the causing of them to be transported or shipped, each day of the violation constitutes a separate offense. Any person who knowingly violates §171.2(g) of this subchapter or willfully violates a provision of the Federal hazardous material transportation law or an order or regulation issued thereunder shall be fined under Title 18, United States Code, or imprisoned for not more than 5 years, or both.

[Amdt. 171-150, 62 FR 1215, Jan. 8, 1997, as amended by Amdt. 171-152, 62 FR 2977, Jan. 21, 1997; Amdt. 171-154, 62 FR 49566, Sept. 22, 1997]

§171.2 General requirements.

(a) No person may offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance with subpart G of part 107 of this chapter, if applicable, and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by applicable requirements of this subchapter, or an exemption, approval or registration issued under this subchapter or subchapter A of this chapter.

(b) No person may transport a hazardous material in commerce unless that person is registered in conformance with subpart G of part 107 of this chapter, if applicable, and the hazardous material is handled and transported in accordance with applicable requirements of this subchapter, or an exemption, approval or registration issued under this subchapter or subchapter A of this chapter.

(c) No person may represent, mark, certify, sell, or offer a packaging or container as meeting the requirements of this subchapter or an exemption, approval or registration issued under this subchapter or subchapter A of this chapter, governing its use in the transportation in commerce of a hazardous material, whether or not it is used or intended to be used for the transportation of a hazardous material, unless the packaging or container is manufactured, fabricated, marked, maintained, reconditioned, repaired and retested, as appropriate, in accordance with applicable requirements of this subchapter, or an exemption, approval or registration issued under this subchapter or subchapter A of this chapter.

(d) The representations, markings, and certifications subject to the prohibitions of paragraph (c) of this section include, but are not limited to-

(1) Specification identifications that include the letters "ICC," "DOT," "CTC," "MC," or "UN";

(2) Exemption, approval, and registration numbers that include the letters "DOT," "EX," "M," or "R"; and

(3) Test dates associated with specification, registration, approval, retest or exemption markings indicating compliance with a test or retest requirement of this subchapter, or an exemption, an approval or a registration issued under this subchapter or subchapter A of this chapter.

(e) When a person performs a function covered by or having an effect on a specification prescribed in part 178, 179 or 180 of this subchapter, an approval issued under this subchapter, or an exemption issued under subpart B of this chapter, that person must perform the function in accordance with that specification, approval, or exemption, as appropriate.

(f) No person shall, by marking or otherwise, represent that-

(1) A container or package for the transportation of hazardous materials is safe, certified, or in compliance with the requirements of this title unless it meets the requirements of all applicable regulations issued under the Federal hazardous material transportation law; or

(2) A hazardous material is present in a package, container, motor vehicle, rail car, aircraft, or vessel, if the hazardous material is not present.

(g) No person shall unlawfully alter, remove, deface, destroy, or otherwise tamper with-

(1) Any marking, label, placard, or description on a document required by the Federal hazardous material transportation law, or the regulations issued thereunder; or

(2) Any package, container, motor vehicle, rail car, aircraft, or vessel used for the transportation of hazardous materials.

(h) No person shall-

(1) Falsify or alter an exemption, approval, registration or other grant of authority issued under this subchapter or subchapter A of this chapter; or

(2) Offer a hazardous material for transportation or transport a hazardous material in commerce, or represent, mark, certify, or sell a packaging or container, under a false or

altered exemption, approval, registration or other grant of authority issued under this subchapter or subchapter A of this chapter.

[Amdt. 171-70, 48 FR 2655, Jan. 20, 1983, as amended by Amdt. No. 171-100, 54 FR 25004, June 12, 1989; Amdt. 171-12, 56 FR 8624, Feb. 28, 1991; Amdt. No. 171-115, 57 FR 30631, July 9, 1992; 57 FR 37902, Aug. 21, 1992; Amdt. No. 171-120, 58 FR 33305, June 16, 1993; Amdt. 171-2, 59 FR 49132, Sept. 26, 1994; Amdt. 171-141, 61 FR 21101, May 9, 1996; 64 FR 10752, Mar. 5, 1999]

§171.3 Hazardous waste.

(a) No person may offer for transportation or transport a hazardous waste (as defined in §171.8 of this subchapter) in interstate or intrastate commerce except in accordance with the requirements of this subchapter.

(b) No person may accept for transportation, transport, or deliver a hazardous waste for which a manifest is required unless that person:

(1) Has marked each motor vehicle used to transport hazardous waste in accordance with §390.21 or §1058.2 of this title even though placards may not be required;

(2) Complies with the requirements for manifests set forth in §172.205 of this subchapter; and

(3) Delivers, as designated on the manifest by the generator, the entire quantity of the waste received from the generator or a transporter to:

(i) The designated facility or, if not possible, to the designated alternate facility;

(ii) The designated subsequent carrier; or

(iii) A designated place outside the United States.

Note: Federal law specifies penalties up to $250,000 fine for an individual and $500,000 for a company and 5 years imprisonment for the willful discharge of hazardous waste at other than designated facilities. 49 U.S.C. 5124.

(c) If a discharge of hazardous waste or other hazardous material occurs during transportation, and an official of a State or local government or a Federal agency, acting within the scope of his official responsibilities, determines that immediate removal of the waste is necessary to prevent further consequence, that official may authorize the removal of the waste without the preparation of a manifest. [NOTE: IN SUCH CASES, EPA DOES NOT REQUIRE CARRIERS TO HAVE EPA IDENTIFICATION NUMBERS.]

Note 1: EPA requires shippers (generators) and carriers (transporters) of hazardous wastes to have identification numbers which must be displayed on hazardous waste manifests. See 40 CFR parts 262 and 263. (Identification number application forms may be obtained from EPA regional offices.)

Note 2: In 40 CFR part 263, the EPA sets forth requirements for the cleanup of releases of hazardous wastes.

[Amdt. 171-53, 45 FR 34586, May 22, 1980, as amended by Amdt. 171-53, 45 FR 74648, Nov. 10, 1980; Amdt. 171-78, 49 FR 10510, Mar. 20, 1984; Amdt. 171-107, 54 FR 40068, Sept. 29, 1989; Amdt. 171-111, 55 FR 52466, Dec. 21, 1990; 56 FR 66157, Dec. 20, 1991; Amdt. 171-2, 59 FR 49132, Sept. 26, 1994; Amdt. 171-141, 61 FR 21102, May 9, 1996]

§171.4 Marine pollutants.

(a) Except as provided in paragraph (c) of this section, no person may offer for transportation or transport a marine pollutant, as defined in §171.8, in intrastate or interstate commerce except in accordance with the requirements of this subchapter.

(b) The requirements of this subchapter for the transportation of marine pollutants are based on the provisions of Annex III of the 1973 International Convention for Prevention of Pollution from Ships, as modified by the Protocol of 1978 (MARPOL 73/78).

(c) *Exceptions. Except when transported aboard vessel, the requirements of this subchapter specific to marine pollutants do not apply to non-bulk packagings transported by motor vehicles, rail cars or aircraft.*

[Amdt. 171-116, 57 FR 52934, Nov. 5, 1993, as amended by Amdt. 107-39, 61 FR 51337, Oct. 1, 1996]

§171.6 Control numbers under the Paperwork Reduction Act.

(a) *Purpose and scope. This section collects and displays the control numbers assigned to the HMR collections of information by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995. This section complies with the requirements of 5 CFR 1320.7(f), 1320.12, 1320.13 and 1320.14 (OMB regulations implementing the Paperwork Reduction Act of 1995) for the display of control numbers assigned by OMB to collections of information of the HMR.*

(b) OMB control numbers. The table in paragraph (b)(2) of this section sets forth the control numbers assigned to collection of information in the HMR by the Office of Management and Budget (OMB) under the Paperwork Reduction Act of 1995.

(1) Column 1 lists the OMB control number assigned to the HMR collections of information. Column 2 contains the Report Title of the approved collection of information. Column 3 lists the part(s) or section(s) in 49 CFR identified or described in the collection of information.

(2) Table.

Current	Title	Title 49 CFR part or section where identified and described

OMB control No.		
2137-0014	Cargo Tank Specification Requirements	§§107.503, 107.504, 178.320, 178.337, 178.338, 178.345, 178.346, 178.347, 178.348, 180.409, 180.417.
2137-0018	Inspection and Testing of Portable Tank and IBC's	§§173.24, 173.32, 173.32 (b) (e), 173.32a, 173.32b, 173.32c, 178.3, 178.245, 178.245-1 (a), 178.245-6, 178.255, 178.255-1, 178.270, 178.271, 178.272, 178.702, 178.703, 178.801, 178.810, 178.813, 180.352.
2137-0022	Testing, Inspection, and Marking Requirements for Cylinders	§§173.34 (c), 173.34 (e) (10), 173.302 (c) (3), (c) (5), 173.302 (e), 173.303 (d), 173.309, 178.2, 178.3, 178.35(f) (g) (h), 178.36 (e), 178.37 (e), 178.38 (e), 178.44 (s), 178.45 (n), 178.46 (m), 178.47 (p), 178.57(q), 178.59 (n), 178.60 (r), 178.61 (p), 178.68(n), 178.337, 178.338, 178.345.
2137-0034	Hazardous Materials Shipping Papers and Emergency Response Information	Part 172, §§173.6, 173.7 (a) (1), 173.8, 173.22 (a) (1), 173.56 (b) (1), (d) (1), (e) (2), 173.150 (f) (3) (i), 174.24, 174.26 (b), 174.114, 175.30, 175.35, 175.703, 176.9, 176.24, 176.27, 176.30, 176.31, 176.36, 176.89, 176.90, 176.95, 177.817.
2137-0039	Hazardous Materials Incident Report	§§171.15, 171.16.
2137-0051	Rulemaking and Exemptions Petitions	Part 106, Subpart B, Part 107, Subpart B, §§106.31, 106.33, 107.3, 107.5, 107.7, 107.103, 107.105, 107.107, 107.109, 107.113, 107.117, 107.121, 107.123, 107.125, 107.201, 107.202, 107.203, 107.205, 107.209, 107.211, 107.215, 107.217, 107.219, 107.221, 107.223.
2137-0510	RAM Transportation Requirements	Part 173, Subpart I, §§173.22 (c), 173.411, 173.415 (a), 173.416 (b), 173.417 (a) (5), (b) (3), (4), 173.457 (b), 173.471 (a), (d), 173.472, 173.473 (a), (d), 173.476 (a), (b), (c).
2137-0542	Cryogenic Liquids Requirements	§§173.318, 177.816, 177.840, 180.405.
2137-0557	Approvals for Hazardous Materials	§§107.401, 107.402, 107.403, 107.404, 107.405, 172.101 (l) (2), 172.102 (c) (1) (60), (c) (3) (B69), 173.2a (c) (4), 173.4 (c), 173.7 (a) (1), 173.21(f)(3)(h)(2)(i), 173.24 (e) (3) (iii), 173.51 (a),(b), 173.56 (a) (2), (b) (1), (2), (4), (c), (f), (g), (i), (j) (3), 173.124 (a) (1) (iii) (b), (a) (2) (iii) (d), 173.128 (d), 173.159 (f), 173.166, 173.171 (a), (c), 173.185 (d) (9), (ii), (iii), i, 173.214, 173.224 (d), 173.225 (b) (4), (c), 173.245 (a) (b), 173.300a, 173.300b, 173.305 (c) (1), 173.315 (i) (12), 173.334 (d), 173.340 (a), (b), (c) (4), 176.340 (c), 178.270-3 (f), 178.270-13 (d), 178.601 (e) (g) (7), (h), (k), 178.603 (b), 178.604 (b) (2), 178.605 (b), 178.606 (b), (c), 178.608 (b) (5), 178.801 (e) (2), (h), (i), 178.813 (c).
2137-0559	Rail Carriers and Tank Car Tank Requirements	§§172.102 (c) (3) (B45), (B46), (B55), (B61), (B69), (B77), (B78), (B81), 173.10 (b) (1), 173.31 (a) (2), (b) (6) (ii), 173.247 (a), 174.9, 174.20 (b), 174.50, 174.61, 174.63 (d), 174.81 Table note b, 174.104 (c), (e), (f), 174.114, 174.204 (a) (1), 179.3, 179.5, 179.7(b)(2), (5)(d), 179.22, 180.505, 180.509, 180.515, 180.517 (a), (b), 180.519 (d).
2137-0572	Testing Requirements for Non-Bulk Packaging	§§178.2 (c), 178.601 (1).
2137-0582	Container Certification Statement	§§176.27 (c), 176.172 (c).
2137-0586	Hazardous Materials Public Sector Training and Planning Grants	Part 110.

2137-0595	Cargo Tank Motor Vehicles in Liquefied Compressed Gas Service	§§173.315 (h) (2), 178.337, 178.337-8, 178.337-9, 180.405, 180.416 (b) (d) (f) (h) (1).

[Amdt. 171-111, 56 FR 66157, Dec. 20, 1991, as amended at 57 FR 1877, Jan. 16, 1992; Amdt. 171-121, 58 FR 51527, Oct. 1, 1993; Amdt. 171-137, 61 FR 33254, June 26, 1996; 62 FR 51558, Oct. 1, 1997; 64 FR 51915, Sept. 27, 1999]

Editorial Note: For a document correcting §171.6, see 64 FR 61220, Nov. 10, 1999.

§171.7 Reference material.

(a) *Matter incorporated by reference-(1) General. There is incorporated, by reference in parts 170-189 of this subchapter, matter referred to that is not specifically set forth. This matter is hereby made a part of the regulations in parts 170-189 of this subchapter. The matter subject to change is incorporated only as it is in effect on the date of issuance of the regulation referring to that matter. The material listed in paragraph (a)(3) has been approved for incorporation by reference by the Director of the Federal Register. Material is incorporated as it exists on the date of the approval and a notice of any change in the material will be published in the FEDERAL REGISTER. MATTERS REFERENCED BY FOOTNOTE ARE INCLUDED AS PART OF THE REGULATIONS OF THIS SUBCHAPTER.*

(2) Accessibility of materials. All incorporated matter is available for inspection at:

(i) The Dockets Branch, room 8419, NASSIF Building, 400 7th Street, SW., Washington, DC 20590; and

(ii) The Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC.

(3) *Table of material incorporated by reference. The following table sets forth material incorporated by reference. The first column lists the name and address of the organization from which the material is available and the name of the material. The second column lists the section(s) of this subchapter, other than §171.7, in which the matter is referenced. The second column is presented for information only and may not be all inclusive.*

Source and name of material	49 CFR reference
Air Transport Association of America, 1301 Pennsylvania Avenue, N.W., Washington, DC 20004-1707	-
ATA Specification No. 300 Packaging of Airline Supplies, Revision 19, July 31, 1996	172.102
The Aluminum Association,	-
420 Lexington Avenue, New York, NY 10017	-
Aluminum Standards and Data, Seventh Edition, June 1982	172.102;

	178..46 and 178.65
American National Standards Institute, Inc.,	-
1430 Broadway, New York, NY 10018	-
ANSI/ASHRAE 15-94, Safety Code for Mechanical Refrigeration	173.306
ANSI B16.5-77, Steel Pipe Flanges, Flanged Fittings	178.345; 178.360
ANSI N14.1 Standard for Packaging of Uranium Hexafluoride for Transport, 1971, 1982, 1987 and 1990 Editions	173.417; 173.420
American Pyrotechnics Association (APA),	-
P.O. Box 213, Chestertown, MD 21620	-
APA Standard 87-1, Standard for Construction and Approval for Transportation of Fireworks, Novelties, and Theatrical Pyrotechnics, January 23, 1998 version	173.56
American Society of Mechanical Engineers,	-
United Engineering Center, 354 47th Street, New York, NY 10017	-
ASME Code, Sections II (Parts A and B), V, VIII (Division 1), and IX of 1992 Edition of American Society of Mechanical Engineers Boiler and Pressure Vessel Code and Addenda through December 31, 1993	173.32; 173.306; 173.315; 173.318; 173.420; 178.245; 178.255; 178.270; 178.271; 178.272; 178.337; 178.338; 178.345; 178.346; 178.347; 178.348; 179.400; 180.407; 180.417
ASME Code, Section V (FR Nondestructive Examination), 1977	180.407
ASME Code, Section IX (FR Welding and Brazing Qualification), 1977 and Addendum (1979)	178.245; 178.270; 178.337; 178.338
American Society for Testing and Materials,	-
100 Barr Harbor Drive, West Conshohocken, PA 19428	-
-	-
Noncurrent ASTM Standards are available from: Engineering Societies Library, 354 E. 47th Street, New York, NY 10017	-
ASTM A 20/A 20M-93a Standard Specification for General Requirements for Steel Plates for Pressure Vessels	178.337-2; 179.102-4; 179.102-17.
ASTM A 47-68 Malleable Iron Castings	179.200
ASTM A 240/A 240M-94b Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels	178.57; 178.358-5; 179.100-7; 179.100-10; 179.102-1; 179.102-4; 179.102-17; 179.200-7; 179.201-5;

	179.220-7; 179.400-5.
ASTM A 242-81 Standard Specification for High-Strength Low-Alloy Structural Steel	179.100
ASTM A 262-93a Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels	179.100-7; 179.200-7; 179.201-4.
ASTM A 300-58 Steel Plates for Pressure Vessels for Service at Low Temperatures	178.337
ASTM A 302/A 302M-93 Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum Nickel	179.100-7; 179.200-7; 179.220-7.
ASTM A 333-67 Seamless and Welded Steel Pipe for Low-Temperature Service	178.45
ASTM A 366/A 366M-91 (1993)e1 Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality	178.601
ASTM A 370-94 Standard Test Methods and Definitions for Mechanical Testing of Steel Products	179.102-1; 179.102-4; 179.102-17.
ASTM A 388-67 Ultrasonic Testing and Inspection of Heavy Steel Forging	178.45
ASTM A 441-81 Standard Specification for High-Strength Low-Alloy Structural Manganese Vanadium Steel	178.338
ASTM A 514-81 Standard Specification for High-Yield Strength Quenched and Tempered Alloy Steel Plate, Suitable for Welding	178.338
ASTM A 516/A 516M-90 Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower- Temperature Service	178.337-2; 179.100-7; 179.100-20; 179.102-1; 179.102-2; 179.102-4; 179.102-17; 179.200-7; 179.220-7.
ASTM A 537/A 537M-91 Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel	179.100-7; 179.102-4; 179.102-17.
ASTM A 568/A 568M-95 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for	178.601
ASTM A 572-82 Standard Specification for High-Strength Low-Alloy Columbian-Vanadium Steels of Structural Quality	178.338; 179.100
ASTM A 588-81 Standard Specification for High-Strength Low-Alloy Structural Steel with 50 Ksi Minimum Yield Point to 4 in. Thick	179.100; 178.338
ASTM A 606-75 Standard Specification for Steel Sheet and Strip Hot-Rolled and Cold-Rolled, High-Strength, Low-Alloy, with Improved Atmospheric Corrosion Resistance, 1975 (Reapproved 1981)	178.338
ASTM A 612-72a High Strength Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service	178.337
ASTM A 633-79a Standard Specification for Normalized High-Strength Low-Alloy Structural Steel, 1979 Edition	178.338
ASTM A 715-81 Standard Specification for Steel Sheet and Strip, Hot-Rolled, High-Strength, Low-Alloy with Improved Formability, 1981	178.338
ASTM B 90-69 Magnesium Alloy Sheet and Plate	178.251
ASTM B 162-93a Standard Specification for Nickel Plate, Sheet, and Strip	179.200-7.
ASTM B 209-93 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate	179.100-7; 179.200-7; 179.220-7.
ASTM B 557-84 Tension Testing Wrought and Cast Aluminum and Magnesium-Alloy Products	178.46; 178.251.
ASTM B 580-79 Standard Specification for Anodie Oxide Coatings on Aluminum, 1979	173.316;

	173.318
ASTM D 56-97a Standard Test Method for Flash Point by Tag Closed Tester	173.120
ASTM D 93-97 Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester	173.120
ASTM D 445-88 Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)	171.8
ASTM D 1200-88 Viscosity by Ford Viscosity Cup	171.8
ASTM D 1838-64 Copper Strip Corrosion by Liquefied Petroleum (LP) Gases	173.315
ASTM D 3278-96 Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus	173.120
ASTM D 3828-97, Standard Test Methods for Flash Point by Small Scale Closed Tester	173.120.
ASTM D 4206-96 Standard Test Method for Sustained Burning of Liquid Mixtures Using the Small Scale Open-Cup Apparatus	173.120.
ASTM D 4359-90 Standard Test Method for Determining Whether a Material is a Liquid or a Solid	171.8
ASTM E 8-89 Tension Testing of Metallic Materials	178.36; 178.37; 178.38; 178.39; 178.44; 178.45; 178.50; 178.51; 178.53; 178.55; 178.56; 178.57; 178.58; 178.59; 178.60; 178.61; 178.68; 178.251
ASTM E 23-60 Notched Bar Impact Testing of Metallic Materials	178.57; 179.400
ASTM E 112-88 Standard Test Methods for Determining Average Grain Size	178.44.
ASTM E 290-92 Standard Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials	178.46.
ASTM E 681-85 Standard Test Method for Concentration Limits of Flammability of Chemicals	173.115
ASTM G 23-69 Standard Recommended Practice for Operating Light-and-Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Nonmetallic Materials	172.407; 172.519
ASTM G 26-70 Standard Recommended Practice for Operating Light-and-Water Exposure Apparatus (Xenon-Arc-Type) for Exposure of Nonmetallic Materials	172.407; 172.519
ASTM G 31-72 (Reapproved 1995) Standard Practice for Laboratory Immersion Corrosion Testing of Metals	173.137
American Water Works Association,	-
1010 Vermont Avenue, NW., Suite 810, Washington, DC 20005	-
AWWA Standard C207-55, Steel Pipe Flanges, 1955	178.360
American Welding Society,	-
550 N. W. Le Jeune Road, Miami, Florida 33126	-
AWS Code B 3.0; Standard Qualification Procedure; 1972 (FRB 3.0-41, rev. May 1973)	178.356
AWS Code D 1.0; Code for Welding in Building Construction (FR D 1.0-66)	178.356
Association of American Railroads,	-
American Railroads Building, 50 F Street, NW., Washington, DC 20001	-
AAR Manual of Standards and Recommended Practices, Section C-Part III, Specifications for Tank Cars, Specification M-1002, September 1992	173.31.

AAR Manual of Standards and Recommended Practices, Section C-Part III, Specifications for Tank Cars, Specification M-1002, September 1996	174.63; 179.6; 179.7; 179.12; 179.15; 179.16; 179.20; 179.22; 179.100; 179.101; 179.102; 179.103; 179.200; 179.201; 179.220; 179.300; 179.400; 180.509; 180.513; 180.515; 180.517.
AAR Manual of Standards and Recommended Practices, Section I, Specially Equipped Freight Car and Intermodal Equipment, 1988	174.55; 174.63.
AAR Specifications for Design, Fabrication and Construction of Freight Cars, Volume 1, 1988	179.16.
Chlorine Institute, Inc.,	-
2001 L Street, NW., Suite 506, Washington, DC 20036	-
Type $1^{1/2}$ JQ 225, Dwg, H51970, Revision D, April 5, 1989; or Type $1^{1/2}$ JQ 225, Dwg. H50155, Revision F, April 4, 1989	173.315
Section 3, Pamphlet 57, Emergency Shut-Off Systems for Bulk Transfer of Chlorine, 3rd Edition, October 1997	177.840
Standard Chlorine Angle Valve Assembly, Dwg. 104-8, July 1993	178.337-9
Excess Flow Valve with Removable Seat, Dwg. 101-7, July 1993	178.337-8
Excess Flow Valve with Removable Basket, Dwg. 106-6, July 1993	178.337-8
Standards for Housing and Manway Covers for Steel Cargo Tanks, Dwg. 137-3, September 1, 1982	178.337-10
Compressed Gas Association, Inc.,	-
1725 Jefferson Davis Highway, Arlington, Virginia 22202	-
CGA Pamphlet C-3, Standards for Welding and Brazing on Thinned Walled Containers, 1975	178.47; 178.50; 178.51; 178.53; 178.54; 178.56; 178.57; 178.58; 178.59; 178.60; 178.61; 178.65; 178.68.
CGA Pamphlet C-5, Cylinder Service Life-Seamless Steel High Pressure Cylinders, 1991	173.302
CGA Pamphlet C-6, Standards for Visual Inspection of Steel Compressed Gas Cylinders, 1993	173.34; 180.519
CGA Pamphlet C-6.1, Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders, 1995	173.34
CGA Pamphlet C-6.2, Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders, 1988	173.34
CGA Pamphlet C-6.3, Guidelines for Visual Inspection and Requalification of Low Pressure Aluminum Compressed Gas Cylinders, 1991	173.34

CGA Pamphlet C-7, A Guide for the Preparation of Precautionary Markings for Compressed Gas Containers, appendix A, issued 1992 (6th Edition).	172.400a
CGA Pamphlet C-8, Standard for Requalification of DOT-3HT Cylinder Design, 1985	173.34
CGA Pamphlet C-11, Recommended Practices for Inspection of Compressed Gas Cylinders at Time of Manufacture, 1993	178.35.
CGA Pamphlet C-12, Qualification Procedure for Acetylene Cylinder Design, 1994	173.34; 173.303; 178.59; 178.60.
CGA Pamphlet C-13, Guidelines for Periodic Visual Inspection and Requalification of Acetylene Cylinders, 1992	173.34; 173.303
CGA Pamphlet C-14, Procedures for Fire Testing of DOT Cylinder Pressure Relief Device Systems, 1979	173.34
CGA Pamphlet G-2.2 Tentative Standard Method for Determining Minimum of 0.2% Water in Anhydrous Ammonia, 1985	173.315
CGA Pamphlet G-4.1, Cleaning Equipment for Oxygen Service, 1985	178.338
CGA Pamphlet S-1.1., Pressure Relief Device Standards-Part 1-Cylinders for Compressed Gases, 1994 (with the exception of paragraph 9.1.1.1)	173.34
CGA Pamphlet S-1.2, Safety Relief Device Standards Part 2-Cargo and Portable Tanks for Compressed Gases, 1980	173.315; 173.318
CGA Technical Bulletin TB-2, Guidelines for Inspection and Repair of MC-330 and MC-331 Cargo Tanks, 1980	180.413
Department of Defense (*DOD*),	-
2461 Eisenhower Avenue, Alexandria, VA 22331	-
DOD TB 700-2; NAVSEAINST 8020.8B; AFTO 11A-1-47; DLAR 8220.1: Explosives Hazard Classification Procedures, January 1998	173.56
Department of Energy (*USDOE*),	-
100 Independence Avenue SW., Washington, DC 20545	-
USDOE publications available from: Superintendent of Documents, Government Printing Office (GPO) or The National Technical Information Service (NTIS)	-
USDOE, CAPE-1662, Revision 1, and Supplement 1, Civilian Application Program Engineering Drawings	178.356; 178.358
USDOE, Material and Equipment Specification No. SP-9, Rev. 1, and Supplement-Fire Resistant Phenolic Foam	178.356; 178.358
USDOE, ORO 651-Uranium Hexafloride; A Manual of Good Practices, Revision 6, 1991 edition	173.417
USDOE, KSS-471, November 30, 1986-Proposal for Modifications to U.S. Department of Transportation Specification 21PF-1, Fire and Shock Resistant Phenolic Foam-Insulated Metal Overpack	178.358
Fertilizer Institute,	-
501 Second Street, NE., Washington, DC 20002	-
Definition and Test Procedures for Ammonium Nitrate Fertilizer, August 1984	174.510
General Services Administration,	-
Specification Office, Rm. 6662, 7th and D Street, SW., Washington, DC 20407	-
Federal Specification RR-C-901C, Cylinders, Compressed Gas: High Pressure Steel DOT 3AA, and Aluminum Applications, January 15, 1981 (Superseding RR-C-901B, August 1, 1967)	173.302; 173.304; 173.336
Health and Human Services,	-
Centers for Disease Control and Prevention, 1600 Clifton Road N.E., Atlanta, GA 30333	-
Also available from: Superintendent of Documents, Government Printing Office (GPO), HHS Publication No. (CDC) 93-8385, Biosafety in Microbiological and Biomedical Laboratories, 3rd Edition, May 1993, Section II	173.134
Institute of Makers of Explosives,	-
1120 19th Street, Suite 310, Washington, DC 20036-3605	-
IME Safety Library Publication No. 22 (IME Standard 22), Recommendation for the Safe Transportation of Detonators in a Vehicle with Certain Other Explosive Materials, May	173.63, 177.835

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International Atomic Energy Agency (IAEA),	-
Wagramerstrasse 5, P.O. Box 100, A-1400, Vienna, Austria	-
-	-
Also available from: Unipub Incorporated, P.O. Box 433, New York, NY 10016	-
IAEA, Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6, 1985 Edition (As Amended 1990); Including 1985 Edition (Supplemented 1986 and 1988)	171.12
International Civil Aviation Organization (ICAO),	-
P.O. Box 400, Place de l'Aviation Internationale, 1000 Sherbrooke Street West, Montreal, Quebec, Canada H3A 2R2	-
-	-
ICAO Technical Instructions available from: INTEREG, International Regulations, Publishing and Distribution Organization, P.O. Box 60105, Chicago, IL 60660	-
Technical Instructions for the Safe Transport of Dangerous Goods by Air, DOC 9284-AN/905, 1999-2000 Edition	171.11; 172.401
International Maritime Organization (IMO),	-
4 Albert Embankment, London, SE17SR, United Kingdom	-
-	-
or New York Nautical Instrument & Service Corporation, 140 W. Broadway, New York, NY 10013	-
International Maritime Dangerous Goods (IMDG) Code, 1994 Consolidated Edition, as amended by Amendment 29 (1998) (English edition)	171.12; 172;401; 172.407; 173.21, 176.2; 176.5; 176.11; 176.27; 176.30
International Organization for Standardization,	-
Case Postale 56, CH-1211, Geneve 20, Switzerland	-
Also available from: ANSI, 1430 Broadway, New York, NY 10018	-
ISO-82-1974(E) Steels Tensile Testing	178.270-3
ISO-2431-1984(E) Standard Cup Method	173.121
ISO 535-1991(E) Paper and board-Determination of water absorptiveness-Cobb method	178.516
ISO 3036-1975(E) Board-Determination of puncture resistance	178.708
ISO 3574-1986(E) Cold-reduced carbon steel sheet of commercial and drawing qualities	178.503
ISO 2592-1973(E) Petroleum products-Determination of flash and fire points-Cleveland open cup method	173.120
ISO 8115 Cotton bales-Dimensions and density, 1986 Edition	172.102
ISO 9328-1-1991(E) Steel plates and strips for pressure purposes-Technical delivery conditions-Part 1: General requirements	173.137
ISO/TR 4826-1979(E) - Sealed radioactive sources-Leak test methods	173.469
ISO 2919-1980(E) - Sealed radioactive sources-Classification	173.469
ISO 1496-3-1995(E) - Series 1 Freight Containers-Specification and Testing-Part 3: Tank Containers for Liquids, Gases and Pressurized Dry Bulk	173.411
Health and Human Services	-
Centers for Disease Control and Prevention, 1600 Clifton Road N.E., Atlanta GA 30333	-
Also available from: Superintendent of Documents, Government Printing Office (GPO), HHS Publication No. (CDC) 93-8395, Biosafety in Microbiological and Biomedical Laboratories, 3rd Edition, May 1993, Section II	173.134
National Board of Boiler and Pressure Vessel Inspectors,	-
1055 Crupper Avenue, Columbus, Ohio 43229	-
National Board Inspection Code, A Manual for Boiler and Pressure Vessel Inspectors, NB-23, 1992 Edition	180.413
National Fire Protection Association,	-
Batterymarch Park, Quincy, MA 02269	-
NFPA Pamphlet No. 58-Standard for the Storage and Handling of Liquefied Petroleum	173.315

Gases, 1979	
National Institute of Standards and Technology,	-
Department of Commerce, 5285 Port Royal Road, Springfield, VA 22151	-
USDC, NBS Handbook H-28 (1957), 1957 Handbook of Screw-Thread Standards for Federal Services, Part II, December 1966 Edition	178.45, 178.46
National Motor Freight Traffic Association, Inc.,	-
Agent 1616 P Street, NW., Washington, DC 20036	-
National Motor Freight Classification NMF 100-I, 1982	177.841
Organization for Economic Cooperation and Development (OECD)	-
OECD Publications and Information Center, 2001 L Street, Suite 700, Washington, DC 20036	-
OECD Guideline for Testing of Chemicals, No.404 "Acute Dermal Irritation/Corrosion", 1992	173.137
Transport Canada,	-
TDG Canadian Government Publishing Center, Supply and Services, Canada, Ottawa, Ontario, Canada K1A 059	-
Transportation of Dangerous Goods Regulations, 1 July 1985, SOR/85/77, incorporating the following Registration Numbers: SOR/85-314, SOR/85-585, SOR/85-609, SOR/86-526, SOR/88-635, SOR/87-335, SOR/87-186, SOR/89-39, SOR/89-294, SOR/90-847, SOR/91-711, SOR/91-712, SOR/92-447, SOR/92-600, SOR/93-203, SOR/93-274, SOR/93-525, SOR/94-146 and SOR/94-264 (English edition), SOR/95-241, and SOR95-547	171.12a; 172.401; 172.502; 174.11
Truck Trailer Manufacturers Association,	-
1020 Princess Street, Alexandria, Virginia 22314	-
TTMA RP No. 81, Performance of Spring Loaded Pressure Relief Valves on MC 306, MC 307, and MC 312 Tanks, May 24, 1989 Edition	178.345-10
TTMA RP No. 61-94, Performance of Manhole and/or Fill Opening Assemblies on MC 306 and DOT 406 Cargo Tanks, December 28, 1994 Edition.	180.405
TTMA TB No. 107, Procedure for Testing Inservice, Unmarked, and/or Uncertified MC 306 Type Cargo Tank Manhole Covers, May 24, 1989 Edition	180.405
United Nations,	-
United Nations Sales Section, New York, NY 10017	-
UN Recommendations on the Transport of Dangerous Goods, Tenth Revised Edition (1997)	172.401; 172.407;
UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Second Revised Edition, 1995	172.102, 173.21, 173.56 173.57, 173.124 173.128, 173.166 173.185.

(b) *List of informational materials not requiring incorporation by reference. The materials listed in this paragraph do not require approval for incorporation by reference and are included for informational purposes. These materials may be used as noted in those sections in which the material is referenced.*

Source and name of material	49 CFR reference
Association of American Railroads,	-
American Railroads Building, 50 F Street, NW., Washington, DC 20001	-

AAR Catalog Nos. SE60CHT; SE60CC; SE60CHTE; SE60CE; SE60DC; SE60DE	179.14
AAR Catalog Nos. SE67CC; SE67CE; SE67BHT; SE67BC; SE67BHTE; SE67BE	179.14
AAR Catalog Nos. SE68BHT; SE68BC; SE68BHTE; SE68BE	179.14
AAR Catalog Nos. SE69AHTE; SE69AE	179.14
AAR Catalog Nos. SF70CHT; SF70CC; SF70CHTE; SF70CE	179.14
AAR Catalog Nos. SF73AC; SF73AE; SF73AHT; SF73AHTE	179.14
AAR Catalog Nos. SF79CHT; SF79CC; SF79CHTE; SF79CE	179.14
Bureau of Explosives,	-
Hazardous Materials Systems (BOE), Association of American Railroads, American Railroads Building, 50 F Street, NW., Washington, DC 20001	-
Fetterley's Formula (The Determination of the Relief Dimensions for Safety Valves on Containers in which Liquefied gas is charged and when the exterior surface of the container is exposed to a temperature of 1,200 °F.)	173.315
Pamphlet 6, Illustrating Methods for Loading and Bracing Carload and Less-Than-Carload Shipments of Explosives and Other Dangerous Articles, 1962	174.55; 174.101; 174.112; 174.115; 174.290
Pamphlet 6A (includes appendix No. 1, October 1944 and appendix 2, December 1945), Illustrating Methods for Loading and Bracing Carload and Less-Than-Carload Shipments of Loaded Projectiles, Loaded Bombs, etc., 1943	174.101; 174.290
Pamphlet 6C, Illustrating Methods for Loading and Bracing Trailers and Less-Than-Trailer Shipments of Explosives and Other Dangerous Articles Via Trailer-on-Flatcar (TOFC) or Container-on-Flatcar (COFC), 1985	174.55; 174.63; 174.101; 174.112; 174.115
Emergency Handling of Hazardous Materials in Surface Transportation, 1989	171.7
Department of Transportation (*USDOT*),	-
400 Seventh St., SW., Washington, DC 20590	-
-	-
National Association of Corrosion Engineers,	-
1440 South Creek, Houston, Texas 77084	-
NACE Standard TM-01-69, Test Method Laboratory Corrosion Testing of Metals for the Process Industries, 1969	173.136
Society of Plastics Industries, Inc.,	-
Organic Peroxide Producers Safety Division, 1275 K Street, NW., Suite 400, Washington, DC 20005	-
Self Accelerating Decomposition Temperature Test, 1972	173.21

[Amdt. 171-111, 55 FR 52466, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.7, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45396, Aug. 19, 1999, §171.7 paragraph (a)(3) was amended by adding an entry for "Air Transport Association of America", effective Mar. 1, 2000.

§171.8 Definitions and abbreviations.

In this subchapter,

Aerosol means any non-refillable metal receptacle containing a gas compressed, liquefied or dissolved under pressure, the sole purpose of which is to expel a nonpoisonous (other than a Division 6.1 Packing Group III material) liquid, paste, or powder and fitted with a self-closing release device allowing the contents to be ejected by the gas.

Agricultural product means a hazardous material, other than a hazardous waste, whose end use directly supports the production of an agricultural commodity including, but not limited to a fertilizer, pesticide, soil amendment or fuel. An agricultural product is limited to a material in Class 3, 8 or 9, Division 2.1, 2.2, 5.1, or 6.1, or an ORM-D material.

Approval means a written authorization, including a competent authority approval, from the Associate Administrator to perform a function for which prior authorization by the Associate Administrator is required under subchapter C of this chapter.

Approved means approval issued or recognized by the Department unless otherwise specifically indicated in this subchapter.

Asphyxiant gas means a gas which dilutes or replaces oxygen normally in the atmosphere.

Atmospheric gases means air, nitrogen, oxygen, argon, krypton, neon and xenon.

Authorized Inspection Agency means: (1) A jurisdiction which has adopted and administers one or more sections of the ASME Boiler and Pressure Vessel Code as a legal requirement and has a representative serving as a member of the ASME Conference Committee; or (2) an insurance company which has been licensed or registered by the appropriate authority of a State of the United States or a Province of Canada to underwrite boiler and pressure vessel insurance in such State or Province.

Authorized Inspector means an Inspector who is currently commissioned by the National Board of Boiler and Pressure Vessel Inspectors and employed as an Inspector by an Authorized Inspection Agency.

Bag means a flexible packaging made of paper, plastic film, textiles, woven material or other similar materials.

Bar means 1 BAR = 100 kPa (14.5 psi).

Barge means a non-selfpropelled vessel.

Bottle means an inner packaging having a neck of relatively smaller cross section than the body and an opening capable of holding a closure for retention of the contents.

Bottom shell means that portion of a tank car tank surface, excluding the head ends of the tank car tank, that lies within two feet, measured circumferentially, of the bottom longitudinal center line of the tank car tank.

Box means a packaging with complete rectangular or polygonal faces, made of metal, wood, plywood, reconstituted wood, fiberboard, plastic, or other suitable material. Holes appropriate to the size and use of the packaging, for purposes such as ease of handling or opening, or to meet classification requirements, are permitted as long as they do not compromise the integrity of the packaging during transportation, and are not otherwise prohibited in this subchapter.

Break-bulk means packages of hazardous materials that are handled individually, palletized, or unitized for purposes of transportation as opposed to bulk and containerized freight.
Btu means British thermal unit.
Bulk packaging means a packaging, other than a vessel or a barge, including a transport vehicle or freight container, in which hazardous materials are loaded with no intermediate form of containment and which has:
(1) A maximum capacity greater than 450 L (119 gallons) as a receptacle for a liquid;
(2) A maximum net mass greater than 400 kg (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid; or
(3) A water capacity greater than 454 kg (1000 pounds) as a receptacle for a gas as defined in §173.115 of this subchapter.
Bureau of Explosives means the Bureau of Explosives (B of E) of the Association of American Railroads.
C means Celsius or Centigrade.
Captain of the Port (COTP) means the officer of the Coast Guard, under the command of a District Commander, so designated by the Commandant for the purpose of giving immediate direction to Coast Guard law enforcement activities within an assigned area. As used in this subchapter, the term Captain of the Port includes an authorized representative of the Captain of the Port.
Carfloat means a vessel that operates on a short run on an irregular basis and serves one or more points in a port area as an extension of a rail line or highway over water, and does not operate in ocean, coastwise, or ferry service.
Cargo aircraft only means an aircraft that is used to transport cargo and is not engaged in carrying passengers. For purposes of this subchapter, the terms cargo aircraft only, cargo-only aircraft and cargo aircraft have the same meaning.
Cargo tank means a bulk packaging which:
(1) Is a tank intended primarily for the carriage of liquids or gases and includes appurtenances, reinforcements, fittings, and closures (for tank, see 49 CFR 178.345-1(c), 178.337-1, or 178.338-1, as applicable);
(2) Is permanently attached to or forms a part of a motor vehicle, or is not permanently attached to a motor vehicle but which, by reason of its size, construction or attachment to a motor vehicle is loaded or unloaded without being removed from the motor vehicle; and
(3) Is not fabricated under a specification for cylinders, portable tanks, tank cars, or multi-unit tank car tanks.
Cargo tank motor vehicle means a motor vehicle with one or more cargo tanks permanently attached to or forming an integral part of the motor vehicle.
Cargo vessel means: (1) Any vessel other than a passenger vessel; and
(2) Any ferry being operated under authority of a change of character certificate issued by a Coast Guard Officer-in-Charge, Marine Inspection.
Carrier means a person engaged in the transportation of passengers or property by:
(1) Land or water, as a common, contract, or private carrier, or
(2) Civil aircraft.

CC means closed-cup.
Character of vessel means the type of service in which the vessel is engaged at the time of carriage of a hazardous material.
Class means hazard class. See hazard class.
Class 1. See §173.50 of this subchapter.
Class 2. See §173.115 of this subchapter.
Class 3. See §173.120 of this subchapter.
Class 4. See §173.124 of this subchapter.
Class 5. See §173.128 of this subchapter.
Class 6. See §173.132 of this subchapter.
Class 7. See §173.403 of this subchapter.
Class 8. See §173.136 of this subchapter.
Class 9. See §173.140 of this subchapter.
Closure means a device which closes an opening in a receptacle.
COFC means container-on-flat-car.
Combination packaging means a combination of packaging, for transport purposes, consisting of one or more inner packagings secured in a non-bulk outer packaging. It does not include a composite packaging.
Combustible liquid. See §173.120 of this subchapter.
Compatibility group letter means a designated alphabetical letter used to categorize different types of explosive substances and articles for purposes of stowage and segregation. See §173.52 of this subchapter.
Competent Authority means a national agency responsible under its national law for the control or regulation of a particular aspect of the transportation of hazardous materials (dangerous goods). The term Appropriate Authority, as used in the ICAO Technical Instructions, has the same meaning as Competent Authority. For purposes of this subchapter, the Associate Administrator for Hazardous Materials Safety is the Competent Authority for the United States.
Composite packaging means a packaging consisting of an outer packaging and an inner receptacle, so constructed that the inner receptacle and the outer packaging form an integral packaging. Once assembled it remains thereafter an integrated single unit; it is filled, stored, shipped and emptied as such.
Compressed gas. See §173.115 of this subchapter.
Consumer commodity means a material that is packaged and distributed in a form intended or suitable for sale through retail sales agencies or instrumentalities for consumption by individuals for purposes of personal care or household use. This term also includes drugs and medicines.
Containership means a cargo vessel designed and constructed to transport, within specifically designed cells, portable tanks and freight containers which are lifted on and off with their contents intact.
Corrosive material. See §173.136 of this subchapter.
Crate means an outer packaging with incomplete surfaces.
Crewmember means a person assigned to perform duty in an aircraft during flight time.
Cryogenic liquid. See §173.115(g) of this subchapter.

Cylinder means a pressure vessel designed for pressures higher than 40 psia and having a circular cross section. It does not include a portable tank, multi-unit tank car tank, cargo tank, or tank car.
Dangerous when wet material. See §173.124 of this subchapter.
Design Certifying Engineer means a person registered with the Department in accordance with subpart F of part 107 of this chapter who has the knowledge and ability to perform stress analysis of pressure vessels and to otherwise determine whether a cargo tank design and construction meets the applicable DOT specification. In addition, Design Certifying Engineer means a person who meets, at a minimum, any one of the following:
(1) Has an engineering degree and one year of work experience in cargo tank structural or mechanical design.
(2) Is currently registered as a professional engineer by the appropriate authority of a State of the United States or a Province of Canada.
(3) Has at least three years experience in performing the duties of a Design Certifying Engineer by September 1, 1991, and was registered with the Department by December 31, 1995.
Designated facility means a hazardous waste treatment, storage, or disposal facility that has been designated on the manifest by the generator.
District Commander means the District Commander of the Coast Guard, or his authorized representative, who has jurisdiction in the particular geographical area.
Division means a subdivision of a hazard class.
DOD means the U.S. Department of Defense.
Domestic transportation means transportation between places within the United States other than through a foreign country.
Drum means a flat-ended or convex-ended cylindrical packaging made of metal, fiberboard, plastic, plywood, or other suitable materials. This definition also includes packagings of other shapes made of metal or plastic (e.g., round taper-necked packagings or pail-shaped packagings) but does not include cylinders, jerricans, wooden barrels or bulk packagings.
Elevated temperature material means a material which, when offered for transportation or transported in a bulk packaging:
(1) Is in a liquid phase and at a temperature at or above 100 ^{o}C (212 ^{o}F);
(2) Is in a liquid phase with a flash point at or above 37.8 ^{o}C (100 ^{o}F) that is intentionally heated and offered for transportation or transported at or above its flash point; or
(3) Is in a solid phase and at a temperature at or above 240 ^{o}C (464 ^{o}F).
Engine means a locomotive propelled by any form of energy and used by a railroad.
EPA means U.S. Environmental Protection Agency.
Etiologic agent. See §173.134 of this subchapter.
EX number means a number, preceded by the prefix Ex-, which is assigned by the Associate Administrator for Hazardous Materials Safety to identify an explosive which has been approved. See §173.56 of this subchapter.
Exemption means a document issued under the authority of 49 U.S.C. 5117 by the Associate Administrator that authorizes a person to perform a function that is not

otherwise authorized under this subchapter, subchapter C, or other regulations issued under 49 U.S.C. 5101-5127 (e.g., Federal Highway Administration routing).
Explosive. See §173.50 of this subchapter.
F means degree Fahrenheit.
Farmer means a person engaged in the production or raising of crops, poultry, or livestock.
Federal hazardous material transportation law means 49 U.S.C. 5101 et seq.
Ferry vessel means a vessel which is limited in its use to the carriage of deck passengers or vehicles or both, operates on a short run on a frequent schedule between two points over the most direct water route, other than in ocean or coastwise service, and is offered as a public service of a type normally attributed to a bridge or tunnel.
Filling density has the following meanings:
(1) For compressed gases in cylinders, see §173.304(a)(2) table note 1.
(2) For compressed gases in tank cars, see §173.314(c) table note 1.
(3) For compressed gases in cargo tanks and portable tanks, see §173.315(a) table note 1.
(4) For cryogenic liquids in cylinders, except hydrogen, see §173.316(c)(1).
(5) For hydrogen, cryogenic liquid in cylinders, see §173.316(c)(3) table note 1.
(6) For cryogenic liquids in cargo tanks, see §173.318(f)(1).
(7) For cryogenic liquids in tank cars, see §173.319(d)(1).
Flammable gas. See §173.115 of this subchapter.
Flammable liquid. See §173.120 of this subchapter.
Flammable solid. See §173.124 of this subchapter.
Flash point. See §173.120 of this subchapter.
Freight container means a reusable container having a volume of 64 cubic feet or more, designed and constructed to permit being lifted with its contents intact and intended primarily for containment of packages (in unit form) during transportation.
Fuel tank means a tank other than a cargo tank, used to transport flammable or combustible liquid, or compressed gas for the purpose of supplying fuel for propulsion of the transport vehicle to which it is attached, or for the operation of other equipment on the transport vehicle.
Fumigated lading. See §§172.302(g) and 173.9.
Gas means a material which has a vapor pressure greater than 300 kPa (43.5 psi) at 50 ^{o}C (122 ^{o}F) or is completely gaseous at 20 ^{o}C (68 ^{o}F) at a standard pressure of 101.3 kPa (14.7 psi).
General public means, for purposes of subpart I of part 172, and subpart I of part 173 of this subchapter, any person other than an occupationally exposed hazmat employee.
Gross weight or Gross mass means the weight of a packaging plus the weight of its contents.
Hazard class means the category of hazard assigned to a hazardous material under the definitional criteria of part 173 of this subchapter and the provisions of the §172.101 table. A material may meet the defining criteria for more than one hazard class but is assigned to only one hazard class.

Hazard zone means one of four levels of hazard (Hazard Zones A through D) assigned to gases, as specified in §173.116(a) of this subchapter, and one of two levels of hazards (Hazard Zones A and B) assigned to liquids that are poisonous by inhalation, as specified in §173.133(a) of this subchapter. A hazard zone is based on the LC50 value for acute inhalation toxicity of gases and vapors, as specified in §173.133(a).
Hazardous material means a substance or material, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. The term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials as defined in this section, materials designated as hazardous under the provisions of §172.101 of this subchapter, and materials that meet the defining criteria for hazard classes and divisions in part 173 of this subchapter.
Hazardous substance for the purposes of this subchapter, means a material, including its mixtures and solutions, that-
(1) Is listed in the appendix A to §172.101 of this subchapter;
(2) Is in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) listed in the appendix A to §172.101 of this subchapter; and
(3) When in a mixture or solution-
(i) For radionuclides, conforms to paragraph 7 of the appendix A to §172.101.
(ii) For other than radionuclides, is in a concentration by weight which equals or exceeds the concentration corresponding to the RQ of the material, as shown in the following table:

RQ pounds (kilograms)	Concentration by weight	
-	Percent	PPM
5000 (2270)	10	100,000
1000 (454)	2	20,000
100 (45.4)	0.2	2,000
10 (4.54)	0.02	200
1 (0.454)	0.002	20

The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance in appendix A to §172.101 of this subchapter, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

Hazardous waste, for the purposes of this chapter, means any material that is subject to the Hazardous Waste Manifest Requirements of the U.S. Environmental Protection Agency specified in 40 CFR part 262.

Hazmat employee means a person who is employed by a hazmat employer and who in the course of employment directly affects hazardous materials transportation safety. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term includes an individual, including a self-employed individual, employed by a hazmat employer who, during the course of employment:

(1) Loads, unloads, or handles hazardous materials;

(2) Manufactures, tests, reconditions, repairs, modifies, marks, or otherwise represents containers, drums, or packagings as qualified for use in the transportation of hazardous materials;

(3) Prepares hazardous materials for transportation;

(4) Is responsible for safety of transporting hazardous materials; or

(5) Operates a vehicle used to transport hazardous materials.

Hazmat employer means a person who uses one or more of its employees in connection with: transporting hazardous materials in commerce; causing hazardous materials to be transported or shipped in commerce; or representing, marking, certifying, selling, offering, manufacturing, reconditioning, testing, repairing, or modifying containers, drums, or packagings as qualified for use in the transportation of hazardous materials. This term includes an owner-operator of a motor vehicle which transports hazardous materials in commerce. This term also includes any department, agency, or instrumentality of the United States, a State, a political subdivision of a State, or an Indian tribe engaged in an activity described in the first sentence of this definition.

Hermetically sealed means closed by fusion, gasketing, crimping, or equivalent means so that no gas or vapor can enter or escape.

IAEA means International Atomic Energy Agency.

IATA means International Air Transport Association.

ICAO means International Civil Aviation Organization.

IMO means International Maritime Organization.

Infectious substance (etiologic agent). See §173.134 of this subchapter.

Inner packaging means a packaging for which an outer packaging is required for transport. It does not include the inner receptacle of a composite packaging.

Inner receptacle means a receptacle which requires an outer packaging in order to perform its containment function. The inner receptacle may be an inner packaging of a combination packaging or the inner receptacle of a composite packaging.

Intermediate bulk container (IBC) means a rigid or flexible portable packaging, other than a cylinder or portable tank, which is designed for mechanical handling. Standards for intermediate bulk containers manufactured in the United States are set forth in subparts N and O of part 178 of this subchapter.

Intermediate packaging means a packaging which encloses an inner packaging or article and is itself enclosed in an outer packaging.

Intermodal container means a freight container designed and constructed to permit it to be used interchangeably in two or more modes of transport.

Intermodal portable tank or IM portable tank means a specific class of portable tanks designed primarily for international intermodal use.

International transportation means transportation-

(1) Between any place in the United States and any place in a foreign country;

(2) Between places in the United States through a foreign country; or

(3) Between places in one or more foreign countries through the United States.

Irritating material. See §173.132(a)(2) of this subchapter.

Jerrican means a metal or plastic packaging of rectangular or polygonal cross-section.

Limited quantity, when specified as such in a section applicable to a particular material, means the maximum amount of a hazardous material for which there is a specific labeling or packaging exception.

Liquid means a material, other than an elevated temperature material, with a melting point or initial melting point of 20 ^{o}C (68 ^{o}F) or lower at a standard pressure of 101.3 kPa (14.7 psi). A viscous material for which a specific melting point cannot be determined must be subjected to the procedures specified in ASTM D 4359 "Standard Test Method for Determining Whether a Material is Liquid or Solid".

Liquid phase means a material that meets the definition of liquid when evaluated at the higher of the temperature at which it is offered for transportation or at which it is transported, not at the 37.8 ^{o}C (100 ^{o}F) temperature specified in ASTM D 4359-84.

Magazine vessel means a vessel used for the receiving, storing, or dispensing of explosives.

Magnetic material. See §173.21(d) of this subchapter.

Marine pollutant, means a material which is listed in appendix B to §172.101 of this subchapter (also see §171.4) and, when in a solution or mixture of one or more marine pollutants, is packaged in a concentration which equals or exceeds:

(1) Ten percent by weight of the solution or mixture for materials listed in the appendix; or

(2) One percent by weight of the solution or mixture for materials that are identified as severe marine pollutants in the appendix.

Marking means a descriptive name, identification number, instructions, cautions, weight, specification, or UN marks, or combinations thereof, required by this subchapter on outer packagings of hazardous materials.

Material of trade means a hazardous material, other than a hazardous waste, that is carried on a motor vehicle-

(1) For the purpose of protecting the health and safety of the motor vehicle operator or passengers;

(2) For the purpose of supporting the operation or maintenance of a motor vehicle (including its auxiliary equipment); or

(3) By a private motor carrier (including vehicles operated by a rail carrier) in direct support of a principal business that is other than transportation by motor vehicle.

Material poisonous by inhalation means:

(1) A gas meeting the defining criteria in §173.115(c) of this subchapter and assigned to Hazard Zone A, B, C, or D in accordance with §173.116(a) of this subchapter;

(2) A liquid (other than as a mist) meeting the defining criteria in §173.132(a)(1)(iii) of this subchapter and assigned to Hazard Zone A or B in accordance with §173.133(a) of this subchapter; or

(3) Any material identified as an inhalation hazard by a special provision in column 7

of the §172.101 table.

Maximum Allowable Working Pressure or MAWP For DOT specification cargo tanks used to transport liquid hazardous materials, see §178.345-1(k).

Maximum capacity means the maximum inner volume of receptacles or packagings.

Maximum net mass means the allowable maximum net mass of contents in a single packaging, or as used in subpart M of part 178 of this subchapter, the maximum combined mass of inner packaging, and the contents thereof.

Metered delivery service means a cargo tank unloading operation conducted at a metered flow rate of 378.5 liters (100 gallons) per minute or less through an attached delivery hose with a nominal inside diameter of 3.175 centimeters ($1^{1/4}$ inches) or less.

Miscellaneous hazardous material. See §173.140 of this subchapter.

Mixture means a material composed of more than one chemical compound or element.

Mode means any of the following transportation methods; rail, highway, air, or water.

Motor vehicle includes a vehicle, machine, tractor, trailer, or semitrailer, or any combination thereof, propelled or drawn by mechanical power and used upon the highways in the transportation of passengers or property. It does not include a vehicle, locomotive, or car operated exclusively on a rail or rails, or a trolley bus operated by electric power derived from a fixed overhead wire, furnishing local passenger transportation similar to street-railway service.

Name of contents means the proper shipping name as specified in §172.101 of this subchapter.

Navigable waters means, for the purposes of this subchapter, waters of the United States, including the territorial seas.

Non-bulk packaging means a packaging which has:

(1) A maximum capacity of 450 L (119 gallons) or less as a receptacle for a liquid;

(2) A maximum net mass of 400 kg (882 pounds) or less and a maximum capacity of 450 L (119 gallons) or less as a receptacle for a solid; or

(3) A water capacity of 454 kg (1000 pounds) or less as a receptacle for a gas as defined in §173.115 of this subchapter.

Nonflammable gas. See §173.115 of this subchapter.

N.O.S. means not otherwise specified.

N.O.S. description means a shipping description from the §172.101 table which includes the abbreviation n.o.s.

NPT means an American Standard taper pipe thread conforming to requirements of Federal Standard H28, part II, section VII. See §171.7(d)(12).

NRC (non-reusable container) means a packaging (container) whose reuse is restricted in accordance with the provisions of §173.28 of this subchapter.

Occupationally exposed hazmat employee means a hazmat employee whose duties involve exposure to ionizing radiation.

Occupied caboose means a rail car being used to transport non-passenger personnel.

Officer in Charge, Marine Inspection means a person from the civilian or military branch of the Coast Guard designated as such by the Commandant and who under the supervision and direction of the Coast Guard District Commander is in charge of a designated inspection zone for the performance of duties with respect to the enforcement and administration of title 52, Revised Statutes, acts amendatory thereof or supplemental thereto, rules and regulations thereunder, and the inspection required thereby.

Offshore supply vessel means a cargo vessel of less than 500 gross tons that regularly transports goods, supplies or equipment in support of exploration or production of offshore mineral or energy resources.

Operator means a person who controls the use of an aircraft, vessel, or vehicle.

Organic peroxide. See §173.128 of this subchapter.

ORM means other regulated material. See §173.144 of this subchapter.

Outage or ullage means the amount by which a packaging falls short of being liquid full, usually expressed in percent by volume.

Outer packaging means the outermost enclosure of a composite or combination packaging together with any absorbent materials, cushioning and any other components necessary to contain and protect inner receptacles or inner packagings.

Overpack, except as provided in subpart K of part 178 of this subchapter, means an enclosure that is used by a single consignor to provide protection or convenience in handling of a package or to consolidate two or more packages. Overpack does not include a transport vehicle, freight container, or aircraft unit load device. Examples of overpacks are one or more packages:

(1) Placed or stacked onto a load board such as a pallet and secured by strapping, shrink wrapping, stretch wrapping, or other suitable means; or

(2) Placed in a protective outer packaging such as a box or crate.

Oxidizer. See §173.127 of this subchapter.

Oxidizing gas means a gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does.

Oxygen generator (chemical) means a device containing chemicals that upon activation release oxygen as a product of chemical reaction.

Package or Outside Package means a packaging plus its contents. For radioactive materials, see §173.403 of this subchapter.

Packaging means a receptacle and any other components or materials necessary for the receptacle to perform its containment function in conformance with the minimum packing requirements of this subchapter. For radioactive materials packaging, see §173.403 of this subchapter.

Packing group means a grouping according to the degree of danger presented by hazardous materials. Packing Group I indicates great danger; Packing Group II, medium danger; Packing Group III, minor danger. See §172.101(f) of this subchapter.

Passenger (With respect to vessels and for the purposes of part 176 only) means a person being carried on a vessel other than:

(1) The owner or his representative;

(2) The operator;

(3) A bona fide member of the crew engaged in the business of the vessel who has contributed no consideration for his carriage and who is paid for his services; or

(4) A guest who has not contributed any consideration directly or indirectly for his carriage.

Passenger-carrying aircraft means an aircraft that carries any person other than a crewmember, company employee, an authorized representative of the United States, or a person accompanying the shipment.

Passenger vessel means-

(1) A vessel subject to any of the requirements of the International Convention for the Safety of Life at Sea, 1974, which carries more than 12 passengers;

(2) A cargo vessel documented under the laws of the United States and not subject to that Convention, which carries more than 16 passengers;

(3) A cargo vessel of any foreign nation that extends reciprocal privileges and is not subject to that Convention and which carries more than 16 passengers; and

(4) A vessel engaged in a ferry operation and which carries passengers.

Person means an individual, firm, copartnership, corporation, company, association, joint-stock association, including any trustee, receiver, assignee, or similar representative thereof; or government, Indian tribe, or agency or instrumentality of any government or Indian tribe when it offers hazardous material for transportation in commerce or transports hazardous material to further a commercial enterprise, but such term does not include:

(1) The United States Postal Service;

(2) For the purposes of 49 U.S.C. 5123 and 5124, any agency or instrumentality of the Federal Government.

Placarded car means a rail car which is placarded in accordance with the requirements of part 172 of this subchapter except those cars displaying only the FUMIGATION placards as required by §172.510.

Poisonous gas. See §173.115 of this subchapter.

Poisonous materials. See §173.132 of this subchapter.

Portable tank means a bulk packaging (except a cylinder having a water capacity of 1000 pounds or less) designed primarily to be loaded onto, or on, or temporarily attached to a transport vehicle or ship and equipped with skids, mountings, or accessories to facilitate handling of the tank by mechanical means. It does not include a cargo tank, tank car, multi-unit tank car tank, or trailer carrying 3AX, 3AAX, or 3T cylinders.

Preferred route or Preferred highway is a highway for shipment of highway route controlled quantities of radioactive materials so designated by a State routing agency, and any Interstate System highway for which an alternative highway has not been designated by such State agency as provided by §177.825(b) of this subchapter.

Primary hazard means the hazard class of a material as assigned in the §172.101 table.

Private track or Private siding means track located outside of a carrier's right-of-way, yard, or terminals where the carrier does not own the rails, ties, roadbed, or right-of-way and includes track or portion of track which is devoted to the purpose of its user either by lease or written agreement, in which case the lease or written agreement is considered equivalent to ownership.

Proper shipping name means the name of the hazardous material shown in Roman print (not italics) in §172.101 of this subchapter.

P.s.i. or psi means pounds per square inch.

P.s.i.a. or psia means pounds per square inch absolute.

P.s.i.g. or psig means pounds per square inch gauge.

Public vessel means a vessel owned by and being used in the public service of the United States. It does not include a vessel owned by the United States and engaged in a trade or commercial service or a vessel under contract or charter to the United States.

Pyrophoric liquid. See §173.124(b) of this subchapter.

Radioactive materials. See §173.403 of this subchapter for definitions relating to radioactive materials.

Rail car means a car designed to carry freight or non-passenger personnel by rail, and includes a box car, flat car, gondola car, hopper car, tank car, and occupied caboose.

Railroad means a person engaged in transportation by rail.

Receptacle means a containment vessel for receiving and holding materials, including any means of closing.

Registered Inspector means a person registered with the Department in accordance with subpart F of part 107 of this chapter who has the knowledge and ability to determine whether a cargo tank conforms with the applicable DOT specification. In addition, Registered Inspector means a person who meets, at a minimum, any one of the following:

(1) Has an engineering degree and one year of work experience.

(2) Has an associate degree in engineering and two years of work experience.

(3) Has a high school diploma or General Equivalency Diploma) and three years of work experience.

(4) Has at least three years experience in performing the duties of a Registered Inspector by September 1, 1991, and was registered with the Department by December 31, 1995.

Regulated medical waste. See §173.134 of this subchapter.

Reportable quantity (RQ) for the purposes of this subchapter means the quantity specified in column 2 of the appendix to §172.101 for any material identified in column 1 of the appendix.

Research means investigation or experimentation aimed at the discovery of new theories or laws and the discovery and interpretation of facts or revision of accepted theories or laws in the light of new facts.

Residue means the hazardous material remaining in a packaging, including a tank car, after its contents have been unloaded to the maximum extent practicable and before the packaging is either refilled or cleaned of hazardous material and purged to remove any hazardous vapors.

RSPA means the Research and Special Programs Administration, U.S. Department of Transportation, Washington, DC 20590.

SADT means self-accelerated decomposition temperature. See §173.21(f) of this subchapter.

Salvage packaging means a special packaging conforming to §173.3 of this subchapter into which damaged, defective or leaking hazardous materials packages, or hazardous materials that have spilled or leaked, are placed for purposes of transport for recovery or disposal.

SCF (standard cubic foot) means one cubic foot of gas measured at 60 °F. and 14.7 psia.

Self-defense spray means an aerosol or non-pressurized device that:

(1) Is intended to have an irritating or incapacitating effect on a person or animal; and

(2) Meets no hazard criteria other than for Class 9 (for example, a pepper spray; see §173.140(a) of this subchapter) and, for an aerosol, Division 2.1 or 2.2 (see §173.115 of this subchapter), except that it may contain not more than two percent by mass of a tear gas substance (e.g., chloroacetophenone (CN) or 0-chlorobenzylmalonitrile (CS); see §173.132(a)(2) of this subchapter.)

Sheathing means a covering consisting of a smooth layer of wood placed over metal and secured to prevent any movement.

Shipping paper means a shipping order, bill of lading, manifest or other shipping document serving a similar purpose and containing the information required by §§172.202, 172.203 and 172.204.

Siftproof packaging means a packaging impermeable to dry contents, including fine solid material produced during transportation.

Single packaging means a non-bulk packaging other than a combination packaging.

Solid means a material which is not a gas or a liquid.

Solution means any homogeneous liquid mixture of two or more chemical compounds or elements that will not undergo any segregation under conditions normal to transportation.

Specification packaging means a packaging conforming to one of the specifications or standards for packagings in part 178 or part 179 of this subchapter.

Spontaneously combustible material. See §173.124(b) of this subchapter.

State means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Virgin Islands, American Samoa, Guam, or any other territory or possession of the United States designated by the Secretary.

State-designated route means a preferred route selected in accordance with U.S. DOT "Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantities of Radioactive Materials" or an equivalent routing analysis which adequately considers overall risk to the public.

Stowage means the act of placing hazardous materials on board a vessel.

Strong outside container means the outermost enclosure which provides protection against the unintentional release of its contents under conditions normally incident to transportation.

Subsidiary hazard means a hazard of a material other than the primary hazard. (See primary hazard).

Table in §172.101 or §172.101 table means the Hazardous Materials Table in §172.101 of this subchapter.

Technical name means a recognized chemical name or microbiological name currently used in scientific and technical handbooks, journals, and texts. Generic descriptions are authorized for use as technical names provided they readily identify the general chemical group, or microbiological group. Examples of acceptable generic chemical descriptions are organic phosphate compounds, petroleum aliphatic hydrocarbons and tertiary amines. For proficiency testing only, generic microbiological descriptions such as bacteria, mycobacteria, fungus, and viral samples may be used. Except for names which appear in subpart B of part 172 of this subchapter, trade names may not be used as technical names.

TOFC means trailer-on-flat-car.

Top shell means the tank car tank surface, excluding the head ends and bottom shell of the tank car tank.

Trailership means a vessel, other than a carfloat, specifically equipped to carry motor transport vehicles and fitted with installed securing devices to tie down each vehicle. The term trailership includes Roll-on/Roll-off (RO/RO) vessels.

Train means one or more engines coupled with one or more rail cars, except during switching operations or where the operation is that of classifying and assembling rail cars within a railroad yard for the purpose of making or breaking up trains.

Trainship means a vessel other than a rail car ferry or carfloat, specifically equipped to transport railroad vehicles, and fitted with installed securing devices to tie down each vehicle.

Transport vehicle means a cargo-carrying vehicle such as an automobile, van, tractor, truck, semitrailer, tank car or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (trailer, rail car, etc.) is a separate transport vehicle.

UFC means Uniform Freight Classification.

UN means United Nations.

UN standard packaging means a packaging conforming to standards in the UN Recommendations on the Transport of Dangerous Goods.

Unit load device means any type of freight container, aircraft container, aircraft pallet with a net, or aircraft pallet with a net over an igloo.

United States means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, the Virgin Islands, American Samoa, Guam, or any other territory or possession of the United States designated by the Secretary.

Vessel includes every description of watercraft, used or capable of being used as a means of transportation on the water.

Viscous liquid means a liquid material which has a measured viscosity in excess of 2500 centistokes at 25 ^{o}C. (77 ^{o}F.) when determined in accordance with the procedures specified in ASTM Method D 445-72 "Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)" or ASTM Method D 1200-70 "Viscosity of Paints, Varnishes, and Lacquers by Ford Viscosity Cup."

Volatility refers to the relative rate of evaporation of materials to assume the vapor state.

Water reactive material. See §173.124(c) of this subchapter.

Water resistant means having a degree of resistance to permeability by and damage caused by water in liquid form.

Wooden barrel means a packaging made of natural wood, of round cross-section, having convex walls, consisting of staves and heads and fitted with hoops.

W.T. means watertight.

[Amdt. 171-32, 41 FR 15994, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.8, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§171.9 Rules of construction.

(a) In this subchapter, unless the context requires otherwise:
(1) Words imparting the singular include the plural;
(2) Words imparting the plural include the singular; and
(3) Words imparting the masculine gender include the feminine;
(b) In this subchapter, the word: (1) "Shall" is used in an imperative sense;
(2) "Must" is used in an imperative sense;
(3) "Should" is used in a recommendatory sense;
(4) "May" is used in a permissive sense to state authority or permission to do the act described, and the words "no person may * * *" or "a person may not * * *" means that no person is required, authorized, or permitted to do the act described; and
(5) "Includes" is used as a word of inclusion not limitation.

[Amdt. 171-32, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 171-32A, 41 FR 40630, Sept. 20, 1976; Amdt. 171-121, 58 FR 51528, Oct. 1, 1993]

§171.10 Units of measure.

(a) *General. To ensure compatibility with international transportation standards, most units of measure in this subchapter are expressed using the International System of Units ("SI" or metric). Where SI units appear, they are the regulatory standard. U.S. standard or customary units, which appear in parentheses following the SI units, are for information only and are not intended to be the regulatory standard.*

(b) Abbreviations for SI units of measure generally used throughout this subchapter are as shown in paragraph (c) of this section. Customary units shown throughout this subchapter are generally not abbreviated.

(c) *Conversion values. (1) Conversion values are provided in the following table and are based on values provided in ASTM E 380-89, "Standard for Metric Practice."*

(2) If an exact conversion is needed, the following conversion table should be used.

Table of Conversion Factors for SI Units

Measurement	SI to U.S. standard	U.S. standard to SI
Activity	1 TBq=27 Ci	1 Ci=0.037 TBq.
Length	1 cm=0.3937008 in 1 m=3.280840 ft	1 in=2.540000 cm 1 ft=0.3048000 m
Thickness	1 mm=0.03937008 in	1 in=25.40000 mm
Mass (weight)	1 kg=2.204622 lb 1 gr=0.03527397 oz	1 lb=0.4535924 kg 1 oz=28.34952 gr
Pressure	1 kPa=0.1450377 psi 1 Bar=100 kPa=14.504 psi 1 kPa=7.5 mm Hg	1 psi=6.894757 kPa 1 psi=0.06895 Bar
Radiation level	1 Sv/hr=100 rem/hr	1 rem/hr=0.01 Sv/hr
Volume (liquid)	1 l=0.2641720 gal 1 ml=0.03381402 oz 1 m^3=35.31466 ft^3	1 gal=3.785412 l 1 oz=29.57353 ml 1 ft^3=0.02831685 m^3
Density	1 kg/m^3=0.06242797 lb/ft^3	1 lb/ft^3=16.01846 kg/m^3

Abbreviation for units of measure are as follows:

Unit of measure and abbreviation:

(SI): millimeter, mm; centimeter, cm; meter, m; gram, g; kilogram, kg; kiloPascal, kPa; liter, L; milliliter, ml; cubic meter, m^3; Terabecquerel, TBq; Gigabecquerel, GBq; millisievert, mSv;

(U.S.): Inch, in; foot, ft; ounce, oz; pound, lb; pounds per square inch, psi; gallon, gal; cubic feet, ft^3; Curie, Ci; millicurie, mCi; millirem, mrem.

[Amdt. 171-111, 56 FR 66159, Dec. 20, 1991, as amended by Amdt. 171-136, 60 FR 49108, Sept. 21, 1995; Amdt. 171-135, 60 FR 50302, Sept. 28, 1995]

§171.11 Use of ICAO Technical Instructions.

Notwithstanding the requirements of parts 172 and 173 of this subchapter, a hazardous material may be transported by aircraft, and by motor vehicle either before or after being transported by aircraft, in accordance with the ICAO Technical Instructions if the hazardous material:

(a) Is packaged, marked, labeled, classified, described and certified on a shipping paper and otherwise in a condition for shipment as required by the ICAO Technical Instructions;

(b) Is within the quantity limits prescribed for transportation by either passenger-carrying or cargo aircraft, as appropriate, as specified in the ICAO Technical Instructions;

(c) Is not a forbidden material or package according to §173.21 of this subchapter or column 3 of the §172.101 table; and

(d) Fulfills the following additional requirements as applicable:

(1) For a material that meets the definition of a hazardous substance as defined in this subchapter, the shipping paper and package markings must conform to the provisions in §172.203(c) and 172.324, respectively, of this subchapter.

(2) When a hazardous material, which is subject to the requirements of the ICAO Technical Instructions, is also a hazardous waste as defined in this subchapter:

(i) The word "Waste" must precede the proper shipping name on shipping papers and package markings; and

(ii) It must comply with §172.205 with respect to the hazardous waste manifests.

(3) When a hazardous material is not subject to the requirements of the ICAO Technical Instructions, it must be transported as required by this subchapter.

(4) When a hazardous material that is regulated by this subchapter for transportation by highway is transported by motor vehicle on a public highway under the provisions of this section, the following requirements apply:

(i) The motor vehicle must be placarded in accordance with subpart F of part 172 of this subchapter; and

(ii) The shipping paper may include an indication that the shipment is being made under the provisions of this section or the letters "ICAO."

(5) If a liquid or solid material in a package meets the definition of a poison according to this subchapter, and the fact that it is a poison is not disclosed in the shipping name or by a class entry, an indication that the material is a poison shall be entered on the shipping paper in association with the basic description. For transportation by motor vehicle, this indication must be made by entering the word "Poison or Toxic" on the shipping paper in association with the basic description.

(6) For radioactive materials:

(i) Shipping papers for highway route controlled quantity radioactive materials shipments must meet the requirements of §172.203(d)(4) of this subchapter,

(ii) Competent authority certification and any necessary revalidation for Type B, Type B(U), Type B(M), and fissile materials packages must be obtained from the appropriate authorities as specifed in §§173.471, 173.472 and 173.473 of this subchapter, and all requirements of the certificates and revalidations must be met,

(iii) Except for limited quantities of Class 7 (radioactive) material, the provisions of §§172.204(c)(4), 173.448(e), (f) and (g)(3) of this subchapter apply.

(iv) Limited quantities of radioactive materials must meet the provisions of §173.421, §173.424 or §173.426 as appropriate of this subchapter, and

(v) Type A package contents shall be limited in accordance with §173.431 of this subchapter.

(7) If a United States variation is indicated in the ICAO Technical Instructions for any provision governing the transport of the hazardous material, the hazardous material is transported in conformance with that variation.

(8) Abbreviations may not be used in shipping paper entries or package markings unless they are specifically authorized by this subchapter. ICAO class or division numbers are not considered to be abbreviations.

(9) When a hazardous material, which is subject to the requirements of the ICAO Technical Instructions, is a material poisonous by inhalation (see §171.8 of this

subchapter)-

(i) The shipping description must include the words "Toxic Inhalation Hazard" or "Poison-Inhalation Hazard" or "Inhalation Hazard", as required in §172.203(m) of this subchapter;

(ii) The material must be packaged in accordance with the requirements of this subchapter; and

(iii) The package must be marked in accordance with §172.313 of this subchapter and labeled with "POISON INHALATION HAZARD" or "POISON GAS", as appropriate, in accordance with subpart E of part 172 of this subchapter.

(10) Shipments of hazardous materials under this section must conform to the requirements for emergency response information as prescribed in subpart G of part 172 of this subchapter.

(11) Packages of Class 1 (explosive) materials must be marked in accordance with §172.320 of this subchapter.

(12) If an ammonium nitrate fertilizer or ammonium nitrate mixed fertilizer, must not meet the definition and criteria of a Class 1 (explosive) material.

(13) Transportation of marine pollutants, as defined in §171.8 of this subchapter, in bulk packagings must conform to the requirements of §§172.203(1) and 172.322 of this subchapter.

(14) Except as provided for limited quantities of compressed gases in containers of not more than 4 fluid ounces capacity under §173.306(a)(1) of this subchapter, aerosols must meet the definition for "Aerosol" in §171.8.

(15) A chemical oxygen generator is forbidden for transportation aboard a passenger-carrying aircraft and must be approved, classed, described and packaged in accordance with the requirements of this subchapter for transportation on cargo-only aircraft. A chemical oxygen generator (spent) is forbidden for transportation on aircraft.

(16) A cylinder containing Oxygen, compressed, may not be transported on a passenger-carrying aircraft or in an inaccessible cargo location aboard a cargo-only aircraft unless it is packaged as required by Part 173 and Part 178 of this subchapter and is placed in an overpack or outer packaging that satisfies the requirements of Special Provision A52 in §172.102.

[Amdt. 171-69, 47 FR 54821, Dec. 6, 1982]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.11, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45396, Aug. 19, 1999, §171.11 was amended by revising paragraph (d)(15) and adding paragraph (d)(16), effective Mar. 1, 2000. For the convenience of the user, the superseded text is set forth as follows:

§171.11 Use of ICAO Technical Instructions.
* * * * *

(d) * * *

(15) An oxygen generator (chemical) must be classed, approved, and described in accordance with the requirements of this subchapter.

§171.12 Import and export shipments.

(a) *Importer's responsibility. Except in the case of a shipment from Canada conforming to §171.12a of this subchapter, each person importing a hazardous material into the United States shall provide the shipper and the forwarding agent at the place of entry into the United States timely and complete information as to the requirements of this subchapter that will apply to the shipment of the material within the United States. The shipper, directly or through the forwarding agent at the place of entry, shall provide the initial carrier in the United States the certificate of compliance required by §172.204 of this subchapter. The carrier may not accept the material for transportation unless the required certification is provided.*

(b) IMDG Code. The IMDG Code sets forth descriptions, classifications, packagings, labeling and vessel stowage requirements. Notwithstanding the provisions of this subchapter, a material which is packaged, marked, classed, labeled, placarded, described, stowed and segregated, and certified (including a container packing certification, if applicable) in accordance with the IMDG Code, and otherwise conforms to the requirements of this section, may be offered and accepted for transportation and transported within the United States. The following conditions and limitations apply:

(1) The provisions of this paragraph (b) apply only if all or part of the transportation is by vessel.

(2) A number of materials listed in the IMDG Code are not subject to the requirements of this subchapter. The provisions of this subchapter do not apply to materials listed in the IMDG Code which are not designated as hazardous materials under this subchapter. These materials may, however, be transported in the U.S. when described, marked and labeled in accordance with the IMDG Code. 0

(3) A material designated as a hazardous material under this subchapter which is not subject to the requirements of the IMDG Code may not be transported under the provisions of this section.

(4) A forbidden material or package according to §173.21 of this subchapter or column 3 of the §172.101 table may not be transported under the provisions of this section.

(5) Except for packagings conforming to the requirements of Section 26 of the General Introduction to the IMDG Code, bulk packagings must conform to the requirements of this subchapter.

(6) For export, packagings must conform to the applicable requirements in §§173.24, 173.24a and 173.28 of this subchapter.

(7) A Class 1 material must be classed and approved under the procedures in subpart C of part 173 of this subchapter and conform to the requirements of §172.320 and part

176 of this subchapter.
(8) When a hazardous material, which is subject to the requirements of the IMDG Code, is a material poisonous by inhalation (see §171.8 of this subchapter)-
(i) The shipping description must include the words `Toxic Inhalation Hazard' or "Poison-Inhalation Hazard" or "Inhalation Hazard", as required in §172.203(m) of this subchapter;
(ii) The material must be packaged in accordance with the requirements of this subchapter;
(iii) Except as provided in paragraph (b)(8)(iv) of this section, the package must be marked in accordance with §172.313 of this subchapter and labeled and placarded with "POISON INHALATION HAZARD" or "POISON GAS", as appropriate, in accordance with subparts E and F, respectively, of part 172 of this subchapter;
(iv) Until October 1, 2001, the package may be labeled in accordance with the IMDG Code if transported in a closed transport vehicle or freight container marked with identification numbers for the materials in any quantity in the manner specified in paragraphs (c) and (c)(3) of §172.313 of this subchapter and placarded as required by subpart F of part 172 of this subchapter.
(9) Class 7 materials must conform to the provisions of paragraph (d) of this section.
(10) For a hazardous waste, as defined in this subchapter-
(i) The word "Waste" must precede the proper shipping name on shipping papers and packages; and
(ii) The requirements of §172.205 of this subchapter with respect to hazardous waste manifests are applicable.
(11) A hazardous substance as defined in this subchapter must conform to the requirements of §§172.203(c) and 172.324 of this subchapter.
(12) A poisonous material must conform to the requirements of §172.203(m) of this subchapter.
(13) [Reserved]
(14) Any ammonium nitrate fertilizer or ammonium nitrate mixed fertilizer must not meet the definition and criteria of a Class 1 (explosive) material.
(15) Cylinders not manufactured to DOT specifications must conform to the requirements of §173.301(i) and (j) of this subchapter.
(16) Shipments of hazardous materials under this section must conform to the requirements for emergency response information as prescribed in subpart G of part 172 of this subchapter.
(17) Except as provided for limited quantities of compressed gases in containers of not more than 4 fluid ounces capacity under §173.306(a)(1) of this subchapter, aerosols must meet the definition for "Aerosol" in §171.8.
(18) A chemical oxygen generator must be approved in accordance with the requirements of this subchapter. A chemical oxygen generator and a chemical oxygen generator (spent) must be classed, described and packaged in accordance with the requirements of this subchapter.
(c) *Use of IMDG Code in port areas. Section 171.2 notwithstanding, a hazardous material (other than Division 1.1 or 1.2 or Class 7) being imported into or exported from*

the United States or passing through the United States in the course of being shipped between places outside the United States may be offered and accepted for transportation and transported by motor vehicle within a single port area (including contiguous harbors) when packaged, marked, classed, labeled, stowed and segregated in accordance with the IMDG Code, if the hazardous material is offered and accepted in accordance with the requirements of subparts C and F of part 172 of this subchapter pertaining to shipping papers and placarding and otherwise conforms to the applicable requirements of part 176 of this subchapter. The requirement in §172.201(d) of this subchapter for an emergency telephone number does not apply to shipments made in accordance with the IMDG Code if the hazardous material:
(1) Is not offloaded from the vessel;
(2) Is offloaded between ocean vessels at a U.S. port facility without being transported by public highway.
(d) *Use of IAEA regulations for Class 7 (radioactive) materials. Class 7 (radioactive) materials being imported into, or exported from, the United States, or passing through the United States in the course of being shipped between places outside the United States, may be offered and accepted for transportation when packaged, marked, labeled, and otherwise prepared for shipment in accordance with IAEA "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6," if:*
(1) Highway route controlled quantities (see §173.403 of this subchapter) are shipped in accordance with §§172.203(d)(4), 172.507 and 173.22(c) of this subchapter;
(2) For fissile materials and Type B packages, the competent authority certification and any necessary revalidation is obtained from the appropriate competent authorities as specified in §§173.471, 173.472 and 173.473 of this subchapter and all requirements of the certificates and revalidations are met;
(3) Type A package contents are limited in accordance with §173.431 of this subchapter;
(4) The country of origin for the shipment has adopted the IAEA "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6";
(5) The requirements of §§173.448(e), 173.448(f), and 173.448(g)(3) of this subchapter are fulfilled, when applicable; and
(6) Shipments comply with the requirements for emergency response information prescribed in subpart G of part 172 of this subchapter.

[Amdt. 171-111, 55 FR 52472, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.12, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45396, Aug. 19, 1999, §171.12 was amended by revising paragraph (b)(18), effective Mar. 1, 2000. For the convenience of the user, the superseded text is set forth as follows:

§171.12 Import and export shipments.

* * * * *

(b) * * *

(18) An oxygen generator (chemical) must be classed, approved, and described in accordance with the requirements of this subchapter.

* * * * *

§171.12a Canadian shipments and packagings.

(a) *Scope and applicability. This section sets forth provisions for the transportation by rail or highway of shipments of hazardous materials which conform to the regulations of the Government of Canada but which may differ from the requirements of this subchapter with regard to hazard communication, classification or packaging. Except as provided in paragraph (b)(5)(iv) of this section, the provisions apply only to shipments which originate in Canada and either terminate in the U.S. or transit the U.S. to a Canadian or foreign destination, and to the return to Canada of empty bulk packages containing residues of hazardous materials which originally were imported into the U.S. Reciprocal provisions, applicable to exports from the U.S., appear in the regulations of the Government of Canada.*

(b) Conditions and limitations. Notwithstanding the requirements of parts 172, 173, and 178 of this subchapter, and subject to the limitations of paragraph (a) of this section, a hazardous material that is classed, marked, labeled, placarded, described on a shipping paper, and packaged in accordance with the Transportation of Dangerous Goods (TDG) Regulations issued by the Government of Canada may be offered for transportation and transported to or through the United States by motor vehicle or rail car. Copies of the TDG Regulations may be obtained from the Canadian Government Publishing Centre, Ottawa, Ontario K1A 059; Telephone (819) 956-4800. The following conditions and limitations apply:

(1) A number of materials listed in the TDG Regulations may not be subject to the requirements of this subchapter. The provisions of this subchapter do not apply to materials listed in the TDG Regulations which are not designated as hazardous materials under this subchapter. These materials may, however, be transported in the U.S. when described, marked and labeled in accordance with the TDG Regulations.

(2) A material designated as a hazardous material under this subchapter which is not subject to the requirements of the TDG Regulations may not be transported under the provisions of this section.

(3) A forbidden material or package according to §173.21 of this subchapter or column 3 of the §172.101 table may not be transported under the provisions of this section.

(4) A Class 1 material must be classed and approved under the procedures in subpart C of part 173 of this subchapter, and packages of Class 1 materials must be

marked in accordance with §172.320 of this subchapter.

(5) When a hazardous material, which is a material poisonous by inhalation under the provisions of this subchapter (see §171.8 of this subchapter), is subject to the requirements of the TDG Regulations-

(i) The shipping description must include the words `Toxic Inhalation Hazard' or `Poison Inhalation Hazard' or "Inhalation Hazard", as required in §172.203(m) of this subchapter;

(ii) The material must be packaged in accordance with the requirements of this subchapter;

(iii) Except as provided in paragraph (b)(5)(iv) of this section and for a package containing anhydrous ammonia, the package must be marked in accordance with §172.313 of this subchapter and labeled and placarded with "POISON INHALATION HAZARD" or "POISON GAS", as appropriate, in accordance with subparts E and F, respectively, of part 172 of this subchapter. For shipments of anhydrous ammonia, the shipping paper must contain an indication that the markings, labels and placards have been applied in conformance with the TDG Regulations and this paragraph (b)(5);

(iv) Until October 1, 2001, the package may be transported to or from the U.S. while labeled in accordance with the TDG Regulations if transported in a closed transport vehicle or freight container marked with identification numbers for the materials in any quantity in the manner specified in paragraphs (c) and (c)(3) of §172.313 of this subchapter and placarded as required by subpart F of part 172 of this subchapter.

(6) Required shipping descriptions and package markings must be in English. Abbreviations may not be used unless specifically authorized by this subchapter. Identification numbers must be preceded by "UN" or "NA". The use of an identification number preceded by "PIN" is not authorized.

(7) Shipments must conform to the requirements for emergency response information in subpart G of part 172 of this subchapter.

(8) A Class 7 material must conform to the provisions of §171.12(d) of this subchapter;

(9) For a hazardous waste as defined in this subchapter-

(i) The word "Waste" must precede the proper shipping name on shipping papers and packages; and

(ii) The requirements of §172.205 of this subchapter with respect to hazardous waste manifests are applicable;

(10) A hazardous substance as defined in this subchapter must conform to the requirements of §§172.203(c) and 172.324 of this subchapter; and

(11) A poisonous material must conform to the requirements of §172.203(m) of this subchapter.

(12) [Reserved]

(13) When the provisions of this subchapter require that a DOT specification or UN standard packaging must be used for a hazardous material, a packaging authorized by the TDG Regulations may be used only if it corresponds to the DOT specification or UN packaging authorized by this subchapter. Cylinders not manufactured to DOT specifications must conform to the requirements of §173.301(i) and (j) of this

subchapter.

(14) Any ammonium nitrate fertilizer or ammonium nitrate mixed fertilizer must not meet the definition and criteria of a Class 1 (explosive) material.

(15) Transportation of marine pollutants, as defined in §171.8 of this subchapter, must conform to the requirements of §§172.203(l) and 172.322 of this subchapter.

(16) Except as provided for limited quantities of compressed gases in containers of not more than 4 fluid ounces capacity under §173.306(a)(1) of this subchapter, aerosols must meet the definition for "Aerosol" in §171.8.

(17) A chemical oxygen generator must be approved in accordance with the requirements of this subchapter. A chemical oxygen generator and a chemical oxygen generator (spent) must be classed, described and packaged in accordance with the requirements of this subchapter.

[Amdt. 171-111, 55 FR 52473, Dec. 21, 1990, as amended at 56 FR 66160, Dec. 20, 1991; 57 FR 45453, Oct. 1, 1992; Amdt. 171-116, 57 FR 52935, Nov. 5, 1992; Amdt. 171-153, 62 FR 24700, May 6, 1997; 62 FR 30770, June 5, 1997; 64 FR 10753, Mar. 5, 1999; 64 FR 45396, Aug. 19, 1999; 64 FR 50262, Sept. 16, 1999; 64 FR 51720, Sept. 24, 1999; 64 FR 51915, Sept. 27, 1999]

Effective Date Note: At 64 FR 45396, Aug. 19, 1999, §171.12a paragraph (b)(17) was revised, effective Mar. 1, 2000. For the convenience of the user, the superseded text is set forth as follows:

§171.12a Canadian shipments and packagings.

* * * * *

(b) * * *

(17) An oxygen generator (chemical) must be classed, approved, and described in accordance with the requirements of this subchapter.

§171.14 Transitional provisions for implementing certain requirements.

General. The purpose of the provisions of this section is to provide an orderly transition to certain new requirements so as to minimize any burdens associated with them.

(a) Previously filled packages-(1) Packages filled prior to October 1, 1991. Notwithstanding the marking and labeling provisions of subparts D and E, respectively, of part 172, and the packaging provisions of part 173 and subpart B of part 172 of this subchapter, a package may be offered for transportation and transported prior to October 1, 2001, if it-

(i) Conforms to the old requirements of this subchapter in effect on September 30, 1991;

(ii) Was filled with a hazardous material prior to October 1, 1991;

(iii) Is marked "Inhalation Hazard" if appropriate, in accordance with §172.313 of this

subchapter or Special Provision 13, as assigned in the §172.101 table; and
(iv) Is not emptied and refilled on or after October 1, 1991.
(2) *Non-bulk packages filled prior to October 1, 1996. Notwithstanding the packaging provisions of subpart B of part 172 and the packaging provisions of part 173 of this subchapter with respect to UN standard packagings, a non-bulk package other than a cylinder may be offered for transportation and transported domestically prior to October 1, 1999, if it-*
(i) Conforms to the requirements of this subchapter in effect on September 30, 1996;
(ii) Was filled with a hazardous material prior to October 1, 1996; and
(iii) Is not emptied and refilled on or after October 1, 1996.
(b) *Transitional placarding provisions. Until October 1, 2001, placards which conform to specifications for placards in effect on September 30, 1991, or placards specified in the December 21, 1990 final rule may be used, for highway transportation only, in place of the placards specified in subpart F of part 172 of this subchapter, in accordance with the following table:*

PLACARD SUBSTITUTION TABLE

HAZARD CLASS OR DIVISION NO.	CURRENT PLACARD NAME	OLD (SEPT. 30, 1991) PLACARD NAME
Division 1.1	Explosives 1.1	Explosives A.
Division 1.2	Explosives 1.2	Explosives A.
Division 1.3	Explosives 1.3	Explosives B.
Division 1.4	Explosives 1.4	Dangerous.
Division 1.5	Explosives 1.5	Blasting agents.
Division 1.6	Explosives 1.6	Dangerous.
Division 2.1	Flammable gas	Flammable gas.
Division 2.2	Nonflammable gas	Nonflammable gas.
Division 2.3[1]	Poison gas	Poison gas.
Class 3	Flammable	Flammable.
Combustible liquid	Combustible	Combustible.
Division 4.1	Flammable solid	Flammable solid.
Division 4.2	Spontaneously combustible	Flammable solid.
Division 4.3	Dangerous when wet	Flammable solid W.
Division 5.1	Oxidizer	Oxidizer.
Division 5.2	Organic peroxide	Organic peroxide.
Division 6.1, (inhalation hazard, Zone A or B)[1]	Poison inhalation hazard	Poison.
Division 6.1, PG I (other than Zone A or B inhalation hazard), PG II, or PG III	Posion	Poison.
Class 7	Radioactive	Radioactive.
Class 8	Corrosive	Corrosive.
Class 9	Class 9	(none required).

[1]For materials poisonous by inhalation, by all modes of transportation, until October 1, 2001, placards may be used that conform to specifications for placards (1) in effect

on September 30, 1991, (2) specified in the December 21, 1990 final rule, or (3) specified in the July 22, 1997 final rule.

(c) *Non-specification fiber drums. A non-specification fiber drum with a removable head is authorized for a liquid hazardous material in Packing Group III that is not poisonous by inhalation for which the packaging was authorized under the requirements of part 172 or part 173 of this subchapter in effect on September 30, 1991. This authorization expires on the date on which funds are authorized to be appropriated to carry out chapter 51 of title 49, United States Code (related to transportation of hazardous materials), for fiscal years beginning after September 30, 1997. Information concerning this funding authorization date may be obtained by contacting the Office of the Associate Administrator for Hazardous Materials Safety.*

(d) A final rule published in the FEDERAL REGISTER ON MARCH 5, 1999, EFFECTIVE OCTOBER 1, 1999, RESULTED IN REVISIONS TO THIS SUBCHAPTER. DURING THE TRANSITION PERIOD PROVIDED IN PARAGRAPH (D)(1) OF THIS SECTION, A PERSON MAY ELECT TO COMPLY WITH EITHER THE APPLICABLE REQUIREMENTS OF THIS SUBCHAPTER IN EFFECT ON SEPTEMBER 30, 1999, OR THE REQUIREMENTS OF THIS SUBCHAPTER IN THE MARCH 5, 1999 FINAL RULE, IN EFFECT ON OCTOBER 1, 1999.

(1) *Transition dates. The effective date of the March 5, 1999 final rule is October 1, 1999. A delayed compliance date of October 1, 2000 is authorized. On October 1, 2000, all applicable regulatory requirements adopted in the March 5, 1999 final rule in effect on October 1, 1999 must be met.*

(2) Intermixing old and new requirements. Prior to the transition date in paragraph (d)(1) of this section, it is recommended that the hazard communication requirements be consistent where practicable, i.e., marking, labeling, placarding, and shipping paper descriptions should conform to either the old requirements of this subchapter in effect on September 30, 1999, or new requirements of this subchapter in the March 5, 1999 final rule, in effect on October 1, 1999, without intermixing of communication elements. However, intermixing is permitted, during the applicable transition period, for packaging, hazard communication, and handling provisions, as follows:

(i) If either shipping names or identification numbers are identical, a shipping paper may display the old shipping description even if the package is marked and labeled under the new shipping description;

(ii) If either shipping names or identification numbers are identical, a shipping paper may display the new shipping description even if the package is marked and labeled under the old shipping description; and

(iii) Either old or new placards may be used regardless of whether old or new shipping descriptions and package markings are used.

(3) Until October 1, 2003, the KEEP AWAY FROM FOOD labeling and placarding requirements in effect on September 30, 1999, may continue to be used in place of the new requirements for Division 6.1, Packing Group III materials.

[Amdt. 171-131, 59 FR 67406, Dec. 29, 1994, as amended by Amdt. 171-132, 60 FR 26799, 26800, May 18, 1995; Amdt. 171-138, 60 FR 48786, Sept. 20, 1995; Amdt. 171-

139, 61 FR 7958, Feb. 29, 1996; Amdt. 171-150, 62 FR 1227, Jan. 8, 1997; Amdt 171-153, 62 FR 24700, May 6, 1997; 62 FR 29676, June 2, 1997; 62 FR 39404, July 22, 1997; 63 FR 52847, Oct. 1, 1998; 64 FR 10753, Mar. 5, 1999; 64 FR 50263, Sept. 16, 1999; 64 FR 51915, Sept. 27, 1999]

§171.15 Immediate notice of certain hazardous materials incidents.

(a) At the earliest practicable moment, each carrier who transports hazardous materials (including hazardous wastes) shall give notice in accordance with paragraph (b) of this section after each incident that occurs during the course of transportation (including loading, unloading and temporary storage) in which-

(1) As a direct result of hazardous materials-

(i) A person is killed; or

(ii) A person receives injuries requiring his or her hospitalization; or

(iii) Estimated carrier or other property damage exceeds $50,000; or

(iv) An evacuation of the general public occurs lasting one or more hours; or

(v) One or more major transportation arteries or facilities are closed or shut down for one hour or more; or

(vi) The operational flight pattern or routine of an aircraft is altered; or

(2) Fire, breakage, spillage, or suspected radioactive contamination occurs involving shipment of radioactive material (see also §§174.45, 176.48, and 177.807 of this subchapter); or

(3) Fire, breakage, spillage, or suspected contamination occurs involving shipment of infectious substances (etiologic agents); or

(4) There has been a release of a marine pollutant in a quantity exceeding 450 L (119 gallons) for liquids or 400 kg (882 pounds) for solids; or

(5) A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident) that, in the judgment of the carrier, it should be reported to the Department even though it does not meet the criteria of paragraph (a) (1), (2) or (3) of this section.

(b) Except for transportation by aircraft, each notice required by paragraph (a) of this section shall be given to the Department by telephone (toll-free) on 800-424-8802. Notice involving shipments transported by aircraft must be given to the nearest FAA Civil Aviation Security Office by telephone at the earliest practical moment after each incident in place of the notice to the Department. Notice involving etiologic agents may be given to the Director, Centers for Disease Control, U.S. Public Health Service, Atlanta, Ga. (800) 232-0124, in place of the notice to the Department or (toll call) on 202-267-2675. Each notice must include the following information:

(1) Name of reporter.

(2) Name and address of carrier represented by reporter.

(3) Phone number where reporter can be contacted.

(4) Date, time, and location of incident.

(5) The extent of injuries, if any.

(6) Classification, name, and quantity of hazardous materials involved, if such information is available.

(7) Type of incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene.

(c) Each carrier making a report under this section shall also make the report required by §171.16.

Note: Under 40 CFR 302.6 EPA requires persons in charge of facilities (including transport vehicles, vessels and aircraft) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release, to the U.S. Coast Guard National Response Center at (toll free) 800-424-8802 or (toll) 202-267-2675.

[Amdt. 171-7, 35 FR 16837, Oct. 3, 1970]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.15, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§171.16 Detailed hazardous materials incident reports.

(a) Each carrier who transports hazardous materials shall report in writing, in duplicate, on DOT Form F 5800.1 (Rev. 6/89) to the Department within 30 days of the date of discovery, each incident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which any of the circumstances set forth in §171.15(a) occurs or there has been an unintentional release of hazardous materials from a package (including a tank) or any quantity of hazardous waste has been discharged during transportation. If a report pertains to a hazardous waste discharge:

(1) A copy of the hazardous waste manifest for the waste must be attached to the report; and

(2) An estimate of the quantity of the waste removed from the scene, the name and address of the facility to which it was taken, and the manner of disposition of any removed waste must be entered in Section IX of the report form (Form F 5800.1) (Rev. 6/89).

(b) Each carrier making a report under this section shall send the report to the Information Systems Manager, DHM-63, Research and Special Programs Administration, Department of Transportation, Washington, DC 20590-0001; and, for incidents involving transportation by aircraft, a copy of the report shall also be sent to the FAA Civil Aviation Security Office nearest the location of the incident. A copy of the report shall be retained for a period of two years, at the carrier's principal place of business, or at other places as authorized and approved in writing by an agency of the Department of Transportation.

(c) Except as provided in paragraph (d) of this section, the requirements of paragraph

(a) of this section do not apply to incidents involving the unintentional release of a hazardous material-
(1) Transported under one of the following proper shipping names:
(i) Consumer commodity.
(ii) Battery, *electric storage, wet, filled with acid or alkali.*
(iii) Paint and paint related material when shipped in a packaging of five gallons or less.
(2) Prepared and transported as a limited quantity shipment in accordance with this subchapter.
(d) The exceptions to incident reporting provided in paragraph (c) of this section do not apply to:
(1) Incidents required to be reported under §171.15(a);
(2) Incidents involving transportation aboard aircraft;
(3) Except for consumer commodities, materials in Packing Group I; or
(4) Incidents involving the transportation of hazardous waste.

Note: A guideline document for assisting in the completion of DOT Form F 5800.1 (Rev. 6/89) may be obtained from the Office of Hazardous Materials Transportation, DHM-51, U.S. Department of Transportation, Washington, DC 20590-0001.

[Amdt. 171-7, 35 FR 16837, Oct. 3, 1970, as amended by Amdt. 171-56, 45 FR 73683, Nov. 6, 1980; Amdt. No. 171-65, 47 FR 24584, June 7, 1982; Amdt. 171-72, 48 FR 17095, Apr. 21, 1983; Amdt. 171-101, 54 FR 25813, June 19, 1989; Amdt. 171-109, 55 FR 39978, Oct. 1, 1990; Amdt. 171-140, 61 FR 18932, Apr. 29, 1996; Amdt. 171-145, 61 FR 27172, May 30, 1996]

§171.17-171.18 [Reserved]

§171.19 Approvals or authorizations issued by the Bureau of Explosives.

Effective December 31, 1998, approvals or authorizations issued by the Bureau of Explosives (BOE), other than those issued under part 179 of this subchapter, are no longer valid.

[63 FR 37459, July 10, 1998]

§171.20 Submission of Examination Reports.

(a) When it is required in this subchapter that the issuance of an approval by the Associate Administrator for Hazardous Materials Safety be based on an examination by the Bureau of Explosives (or any other test facility recognized by RSPA), it is the responsibility of the applicant to submit the results of the examination to the Associate Administrator for Hazardous Materials Safety.

(b) Applications for approval submitted under paragraph (a) of this section, must be submitted to the Associate Administrator for Hazardous Materials Safety, Research and Special Programs Administration, Washington, DC 20590-0001.

(c) Any applicant for an approval aggrieved by an action taken by the Associate Administrator for Hazardous Materials Safety, under this subpart may file an appeal with the Administrator, RSPA within 30 days of service of notification of a denial.

[Amdt. 171-54, 45 FR 32692, May 19, 1980, as amended by Amdt. 171-66, 47 FR 43064, Sept. 30, 1982; Amdt. 171-109, 55 FR 39978, Oct. 1, 1990; Amdt. 171-111, 56 FR 66162, Dec. 20, 1991]

§171.21 Assistance in investigations and special studies.

(a) A carrier who is responsible for reporting an incident under the provisions of §171.16 shall make all records and information pertaining to the incident available to an authorized representative or special agent of the Department of Transportation upon request. The carrier shall give an authorized representative or special agent of the Department of Transportation reasonable assistance in the investigation of the incident.

(b) If the Department of Transportation makes an inquiry to a carrier of hazardous materials in connection with a study of incidents, the carrier shall-

(1) Respond to the inquiry within 30 days after its receipt or within such other time as the inquiry may specify; and

(2) Provide full, true, and correct answers to any questions included in the inquiry.

[Amdt. 171-101, 54 FR 25813, June 19, 1989]

Pt. 172

49 CFR 172

[CFR] PART 172 SUBPART A - General

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART A]

Subpart A - General

§172.1 Purpose and scope.

This part lists and classifies those materials which the Department of Transportation has designated as hazardous materials for purposes of transportation and prescribes the requirements for shipping papers, package marking, labeling, and transport vehicle placarding applicable to the shipment and transportation of those hazardous materials.

[Amdt. 172-29, 41 FR 15997, Apr. 15, 1976]

§172.3 Applicability.

(a) This part applies to-

(1) Each person who offers a hazardous material for transportation, and

(2) Each carrier by air, highway, rail, or water who transports a hazardous material.

(b) When a person, other than one of those provided for in paragraph (a) of this section, performs a packaging labeling or marking function required by this part, that person shall perform the function in accordance with this part.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-32, 41 FR 38179, Sept. 9, 1976]

[CFR] PART 172 SUBPART B - Table of Hazardous Materials and Special Provisions

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART B]

Subpart B - Table of Hazardous Materials and Special Provisions

§172.101 Purpose and use of hazardous materials table.

(a) The Hazardous Materials Table (Table) in this section designates the materials listed therein as hazardous materials for the purpose of transportation of those materials. For each listed material, the Table identifies the hazard class or specifies that the material is forbidden in transportation, and gives the proper shipping name or directs the user to the preferred proper shipping name. In addition, the Table specifies or references requirements in this subchapter pertaining to labeling, packaging, quantity limits aboard aircraft and stowage of hazardous materials aboard vessels.

(b) *Column 1: Symbols. Column 1 of the Table contains six symbols ("+", "A", "D", "G", "I" and "W" as follows:*

(1) The plus (+) fixes the proper shipping name, hazard class and packing group for that entry without regard to whether the material meets the definition of that class or packing group or meets any other hazard class definition. An appropriate alternate proper shipping name and hazard class may be authorized by the Associate Administrator for Hazardous Materials Safety.

(2) The letter "A" restricts the application of requirements of this subchapter to materials offered or intended for transportation by aircraft, unless the material is a hazardous substance or a hazardous waste.

(3) The letter "D" identifies proper shipping names which are appropriate for describing materials for domestic transportation but may be inappropriate for international transportation under the provisions of international regulations (e.g., IMO, ICAO). An alternate proper shipping name may be selected when either domestic or international transportation is involved.

(4) The letter "G" identifies proper shipping names for which one or more technical names of the hazardous material must be entered in parentheses, in association with the basic description. (See §172.203(k).)

(5) The letter "I" identifies proper shipping names which are appropriate for describing materials in international transportation. An alternate proper shipping name may be selected when only domestic transportation is involved.

(6) The letter "W" restricts the application of requirements of this subchapter to materials offered or intended for transportation by vessel, unless the material is a hazardous substance or a hazardous waste.

(c) *Column 2: Hazardous materials descriptions and proper shipping names. Column 2 lists the hazardous materials descriptions and proper shipping names of materials designated as hazardous materials. Modification of a proper shipping name may otherwise be required or authorized by this section. Proper shipping names are limited to those shown in Roman type (not italics).*

(1) Proper shipping names may be used in the singular or plural and in either capital or lower case letters. Words may be alternatively spelled in the same manner as they

appear in the ICAO Technical Instructions or the IMDG Code. For example "aluminum" may be spelled "aluminium" and "sulfur" may be spelled "sulphur". However, the word "inflammable" may not be used in place of the word "flammable".

(2) Punctuation marks and words in italics are not part of the proper shipping name, but may be used in addition to the proper shipping name. The word "or" in italics indicates that terms in the sequence may be used as the proper shipping name, as appropriate.

(3) The word "poison" or "poisonous" may be used interchangeably with the word "toxic" when only domestic transportation is involved. The abbreviation "n.o.i." or "n.o.i.b.n." may be used interchangeably with "n.o.s.".

(4) Except for hazardous wastes, when qualifying words are used as part of the proper shipping name, their sequence in the package markings and shipping paper description is optional. However, the entry in the Table reflects the preferred sequence.

(5) When one entry references another entry by use of the word "see", if both names are in Roman type, either name may be used as the proper shipping name (e.g., Ethyl alcohol, *see Ethanol).*

(6) When a proper shipping name includes a concentration range as part of the shipping description, the actual concentration, if it is within the range stated, may be used in place of the concentration range. For example, an aqueous solution of hydrogen peroxide containing 30 percent peroxide may be described as "Hydrogen peroxide, aqueous solution with not less than 20 percent but not more than 40 percent hydrogen peroxide" or "Hydrogen peroxide, aqueous solution with 30 percent hydrogen peroxide".

(7) Use of the prefix "mono" is optional in any shipping name, when appropriate. Thus, Iodine monochloride may be used interchangeably with Iodine chloride. In "Glycerol alpha-monochlorohydrin" the term "mono" is considered a prefix to the term "chlorohydrin" and may be deleted.

(8) *Hazardous substances. Appendix A to this section lists materials which are listed or designated as hazardous substances under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Proper shipping names for hazardous substances (see appendix A to this section and §171.8 of this subchapter) shall be determined as follows:*

(i) If the hazardous substance appears in the Table by technical name, then the technical name is the proper shipping name.

(ii) If the hazardous substance does not appear in the Table and is not a forbidden material, then an appropriate generic, or "n.o.s.", shipping name shall be selected corresponding to the hazard class (and packing group, if any) of the material as determined by the defining criteria of this subchapter (see §§173.2 and 173.2a of this subchapter). For example, a hazardous substance which is listed in appendix A but not in the Table and which meets the definition of a flammable liquid might be described as "Flammable liquid, n.o.s." or other appropriate shipping name corresponding to the flammable liquid hazard class.

(9) *Hazardous wastes. If the word "waste" is not included in the hazardous material description in Column 2 of the Table, the proper shipping name for a hazardous waste (as defined in §171.8 of this subchapter), shall include the word "Waste" preceding the*

proper shipping name of the material. For example: Waste acetone.

(10) Mixtures and solutions. (i) A mixture or solution not identified specifically by name, comprised of a hazardous material identified in the Table by technical name and non-hazardous material, shall be described using the proper shipping name of the hazardous material and the qualifying word "mixture" or "solution", as appropriate, unless-

(A) Except as provided in §172.101(i)(4) the packaging specified in Column 8 is inappropriate to the physical state of the material;

(B) The shipping description indicates that the proper shipping name applies only to the pure or technically pure hazardous material;

(C) The hazard class, packing group, or subsidiary hazard of the mixture or solution is different from that specified for the entry;

(D) There is a significant change in the measures to be taken in emergencies;

(E) The material is identified by special provision in Column 7 of the §172.101 Table as a material poisonous by inhalation; however, it no longer meets the definition of poisonous by inhalation or it falls within a different hazard zone than that specified in the special provision; or

(F) The material can be appropriately described by a shipping name that describes its intended application, such as "Coating solution", "Extracts, flavoring" or "Compound, cleaning liquid".

(ii) If one or more of the conditions specified in paragraph (c)(10)(i) of this section is satisfied, then a proper shipping name shall be selected as prescribed in paragraph (c)(12)(ii) of this section.

(iii) A mixture or solution not identified in the Table specifically by name, comprised of two or more hazardous materials in the same hazard class, shall be described using an appropriate shipping description (e.g., "Flammable liquid, n.o.s."). The name that most appropriately describes the material shall be used; e.g., an alcohol not listed by its technical name in the Table shall be described as "Alcohol, n.o.s." rather than "Flammable liquid, n.o.s.". Some mixtures may be more appropriately described according to their application, such as "Coating solution" or "Extracts, flavoring liquid" rather than by an n.o.s. entry. Under the provisions of subparts C and D of this part, the technical names of at least two components most predominately contributing to the hazards of the mixture or solution may be required in association with the proper shipping name.

(11) Except for a material subject to or prohibited by §§173.21, 173.54, 173.56(d), 173.56(e)(1), 173.124(a)(2)(iii) or 173.128(c) of this subchapter, a material for which the hazard class is uncertain and must be determined by testing or a material that is a hazardous waste may be assigned a tentative shipping name, hazard class, identification number, and packing group, based on the shipper's tentative determination according to-

(i) Defining criteria in this subchapter;

(ii) The hazard precedence prescribed in §173.2a of this subchapter; and

(iii) The shipper's knowledge of the material.

(12) Except when the proper shipping name in the Table is preceded by a plus (+)-

(i) If it is specifically determined that a material meets the definition of a hazard class, packing group or hazard zone, other than the class, packing group or hazard zone shown in association with the proper shipping name, or does not meet the defining criteria for a subsidiary hazard shown in Column 6 of the Table, the material shall be described by an appropriate proper shipping name listed in association with the correct hazard class, packing group, hazard zone, or subsidiary hazard for the material.

(ii) *Generic or n.o.s. descriptions. If an appropriate technical name is not shown in the Table, selection of a proper shipping name shall be made from the generic or n.o.s. descriptions corresponding to the specific hazard class, packing group, hazard zone, or subsidiary hazard, if any, for the material. The name that most appropriately describes the material shall be used; e.g., an alcohol not listed by its technical name in the Table shall be described as "Alcohol, n.o.s." rather than "Flammable liquid, n.o.s.". Some mixtures may be more appropriately described according to their application, such as "Coating solution" or "Extracts, flavoring, liquid", rather than by an n.o.s. entry, such as "Flammable liquid, n.o.s." It should be noted, however, that an n.o.s. description as a proper shipping name may not provide sufficient information for shipping papers and package markings. Under the provisions of subparts C and D of this part, the technical name of one or more constituents which makes the product a hazardous material may be required in association with the proper shipping name.*

(iii) Multiple hazard materials. If a material meets the definition of more than one hazard class, and is not identified in the Table specifically by name (e.g., acetyl chloride), the hazard class of the material shall be determined by using the precedence specified in §173.2a of this subchapter, and an appropriate shipping description (e.g., "Flammable liquid, corrosive n.o.s.") shall be selected as described in paragraph (c)(12)(ii) of this section.

(iv) If it is specifically determined that a material is not a forbidden material and does not meet the definition of any hazard class, the material is not a hazardous material.

(13) *Self-reactive materials and organic peroxides. A generic proper shipping name for a self-reactive material or an organic peroxide, as listed in Column 2 of the Table, must be selected based on the material's technical name and concentration, in accordance with the provisions of §§173.224 or 173.225 of this subchapter, respectively.*

(14) A proper shipping name that describes all isomers of a material may be used to identify any isomer of that material if the isomer meets criteria for the same hazard class or division, subsidiary risk(s) and packing group, unless the isomer is specifically identified in the Table.

(15) Hydrates of inorganic substances may be identified using the proper shipping name for the equivalent anhydrous substance if the hydrate meets the same hazard class or division, subsidiary risk(s) and packing group, unless the hydrate is specifically identified in the Table.

(d) *Column 3: Hazard class or Division. Column 3 contains a designation of the hazard class or division corresponding to each proper shipping name, or the word "Forbidden".*

(1) A material for which the entry in this column is "Forbidden" may not be offered for

transportation or transported. This prohibition does not apply if the material is diluted, stabilized or incorporated in a device and it is classed in accordance with the definitions of hazardous materials contained in part 173 of this subchapter.

(2) When a reevaluation of test data or new data indicates a need to modify the "Forbidden" designation or the hazard class or packing group specified for a material specifically identified in the Table, this data should be submitted to the Associate Administrator for Hazardous Materials Safety.

(3) A basic description of each hazard class and the section reference for class definitions appear in §173.2 of this subchapter.

(4) Each reference to a Class 3 material is modified to read "Combustible liquid" when that material is reclassified in accordance with §173.150 (e) or (f) of this subchapter or has a flash point above 60.5 ^{o}C (141 ^{o}F) but below 93 ^{o}C (200 ^{o}F).

(e) *Column 4: Identification number. Column 4 lists the identification number assigned to each proper shipping name. Those preceded by the letters "UN" are associated with proper shipping names considered appropriate for international transportation as well as domestic transportation. Those preceded by the letters "NA" are associated with proper shipping names not recognized for international transportation, except to and from Canada. Identification numbers in the "NA9000" series are associated with proper shipping names not appropriately covered by international hazardous materials (dangerous goods) transportation standards, or not appropriately addressed by international transportation standards for emergency response information purposes, except for transportation between the United States and Canada.*

(f) Column 5: Packing group. Column 5 specifies one or more packing groups assigned to a material corresponding to the proper shipping name and hazard class for that material. Class 2, Class 7, Division 6.2 (other than regulated medical wastes), and ORM-D materials, do not have packing groups. Packing Groups I, II and III indicate the degree of danger presented by the material is either great, medium or minor, respectively. If more than one packing group is indicated for an entry, the packing group for the hazardous material is determined using the criteria for assignment of packing groups specified in subpart D of part 173. When a reevaluation of test data or new data indicates a need to modify the specified packing group(s), the data should be submitted to the Associate Administrator for Hazardous Materials Safety. Each reference in this column to a material which is a hazardous waste or a hazardous substance, and whose proper shipping name is preceded in Column 1 of the Table by the letter "A" or "W", is modified to read "III" on those occasions when the material is offered for transportation or transported by a mode in which its transportation is not otherwise subject to requirements of this subchapter.

(g) Column 6: Labels. Column 6 specifies codes which represent the hazard warning labels required for a package filled with a material conforming to the associated hazard class and proper shipping name, unless the package is otherwise excepted from labeling by a provision in subpart E of this part, or part 173 of this subchapter. The first code is indicative of the primary hazard of the material. Additional label codes are indicative of subsidiary hazards. Provisions in §172.402 may require that a label other than that specified in Column 6 be affixed to the package in addition to that specified in Column 6. No label is required for a material classed as a combustible liquid or for a Class 3 material that is reclassed as a combustible liquid. The codes contained in Column 6 are defined according to the following table:

Label Substitution Table

Label code	Label name
1	Explosive
1.1[1]	Explosive 1.1[1]
1.2[1]	Explosive 1.2[1]
1.3[1]	Explosive 1.3[1]
1.4[1]	Explosive 1.4[1]
1.5[1]	Explosive 1.5[1]
1.6[1]	Explosive 1.6[1]
2.1	Flammable Gas
2.2	Non-Flammable Gas
2.3	Poison Gas
3	Flammable Liquid
4.1	Flammable Solid
4.2	Spontaneously Combustible
4.3	Dangerous When Wet
5.1	Oxidizer
5.2	Organic Peroxide
6.1 (inhalation hazard, Zone A or B)	Poison Inhalation Hazard
6.1 (other than inhalation hazard, Zone A or B)[2]	Poison
7	Radioactive
8	Corrosive
9	Class 9

[1]Refers to the appropriate compatibility group letter.
[2]The packing group for a material is indicated in column 5 of the table.

(h) *Column 7: Special provisions. Column 7 specifies codes for special provisions applicable to hazardous materials. When Column 7 refers to a special provision for a hazardous material, the meaning and requirements of that special provision are as set forth in §172.102 of this subpart.*

(i) Column 8: Packaging authorizations. Columns 8A, 8B and 8C specify the applicable sections for exceptions, non-bulk packaging requirements and bulk packaging requirements, respectively, in part 173 of this subchapter. Columns 8A, 8B and 8C are completed in a manner which indicates that "§173." precedes the designated numerical entry. For example, the entry "202" in Column 8B associated with the proper shipping name "Gasoline" indicates that for this material conformance to non-bulk packaging requirements prescribed in §173.202 of this subchapter is required. When packaging requirements are specified, they are in addition to the standard requirements for all packagings prescribed in §173.24 of this subchapter and any other applicable requirements in subparts A and B of part 173 of this subchapter.

(1) Exceptions. Column 8A contains exceptions from some of the requirements of this subchapter. The referenced exceptions are in addition to those specified in subpart A of part 173 and elsewhere in this subchapter. A "None" in this column means no packaging exceptions are authorized, except as may be provided by special provisions in Column 7.

(2) Non-bulk packaging. Column 8B references the section in part 173 of this subchapter which prescribes packaging requirements for non-bulk packagings. A "None" in this column means non-bulk packagings are not authorized, except as may be provided by special provisions in Column 7. Each reference in this column to a material which is a hazardous waste or a hazardous substance, and whose proper shipping name is preceded in Column 1 of the Table by the letter "A" or "W", is modified to include "§173.203" or "§173.213", as appropriate for liquids and solids, respectively, on those occasions when the material is offered for transportation or transported by a mode in which its transportation is not otherwise subject to the requirements of this subchapter.

(3) Bulk packaging. Column 8C specifies the section in part 173 of this subchapter which prescribes packaging requirements for bulk packagings, subject to the limitations, requirements and additional authorizations of Column 7. A "None" in this column means bulk packagings are not authorized, except as may be provided by special provisions in Column 7. Additional authorizations and limitations for use of IM portable tanks are set forth in Column 7. For each reference in this column to a material which is a hazardous waste or a hazardous substance, and whose proper shipping name is preceded in Column 1 of the Table by the letter "A" or "W" and which is offered for transportation or transported by a mode in which its transportation is not otherwise subject to the requirements of this subchapter:

(i) The column reference is §173.240 or §173.241, as appropriate.

(ii) For a solid material, the exception provided in Special provision B54 is applicable.

(iii) For a Class 9 material which meets the definition of an elevated temperature material, the column reference is §173.247.

(4) For a hazardous material which is specifically named in the Table and whose packaging sections specify packagings not applicable to the form of the material (e.g., packaging specified is for solid material and the material is being offered for transportation in a liquid form) the following table should be used to determine the appropriate packaging section:

Packaging section reference for solid materials	Corresponding packaging section for liquid materials
§173.187	§173.181
§173.211	§173.201
§173.212	§173.202
§173.213	§173.203
§173.240	§173.241
§173.242	§173.243

(j) *Column 9: Quantity limitations. Columns 9A and 9B specify the maximum quantities that may be offered for transportation in one package by passenger-carrying aircraft or passenger-carrying rail car (Column 9A) or by cargo aircraft only (Column 9B), subject to the following:*

(1) "Forbidden" means the material may not be offered for transportation or transported in the applicable mode of transport.

(2) The quantity limitation is "net" except where otherwise specified, such as for "Consumer commodity" which specifies "30 kg gross."

(3) When articles or devices are specifically listed by name, the net quantity limitation applies to the entire article or device (less packaging and packaging materials) rather than only to its hazardous components.

(4) A package offered or intended for transportation by aircraft and which is filled with a material forbidden on passenger-carrying aircraft but permitted on cargo aircraft only, or which exceeds the maximum net quantity authorized on passenger-carrying aircraft, shall be labelled with the CARGO AIRCRAFT ONLY label specified in §172.448 of this part.

(k) *Column 10: Vessel stowage requirements. Column 10A [Vessel stowage] specifies the authorized stowage locations on board cargo and passenger vessels. Column 10B [Other provisions] specifies codes for stowage requirements for specific hazardous materials. The meaning of each code in Column 10B is set forth in §176.84 of this subchapter. Section 176.63 of this subchapter sets forth the physical requirements for each of the authorized locations listed in Column 10A. (For bulk transportation by vessel, see 46 CFR parts 30 to 40, 70, 98, 148, 151, 153 and 154.) The authorized stowage locations specified in Column 10A are defined as follows:*

(1) Stowage category "A" means the material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel.

(2) Stowage category "B" means-

(i) The material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each three meters of overall vessel length; and

(ii) "On deck only" on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

(3) Stowage category "C" means the material must be stowed "on deck only" on a cargo vessel and on a passenger vessel.

(4) Stowage category "D" means the material must be stowed "on deck only" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers or one passenger per each three meters of overall vessel length, but the material is prohibited on passenger vessels in which the limiting number of passengers is exceeded.

(5) Stowage category "E" means the material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each three

meters of overall vessel length, but is prohibited from carriage on passenger vessels in which the limiting number of passengers is exceeded.

(l) *Changes to the Table. (1) Unless specifically stated otherwise in a rule document published in the FEDERAL REGISTER AMENDING THE TABLE-*

(i) Such a change does not apply to the shipment of any package filled prior to the effective date of the amendment; and

(ii) Stocks of preprinted shipping papers and package markings may be continued in use, in the manner previously authorized, until depleted or for a one-year period, subsequent to the effective date of the amendment, whichever is less.

(2) Except as otherwise provided in this section, any alteration of a shipping description or associated entry which is listed in the §172.101 Table must receive prior written approval from the Associate Administrator for Hazardous Materials Safety.

(3) The proper shipping name of a hazardous material changed in the May 6, 1997 final rule, in effect on October 1, 1997, only by the addition or omission of the word "compressed," "inhibited," "liquefied" or "solution" may continue to be used to comply with package marking requirements, until January 1, 2003.

§172.101 Hazardous Materials Table

Symbols	Hazardous materials descriptions and proper shipping names	Hazard class or Division	Identification Numbers	PG	Label Codes	Special provisions	(8) Packaging (73.***)			(9) Quantity limitations		(10) Vessel stowage	
-	-	-	-	-	-	-	Exceptions	Non-bulk	Bulk	Passenger aircraft/rail	Cargo air-craft only	Location	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8A)	(8B)	(8C)	(9A)	(9B)	(10A)	(10B)
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	*Accellerene, see* p-Nitrosodimethylaniline	-	-	-	-	-	-	-	-	-	-	-	-
-	*Accumulators, electric, see* Batteries, wet *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D	Accumulators, pressurized, pneumatic *or* hydraulic (*containing non-flammable gas*)	2.2	NA1956	-	2.2	-	306	306	None	No limit	No limit	A	-
-	Acetal	3	UN1088	II	3	T7	150	202	242	5 L	60 L	E	-
-	Acetaldehyde	3	UN1089	I	3	A3, B16, T20, T26, T29	None	201	243	Forbidden	30 L	E	-
A	Acetaldehyde ammonia	9	UN1841	III	9	-	155	204	240	200 kg	200 kg	A	34
-	Acetaldehyde oxime	3	UN2332	III	3	B1, T8	150	203	242	60 L	220 L	A	-
-	Acetic acid, glacial *or* Acetic acid solution, *with more than 80 percent acid, by mass*	8	UN2789	II	8, 3	A3, A6, A7, A10 B2, T8	154	202	243	1 L	30 L	A	-
-	Acetic acid solution, *not less than 50 percent but not more than 80 percent acid, by mass*	8	UN2790	II	8	A3, A6, A7, A10, B2, T8	154	202	242	1 L	30 L	A	-
-	Acetic acid solution, *with more than 10 percent and less than 50 percent acid, by mass*	8	UN2790	III	8	T8	154	203	242	5 L	60 L	A	-
-	Acetic anhydride	8	UN1715	II	8, 3	A3, A6, A7, A10, B2, T8	154	202	243	1 L	30 L	A	40
-	Acetone	3	UN1090	II	3	T8	150	202	242	5 L	60 L	B	-
-	Acetone cyanohydrin, stabilized	6.1	UN1541	I	6.1	2, A3, B9, B14, B32, B76, B77, N34, T38, T43, T45	None	227	244	Forbidden	30 L	D	25, 40, 49
-	Acetone oils	3	UN1091	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	Acetonitrile	3	UN1648	II	3	T14	150	202	242	5L	60L	B	40
-	*Acetyl acetone peroxide with more than 9 percent by mass*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

	active oxygen												
-	*Acetyl benzoyl peroxide, solid, or with more than 40 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Acetyl bromide	8	UN1716	II	8	B2, T12, T26	154	202	242	1 L	30 L	C	40
-	Acetyl chloride	3	UN1717	II	3, 8	A3, A6, A7, B100, N34, T18, T26	None	202	243	1 L	5 L	B	40
-	*Acetyl cyclohexanesulfonyl peroxide, with more than 82 percent wetted with less than 12 percent water*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Acetyl iodide	8	UN1898	II	8	B2, B101, T9	154	202	242	1 L	30 L	C	40
-	Acetyl methyl carbinol	3	UN2621	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Acetyl peroxide, solid, or with more than 25 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Acetylene, dissolved	2.1	UN1001	-	2.1	-	None	303	None	Forbidden	15kg	D	25, 40, 57
-	*Acetylene (liquefied)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Acetylene silver nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Acetylene tetrabromide, see* Tetrabromoethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*Acid butyl phosphate, see* Butyl acid phosphate	-	-	-	-	-	-	-	-	-	-	-	-
-	Acid, sludge, *see* Sludge acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Acridine	6.1	UN2713	III	6.1	-	153	213	240	100 kg	200kg	A	-
-	Acrolein dimer, stabilized	3	UN2607	III	3	B1, T1	150	203	242	60 L	220 L	A	40
-	Acrolein, inhibited	6.1	UN1092	I	6.1, 3	1, B9, B14, B30, B42, B72, B77, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	Acrylamide	6.1	UN2074	III	6.1	T8	153	213	240	100 kg	200 kg	A	12
-	Acrylic acid, inhibited	8	UN2218	II	8, 3	B2, T8	154	202	243	1 L	30 L	C	25, 40
-	Acrylonitrile, inhibited	3	UN1093	I	3, 6.1	B9, T18, T26	None	201	243	Forbidden	30 L	E	40
-	*Actuating cartridge, explosive, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	Adhesives, *containing a flammable liquid*	3	UN1133	I	3	B42, T7, T30	150	201	243	1 L	30 L	B	-
-	-	-	-	II	3	B52, T7, T30	150	173	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	173	242	60 L	220 L	A	-
-	Adiponitrile	6.1	UN2205	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	Aerosols, *corrosive, Packing Group II or III, (each not exceeding 1 L capacity)*	2.2	UN1950	-	2.2, 8	A34	306	None	None	75 kg	150 kg	A	40, 48, 85
-	Aerosols, *flammable, (each not exceeding 1 L capacity)*	2.1	UN1950	-	2.1	N82	306	None	None	75 kg	150 kg	A	40, 48, 85
-	Aerosols, flammable, n.o.s. (*engine starting fluid) (each not exceeding 1 L capacity)*	2.1	UN1950	-	2.1	N82	306	None	None	Forbidden	150kg	A	40, 48, 85
-	Aerosols, *non-flammable, (each not exceeding 1 L capacity)*	2.2	UN1950	-	2.2	-	306, 307	None	None	75 kg	150 kg	A	48, 85
-	Aerosols, *poison, each not exceeding 1 L capacity*	2.2	UN1950	-	2.2	-	306	None	None	Forbidden	Forbidden	A	40, 48, 85
-	Air bag inflators, compressed gas *or* Air bag modules, compressed gas *or* Seat-belt pretensioners, compressed gas	2.2	UN3353	-	2.2	133	166	166	166	75 kg	150 kg	A	-
-	Air bag inflators, *pyrotechnic or* Air bag modules, *pyrotechnic or* Seat-belt pretensioner, *pyrotechnic*	9	UN3268	III	9	-	166	166	166	25 kg	100 kg	A	-
-	Air, compressed	2.2	UN1002	-	2.2	-	306	302	302	75 kg	150 kg	A	-
-	Air, refrigerated liquid, *(cryogenic liquid)*	2.2	UN1003	-	2.2, 5.1	-	320	316	318, 319	Forbidden	150 kg	D	51
-	Air, refrigerated liquid, *(cryogenic liquid) non-pressurized*	2.2	UN1003	-	2.2, 5.1	-	320	316	318, 319	Forbidden	Forbidden	D	51
-	*Aircraft evacuation slides, see* Life saving appliances *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Aircraft hydraulic power unit fuel tank *(containing a mixture of anhydrous hydrazine and monomethyl hydrazine) (M86 fuel)*	3	UN3165	I	3, 6.1, 8	-	None	172	None	Forbidden	42 L	E	-
-	*Aircraft survival kits, see* Life saving appliances *etc*	-	-	-	-	-	-	-	-	-	-	-	-
G	Alcoholates solution, n.o.s., *in alcohol*	3	UN3274	II	3, 8	-	None	202	243	1 L	5 L	B	-
-	Alcoholic beverages	3	UN3065	II	3	24, B1, T1	150	202	242	5 L	60 L	A	-
-	-	-	-	III	3	24, B1, N11, T1	150	203	242	60 L	220 L	A	-

-	Alcohols, n.o.s	3	UN1987	I	3	T8, T31	None	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
G	Alcohols, flammable, toxic, n.o.s	3	UN1986	I	3, 6.1	T8, T31	None	201	243	Forbidden	30 L	E	40
-	-	-	-	II	3, 6.1	T8, T31	None	202	243	1 L	60 L	B	40
-	-	-	-	III	3, 6.1	B1, T8, T31	None	203	242	60 L	220 L	A	-
-	Aldehydes, n.o.s	3	UN1989	I	3	T8, T31	None	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
G	Aldehydes, flammable, toxic, n.o.s	3	UN1988	I	3, 6.1	T8, T31	None	201	243	Forbidden	30 L	E	40
-	-	-	-	II	3, 6.1	T8, T31	None	202	243	1 L	60 L	B	40
-	-	-	-	III	3, 6.1	B1, T8, T31	150	203	242	60 L	220 L	A	-
-	Aldol	6.1	UN2839	II	6.1	T8	None	202	243	5 L	60 L	A	12
D	Aldrin, *liquid*	6.1	NA2762	II	6.1	-	None	202	243	5 L	60 L	B	-
D	Aldrin, *solid*	6.1	NA2761	II	6.1	-	None	212	242	25 kg	100 kg	A	40
G	Alkali metal alcoholates, self-heating, corrosive, n.o.s	4.2	UN3206	II	4.2, 8	64	None	212	242	15 kg	50 kg	B	-
-	-	-	-	III	4.2, 8	64	None	213	242	25 kg	100 kg	B	-
-	Alkali metal alloys, liquid, n.o.s	4.3	UN1421	I	4.3	A2, A3, B48, N34	None	201	244	Forbidden	1 L	D	-
-	Alkali metal amalgam, liquid	4.3	UN1389	I	4.3	A2, A3, N34	None	201	244	Forbidden	1 L	D	40
-	Alkali metal amalgam, solid	4.3	UN1389	I	4.3	B101, B106, N40	None	211	242	Forbidden	15 kg	D	-
-	Alkali metal amides	4.3	UN1390	II	4.3	A6, A7, A8, A19, A20, B106	151	212	241	15 kg	50 kg	E	40
-	Alkali metal dispersions, *or* Alkaline earth metal dispersions	4.3	UN1391	I	4.3	A2, A3	None	201	244	Forbidden	1 L	D	-
-	*Alkaline corrosive liquids, n.o.s., see* Caustic alkali liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
G	Alkaline earth metal alcoholates, n.o.s	4.2	UN3205	II	4.2	65	None	212	241	15kg	50kg	B	-
-	-	-	-	III	4.2	65	None	213	241	25 kg	100 kg	B	-
-	Alkaline earth metal alloys, n.o.s	4.3	UN1393	II	4.3	A19, B101, B106	151	212	241	15 kg	50 kg	E	-
-	Alkaline earth metal amalgams	4.3	UN1392	I	4.3	A19, B101, B106, N34, N40	None	211	242	Forbidden	15 kg	D	-
G	Alkaloids, liquid, n.o.s., *or* Alkaloid salts, liquid, n.o.s	6.1	UN3140	I	6.1	A4, T42	None	201	243	1 L	30 L	A	-
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
G	Alkaloids, solid, n.o.s. *or* Alkaloid salts, solid, n.o.s. *poisonous*	6.1	UN1544	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Alkyl sulfonic acids, liquid *or* Aryl sulfonic acids, liquid *with more than 5 percent free sulfuric acid*	8	UN2584	II	8	B2, T8, T27	154	202	242	1 L	30 L	B	-
-	Alkyl sulfonic acids, liquid *or* Aryl sulfonic acids, liquid *with not more than 5 percent free sulfuric acid*	8	UN2586	III	8	T8	154	203	241	5 L	60 L	B	-
-	Alkyl sulfonic acids, solid *or* Aryl sulfonic acids, solid, *with more than 5 percent free sulfuric acid*	8	UN2583	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Alkyl sulfonic acids, solid *or* Aryl sulfonic acids, solid *with not more than 5 percent free sulfuric acid*	8	UN2585	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Alkylphenols, liquid, n.o.s. *(including C2-C12 homologues)*	8	UN3145	I	8	T8	None	201	243	0.5 L	2.5 L	B	-
-	-	-	-	II	8	T8	154	202	242	1 L	30 L	B	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	Alkylphenols, solid, n.o.s. *(including C2-C12 homologues)*	8	UN2430	I	8	T8	None	211	242	1 kg	25 kg	B	-
-	-	-	-	II	8	T8	154	212	240	15 kg	50 kg	B	-
-	-	-	-	III	8	T8	154	213	240	25 kg	100 kg	A	-
-	Alkylsulfuric acids	8	UN2571	II	8	B2, T9, T27	154	202	242	1 L	30 L	C	14

-	*Allethrin, see* Pesticides, liquid, toxic, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Allyl acetate	3	UN2333	II	3, 6.1	T8	None	202	243	1 L	60 L	E	40
-	Allyl alcohol	6.1	UN1098	I	6.1, 3	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Allyl bromide	3	UN1099	I	3, 6.1	T18	None	201	243	Forbidden	30 L	B	40
-	Allyl chloride	3	UN1100	I	3, 6.1	T18, T26	None	201	243	Forbidden	30 L	E	40
-	*Allyl chlorocarbonate, see* Allyl chloroformate	-	-	-	-	-	-	-	-	-	-	-	-
-	Allyl chloroformate	6.1	UN1722	I	6.1, 3, 8	2, A3, B9, B14, B32, B74, N41, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Allyl ethyl ether	3	UN2335	II	3, 6.1	T8	None	202	243	1 L	60 L	E	40
-	Allyl formate	3	UN2336	I	3, 6.1	T18, T26	None	201	243	Forbidden	30 L	E	40
-	Allyl glycidyl ether	3	UN2219	III	3	B1, T7	150	203	242	60 L	220 L	A	-
-	Allyl iodide	3	UN1723	II	3, 8	A3, A6, B100, N34, T18	None	202	243	1 L	5 L	B	40
-	Allyl isothiocyanate, stabilized	6.1	UN1545	II	6.1, 3	A3, A7	None	202	243	Forbidden	60 L	D	40
-	Allylamine	6.1	UN2334	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Allyltrichlorosilane, stabilized	8	UN1724	II	8, 3	A7, B2, B6, N34, T8, T26	None	202	243	Forbidden	30 L	C	40
-	Aluminum alkyl halides	4.2	UN3052	I	4.2, 4.3	B9, B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	-
-	Aluminum alkyl hydrides	4.2	UN3076	I	4.2, 4.3	B9, B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	-
-	Aluminum alkyls	4.2	UN3051	I	4.2, 4.3	B9, B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	-
-	Aluminum borohydride *or* Aluminum borohydride in devices	4.2	UN2870	I	4.2, 4.3	B11	None	181	244	Forbidden	Forbidden	D	-
-	Aluminum bromide, anhydrous	8	UN1725	II	8	B106	154	212	240	15 kg	50 kg	A	40
-	Aluminum bromide, solution	8	UN2580	III	8	T8	154	203	241	5 L	60 L	A	-
-	Aluminum carbide	4.3	UN1394	II	4.3	A20, B101, B106, N41	151	212	242	15 kg	50 kg	A	-
-	Aluminum chloride, anhydrous	8	UN1726	II	8	B106	154	212	240	15 kg	50kg	A	40
-	Aluminum chloride, solution	8	UN2581	III	8	T8	154	203	241	5 L	60 L	A	-
-	*Aluminum dross, wet or hot*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Aluminum ferrosilicon powder	4.3	UN1395	II	4.3, 6.1	A19, B106, B108	151	212	242	15 kg	50 kg	A	40, 85, 103
-	-	-	-	III	4.3, 6.1	A19, A20, B106, B108	151	213	241	25 kg	100 kg	A	40, 85, 103
-	Aluminum hydride	4.3	UN2463	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
D	Aluminum, molten	9	NA9260	III	9	-	None	None	247	Forbidden	Forbidden	D	-
-	Aluminum nitrate	5.1	UN1438	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	*Aluminum phosphate solution, see* Corrosive liquids, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Aluminum phosphide	4.3	UN1397	I	4.3, 6.1	A8, A19, B100, N40	None	211	242	Forbidden	15 kg	E	40, 85
-	Aluminum phosphide pesticides	6.1	UN3048	I	6.1	A8	None	211	242	Forbidden	15 kg	E	40, 85
-	Aluminum powder, coated	4.1	UN1309	II	4.1	-	151	212	240	15 kg	50 kg	A	13, 39, 101
-	-	-	-	III	4.1	-	151	213	240	25 kg	100 kg	A	13, 39, 101
-	Aluminum powder, uncoated	4.3	UN1396	II	4.3	A19, A20, B106, B108	151	212	242	15 kg	50 kg	A	39
-	-	-	-	III	4.3	A19, A20, B106, B108	151	213	241	25 kg	100 kg	A	39
-	Aluminum resinate	4.1	UN2715	III	4.1	-	151	213	240	25 kg	100 kg	A	-
-	Aluminum silicon powder, uncoated	4.3	UN1398	III	4.3	A1, A19, B108	151	213	241	25 kg	100 kg	A	40, 85, 103
-	Aluminum smelting by-products *or* Aluminum remelting by-	4.3	UN31	II	4.3	128, B106, B115	Non	212	242	15 kg	50 kg	B	85,

	products		70				e						103
-	-	-	-	III	4.3	128, B106, B115	None	213	241	25 kg	100 kg	B	85, 103
-	*Amatols, see* Explosives, blasting, type B	-	-	-	-	-	-	-	-	-	-	-	-
G	Amines, flammable, corrosive, n.o.s. *or* Polyamines, flammable, corrosive, n.o.s.	3	UN2733	I	3, 8	T42	None	201	243	0.5 L	2.5 L	D	40
-	-	-	-	II	3, 8	T8, T31	None	202	243	1 L	5 L	B	40
-	-	-	-	III	3, 8	B1, T8, T31	150	203	242	5 L	60 L	A	40
G	Amines, liquid, corrosive, flammable, n.o.s. *or* Polyamines, liquid, corrosive, flammable, n.o.s	8	UN2734	I	8, 3	A3, A6, N34, T8, T31	None	201	243	0.5 L	2.5 L	A	-
-	-	-	-	II	8, 3	T8, T31	None	202	243	1 L	30 L	A	-
G	Amines, liquid, corrosive, n.o.s, *or* Polyamines, liquid, corrosive, n.o.s	8	UN2735	I	8	A3, A6, B10, N34, T42	None	201	243	0.5 L	2.5 L	A	-
-	-	-	-	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T8	154	203	241	5 L	60 L	A	-
G	Amines, solid, corrosive, n.o.s., *or* Polyamines, solid, corrosive n.o.s	8	UN3259	I	8	-	None	211	242	1 kg	25 kg	A	-
-	-	-	-	II	8	-	154	212	240	15 kg	50 kg	A	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
-	2-Amino-4-chlorophenol	6.1	UN2673	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	2-Amino-5-diethylaminopentane	6.1	UN2946	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	2-Amino-4,6-Dinitrophenol, wetted *with not less than 20 percent water by mass*	4.1	UN3317	I	4.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	E	28, 36
-	2-(2-Aminoethoxy) ethanol	8	UN3055	III	8	T2	154	203	241	5 L	60 L	A	-
-	N-Aminoethylpiperazine	8	UN2815	III	8	T7	154	203	241	5 L	60 L	A	12
+	Aminophenols (o-; m-; p-)	6.1	UN2512	III	6.1	T1	153	213	240	100 kg	200 kg	A	-
-	*Aminopropyldiethanolamine, see* Amines,*etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*n-Aminopropylmorpholine, see* Amines, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Aminopyridines *(o-; m-; p-)*	6.1	UN2671	II	6.1	T7	None	212	242	25 kg	100 kg	B	12, 40
I	Ammonia, anhydrous	2.3	UN1005	-	2.3, 8	4	None	304	314, 315	Forbidden	25 kg	D	40, 57
D	Ammonia, anhydrous	2.2	UN1005	-	2.2	13	None	304	314, 315	Forbidden	25 kg	D	40, 57
D	Ammonia solution, *relative density less than 0.880 at 15 degrees C in water, with more than 50 percent ammonia*	2.2	UN3318	-	2.2	13	None	304	314, 315	Forbidden	25 kg	D	40, 57
I	Ammonia solution, *relative density less than 0.880 at 15 degrees C in water, with more than 50 percent ammonia*	2.3	UN3318	-	2.3, 8	4	None	304	314, 315	Forbidden	25 kg	D	40, 57
-	Ammonia solutions, *relative density between 0.880 and 0.957 at 15 degrees C in water, with more than 10 percent but not more than 35 percent ammonia*	8	UN2672	III	8	T14	154	203	241	5 L	60 L	A	40, 85
-	Ammonia solutions, *relative density less than 0.880 at 15 degrees C in water, with more than 35 percent but not more than 50 percent ammonia*	2.2	UN2073	-	2.2	-	306	304	314, 315	Forbidden	150 kg	E	40, 57
-	Ammonium arsenate	6.1	UN1546	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Ammonium azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Ammonium bifluoride, solid, see* Ammonium hydrogen di-fluoride, solid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ammonium bifluoride solution, see* Ammonium hydrogen difluoride, solution	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ammonium bromate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Ammonium chlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium dichromate	5.1	UN1439	II	5.1	-	152	212	242	5 kg	25 kg	A	-
-	Ammonium dinitro-o-cresolate	6.1	UN1843	II	6.1	T8	None	212	242	25 kg	100 kg	B	36, 65, 66, 77
-	Ammonium fluoride	6.1	UN2505	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	Ammonium fluorosilicate	6.1	UN2854	III	6.1	-	153	213	240	100 kg	200 kg	A	26

-	*Ammonium fulminate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium hydrogen sulfate	8	UN2506	II	8	-	154	212	240	15 kg	50 kg	A	40
-	Ammonium hydrogendifluoride, solid	8	UN1727	II	8	B106, N34	154	212	240	15 kg	50 kg	A	25, 26, 40
-	Ammonium hydrogendifluoride, solution	8	UN2817	II	8, 6.1	N34, T15	None	202	243	1 L	30 L	B	40
-	-	-	-	III	8, 6.1	T8	154	203	241	5 L	60 L	B	40, 95
-	*Ammonium hydrosulfide, solution, see* Ammonium sulfide solution	-	-	-	-	-	-	-	-	-	-	-	-
D	Ammonium hydroxide, *see* Ammonia solutions, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium metavanadate	6.1	UN2859	II	6.1	-	None	212	242	25 kg	100 kg	A	-
D	Ammonium nitrate fertilizers	5.1	NA2072	III	5.1	7	152	213	240	25 kg	100 kg	B	48, 59, 60, 117
-	Ammonium nitrate fertilizers;*uniform non-segregating mixtures of ammonium nitrate with added matter which is inorganic and chemically inert towards ammonium nitrate, with not less than 90 percent ammonium nitrate and not more than 0.2 percent combustible material (including organic material calculated as carbon), or with more than 70percent but less than 90 percent ammonium nitrate and not more than 0.4 percent total combustible material.*	5.1	UN2067	III	5.1	52	152	213	240	25 kg	100 kg	B	48, 59, 60, 117
A, W	Ammonium nitrate fertilizers: *uniform non-segregating mixtures of nitrogen/phosphate or nitrogen/postash types or complete fertilizers of nitrogen/phosphate/postash type, with not more than 70 percent ammonium nitrate and not more than 0.4 percent total added combustible material or with not more than 45 percent ammonium nitrate with unrestricted combustible material*	9	UN2071	III	9	132	155	213	240	200 kg	200 kg	A	-
D	Ammonium nitrate-fuel oil mixture *containing only prilled ammonium nitrate and fuel oil*	1.5D	NA0331	II	1.5D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Ammonium nitrate, liquid *(hot concentrated solution)*	5.1	UN2426	-	5.1	B5, B100, T25	None	None	243	Forbidden	Forbidden	D	59, 60
D	Ammonium nitrate mixed fertlizers	5.1	NA2069	III	5.1	10	152	213	240	25 kg	100 kg	B	48, 59, 60, 117
-	Ammonium nitrate, *with more than 0.2 percent combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance*	1.1D	UN0222	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 19E
-	Ammonium nitrate, *with not more than 0.2 percent of combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance*	5.1	UN1942	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	48, 59, 60, 116
-	*Ammonium nitrite*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium perchlorate	1.1D	UN0402	II	1.1D	107	None	62	None	Forbidden	Forbidden	B	1E, 5E, 19E
-	Ammonium perchlorate	5.1	UN1442	II	5.1	107, A9	152	212	242	5 kg	25 kg	E	58, 69, 106
-	*Ammonium permanganate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium persulfate	5.1	UN1444	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Ammonium picrate, *dry or wetted with less than 10 percent water, by mass*	1.1D	UN0004	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 19E
-	Ammonium picrate, wetted *with not less than 10 percent water, by mass*	4.1	UN1310	I	4.1	23, A2, N41	None	211	None	0.5 kg	0.5 kg	D	28, 36
-	Ammonium polysulfide, solution	8	UN2818	II	8, 6.1	T14	None	202	243	1 L	30 L	B	12, 26, 40
-	-	-	-	III	8, 6.1	T7	154	203	241	5 L	60 L	B	12, 26, 40
-	Ammonium polyvanadate	6.1	UN2861	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Ammonium silicofluoride, see* Ammonium fluorosilicate	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammonium sulfide solution	8	UN2683	II	8, 6.1, 3	T14	None	202	243	1 L	30 L	B	12, 22, 26, 100
-	*Ammunition, blank, see* Cartridges for weapons, blank	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammunition, illuminating *with or without burster, expelling charge or propelling charge*	1.2G	UN0171	II	1.2G	-	-	62	None	Forbidden	Forbidden	B	-
-	Ammunition, illuminating *with or without burster, expelling charge or propelling charge*	1.3G	UN0254	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	-
-	Ammunition, illuminating *with or without burster, expelling*	1.4G	UN02	II	1.4	-	-	62	Non	Forbidden	75 kg	A	24E

	charge or propelling charge		97		G				e				
-	Ammunition, incendiary *liquid or gel, with burster, expelling charge or propelling charge*	1.3J	UN0247	II	1.3J	-	-	62	None	Forbidden	Forbidden	E	7E, 13E, 23E
-	*Ammunition, incendiary (water-activated contrivances) with burster, expelling charge or propelling charge, see* Contrivances, water-activated, etc	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammunition, incendiary, white phosphorus, *with burster, expelling charge or propelling charge*	1.2H	UN0243	II	1.2H	-	-	62	None	Forbidden	Forbidden	E	8E, 14E, 15E, 17E
-	Ammunition, incendiary, white phosphorus, *with burster, expelling charge or propelling charge*	1.3H	UN0244	II	1.3H	-	-	62	None	Forbidden	Forbidden	E	8E, 14E, 15E, 17E
-	Ammunition, incendiary *with or without burster, expelling charge, or propelling charge*	1.2G	UN0009	II	1.2G	-	-	62	None	Forbidden	Forbidden	B	-
-	Ammunition, incendiary *with or without burster, expelling charge, or propelling charge*	1.3G	UN0010	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	-
-	Ammunition, incendiary *with or without burster, expelling charge or propelling charge*	1.4G	UN0300	II	1.4G	-	-	62	None	Forbidden	75 kg	A	24E
-	Ammunition, practice	1.4G	UN0362	II	1.4G	-	-	62	None	Forbidden	75 kg	A	24E
-	Ammunition, practice	1.3G	UN0488	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	-
-	Ammunition, proof	1.4G	UN0363	II	1.4G	-	-	62	None	Forbidden	75kg	A	24E
-	*Ammunition, rocket, see* Warheads, rocket *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ammunition, SA (small arms), see* Cartridges for weapons, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ammunition, smoke (water-activated contrivances), white phosphorus, with burster, expelling charge or propelling charge, see* Contrivances, water-activated, *etc. (UN 0248)*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ammunition, smoke (water-activated contrivances), without white phosphorus or phosphides, with burster, expelling charge or propelling charge, see* Contrivances, water-activated, *etc. (UN 0249)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammunition smoke, white phosphorus *with burster,expelling charge, or propelling charge*	1.2H	UN0245	II	1.2H	-	-	62	None	Forbidden	Forbidden	E	8E, 14E, 15E, 17E
-	Ammunition, smoke, white phosphorus *with burster, expelling charge, or propelling charge*	1.3H	UN0246	II	1.3H	-	-	62	None	Forbidden	Forbidden	E	8E, 14E, 15E, 17E
-	Ammunition, smoke *with or without burster, expelling charge or propelling charge*	1.2G	UN0015	II	1.2G, 8	-	-	62	None	Forbidden	Forbidden	E	17E, 20E
-	Ammunition, smoke *with or without burster, expelling charge or propelling charge*	1.3G	UN0016	II	1.3G, 8	-	-	62	None	Forbidden	Forbidden	E	17E, 20E
-	Ammunition, smoke *with or without burster, expelling charge or propelling charge*	1.4G	UN0303	II	1.4G, 8	-	-	62	None	Forbidden	75 kg	E	17E, 20E
-	*Ammunition, sporting, see* Cartridges for weapons, *etc. (UN 0012; UN 0328; UN 0339)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Ammunition, tear-producing, non-explosive, *without burster or expelling charge, non-fuzed*	6.1	UN2017	II	6.1, 8	-	None	212	None	Forbidden	50 kg	E	13, 40
-	Ammunition, tear-producing *with burster, expelling charge or propelling charge*	1.2G	UN0018	II	1.2G, 8, 6.1	-	-	62	None	Forbidden	Forbidden	E	20E
-	Ammunition, tear-producing *with burster, expelling charge or propelling charge*	1.3G	UN0019	II	1.3G, 8, 6.1	-	-	62	None	Forbidden	Forbidden	E	17E, 20E
-	Ammunition, tear-producing *with burster, expelling charge or propelling charge*	1.4G	UN0301	II	1.4G, 8, 6.1	-	-	62	None	Forbidden	75 kg	E	17E, 20E
-	Ammunition, toxic, non-explosive, *without burster or expelling charge, non-fuzed*	6.1	UN2016	II	6.1	-	None	212	None	Forbidden	100 kg	E	13, 40
-	*Ammunition, toxic (water-activated contrivances), with burster, expelling charge or propelling charge, see* Contrivances, water-activated, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
G	Ammunition, toxic *with burster, expelling charge, or propelling charge*	1.2K	UN0020	II	1.2K, 6.1	-	-	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Ammunition, toxic *with burster, expelling charge, or propelling charge*	1.3K	UN0021	II	1.3K, 6.1	-	-	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E

-	Amyl acetates	3	UN1104	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Amyl acid phosphate	8	UN2819	III	8	T7	154	203	241	5 L	60 L	A	-
-	Amyl butyrates	3	UN2620	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Amyl chlorides	3	UN1107	II	3	T1	150	202	242	5 L	60 L	B	-
-	Amyl formates	3	UN1109	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Amyl mercaptans	3	UN1111	II	3	A3, T8	None	202	242	5 L	60 L	B	95, 102
-	n-Amyl methyl ketone	3	UN1110	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Amyl nitrate	3	UN1112	III	3	B1, T1	150	203	242	60 L	220 L	A	40
-	Amyl nitrites	3	UN1113	II	3	T8	150	202	242	5 L	60 L	E	40
-	Amylamines	3	UN1106	II	3, 8	T1	None	202	243	1 L	5 L	B	-
-	-	-	-	III	3, 8	B1	150	203	242	5 L	60 L	A	-
-	Amyltrichlorosilane	8	UN1728	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Anhydrous ammonia *see Ammonia, anhydrous*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Anhydrous hydrofluoric acid, see* Hydrogen fluoride, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
+	Aniline	6.1	UN1547	II	6.1	T8	None	202	243	5 L	60 L	A	40
-	Aniline hydrochloride	6.1	UN1548	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*Aniline oil, see* Aniline	-	-	-	-	-	-	-	-	-	-	-	-
-	Anisidines	6.1	UN2431	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	Anisole	3	UN2222	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Anisoyl chloride	8	UN1729	II	8	B2, T8	154	202	242	1 L	30 L	C	40
-	*Anti-freeze, liquid, see* Flammable liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	*Antimonous chloride, see* Antimony trichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Antimony compounds, inorganic, liquid, n.o.s	6.1	UN3141	III	6.1	35, T7	153	203	241	60 L	220 L	A	-
-	Antimony compounds, inorganic, solid, n.o.s	6.1	UN1549	III	6.1	35	153	213	240	100 kg	200 kg	A	-
-	Antimony lactate	6.1	UN1550	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Antimony pentachloride, liquid	8	UN1730	II	8	B2, T8, T26	None	202	242	1 L	30 L	C	40
-	Antimony pentachloride, solutions	8	UN1731	II	8	B2, T8, T27	154	202	242	1 L	30 L	C	40
-	-	-	-	III	8	T7, T26	154	203	241	5 L	60 L	C	40
-	Antimony pentafluoride	8	UN1732	II	8, 6.1	A3, A6, A7, A10, N3, T12, T26	None	202	243	Forbidden	30 L	D	40
-	Antimony potassium tartrate	6.1	UN1551	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Antimony powder	6.1	UN2871	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*Antimony sulfide and a chlorate, mixtures of*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Antimony sulfide, solid, see* Antimony compounds, inorganic, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
D	Antimony tribromide, solid	8	NA1549	II	8	-	154	212	240	25 kg	100 kg	A	13
D	Antimony tribromide, solution	8	NA1549	II	8	B2	154	202	242	1 L	30 L	C	13
-	Antimony trichloride, liquid	8	UN1733	II	8	B2	154	202	242	1 L	30 L	C	40
-	Antimony trichloride, solid	8	UN1733	II	8	B106	154	212	240	15 kg	50 kg	A	40
D	Antimony trifluoride, solid	8	NA1549	II	8	-	154	212	240	25 kg	25 kg	A	13
D	Antimony trifluoride, solution	8	NA1549	II	8	B2	154	202	242	1 L	30 L	C	13
-	*Aqua ammonia, see* Ammonia solution, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Argon, compressed	2.2	UN1006	-	2.2	-	306	302	314, 315	75 kg	150 kg	A	-
-	Argon, refrigerated liquid *(cryogenic liquid)*	2.2	UN1951	-	2.2	-	320	316	318	50 kg	500 kg	B	-
-	Arsenic	6.1	UN15	II	6.1	-	Non	212	242	25 kg	100 kg	A	-

			58				e						
-	Arsenic acid, liquid	6.1	UN1553	I	6.1	T18, T27	None	201	243	1 L	30 L	B	46
-	Arsenic acid, solid	6.1	UN1554	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Arsenic bromide	6.1	UN1555	II	6.1	-	None	212	242	25 kg	100 kg	A	12, 40
-	*Arsenic chloride, see* Arsenic trichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Arsenic compounds, liquid, n.o.s. *inorganic, including arsenates, n.o.s.; arsenites, n.o.s.; arsenic sulfides, n.o.s.; and organic compounds of arsenic, n.o.s.*	6.1	UN1556	I	6.1	-	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	-	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	-	153	203	241	60 L	220 L	B	40
-	Arsenic compounds, solid, n.o.s. *inorganic, including arsenates, n.o.s.; arsenites, n.o.s.; arsenic sulfides, n.o.s.; and organic compounds of arsenic, n.o.s.*	6.1	UN1557	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Arsenic pentoxide	6.1	UN1559	II	6.1	-	None	212	242	25 kg	100 kg	A	-
D	Arsenic sulfide	6.1	NA1557	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Arsenic sulfide and a chlorate, mixtures of*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Arsenic trichloride	6.1	UN1560	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	40
-	Arsenic trioxide	6.1	UN1561	II	6.1	-	None	212	242	25 kg	100 kg	A	-
D	Arsenic trisulfide	6.1	NA1557	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Arsenic, white, solid, see* Arsenic trioxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Arsenical dust	6.1	UN1562	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Arsenical pesticides, liquid, flammable, toxic*, flash point less than 23 degrees C*	3	UN2760	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Arsenical pesticides, liquid, toxic	6.1	UN2994	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Arsenical pesticides, liquid, toxic, flammable *flashpoint not less than 23 degrees C*	6.1	UN2993	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
-	Arsenical pesticides, solid, toxic	6.1	UN2759	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Arsenious acid, solid, see* Arsenic trioxide	-	-	-	-	-	-	-	-	-	-	-	-
-	*Arsenious and mercuric iodide solution, see* Arsenic compounds, liquid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Arsine	2.3	UN2188	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40
-	Articles, explosive, extremely insensitive *or* Articles, EEI	1.6N	UN0486	II	1.6N	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.4S	UN0349	II	1.4S	101	None	62	None	25 kg	100 kg	A	-
G	Articles, explosive, n.o.s	1.4B	UN0350	II	1.4B	101	None	62	None	Forbidden	Forbidden	A	24E
G	Articles, explosive, n.o.s	1.4C	UN0351	II	1.4C	101	None	62	None	Forbidden	75 kg	A	24E
G	Articles, explosive, n.o.s	1.4D	UN0352	II	1.4D	101	None	62	None	Forbidden	75 kg	A	24E
G	Articles, explosive, n.o.s	1.4G	UN0353	II	1.4G	101	None	62	None	Forbidden	75 kg	A	24E
G	Articles, explosive, n.o.s	1.1L	UN0354	II	1.1L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Articles, explosive, n.o.s	1.2L	UN0355	II	1.2L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E

G	Articles, explosive, n.o.s	1.3L	UN0356	II	1.3L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Articles, explosive, n.o.s	1.1C	UN0462	II	1.1C	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.1D	UN0463	II	1.1D	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.1E	UN0464	II	1.1E	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.1F	UN0465	II	1.1F	101	None	62	None	Forbidden	Forbidden	E	-
G	Articles, explosive, n.o.s	1.2C	UN0466	II	1.2C	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.2D	UN0467	II	1.2D	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.2E	UN0468	II	1.2E	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.2F	UN0469	II	1.2F	101	None	62	None	Forbidden	Forbidden	E	-
G	Articles, explosive, n.o.s	1.3C	UN0470	II	1.3C	101	None	62	None	Forbidden	Forbidden	B	-
G	Articles, explosive, n.o.s	1.4E	UN0471	II	1.4E	101	None	62	None	Forbidden	75 kg	A	24E
G	Articles, explosive, n.o.s	1.4F	UN0472	II	1.4F	101	None	62	None	Forbidden	Forbidden	E	-
-	Articles, pressurized pneumatic *or* hydraulic *containing non-flammable gas*	2.2	UN3164	-	2.2	-	306	302, 304	None	No limit	No limit	A	-
-	Articles, pyrophoric	1.2L	UN0380	II	1.2L	-	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
-	Articles, pyrotechnic *for technical purposes*	1.1G	UN0428	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Articles, pyrotechnic *for technical purposes*	1.2G	UN0429	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	Articles, pyrotechnic *for technical purposes*	1.3G	UN0430	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Articles, pyrotechnic *for technical purposes*	1.4G	UN0431	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Articles, pyrotechnic *for technical purposes*	1.4S	UN0432	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
D	Asbestos	9	NA2212	III	9	-	155	216	240	200 kg	200 kg	A	34, 40
-	*Ascaridole (organic peroxide)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
D	Asphalt, *at or above its flashpoint*	3	NA1999	III	3	-	150	203	247	Forbidden	Forbidden	D	-
D	Asphalt, cut back, *see* Tars, liquid, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Automobile, motorcycle, tractor, other self-propelled vehicle, engine, or other mechanical apparatus, see* Vehicles *or* Battery *etc*	-	-	-	-	-	-	-	-	-	-	-	-
AG	Aviation regulated liquid, n.o.s	9	UN3334	-	9	A35	155	204	-	No limit	No limit	A	-
AG	Aviation regulated solid, n.o.s	9	UN3335	-	9	A35	155	204	-	No limit	No limit	A	-
-	*Azaurolic acid (salt of) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Azido guanidine picrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*5-Azido-1-hydroxy tetrazole*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Azido hydroxy tetrazole (mercury and silver salts)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*3-Azido-1,2-Propylene glycol dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Azidodithiocarbonic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Azidoethyl nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1-Aziridinylphosphine oxide-(tris), see* Tris-(1-aziridinyl) phosphine oxide, solution	-	-	-	-	-	-	-	-	-	-	-	-
-	Azodicarbonamide	4.1	UN3242	II	4.1	38	151	212	240	Forbidden	Forbidden	D	12, 61, 74
-	*Azotetrazole (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Barium	4.3	UN1400	II	4.3	A19, B100, B106	151	212	241	15 kg	50 kg	E	-
-	Barium alloys, pyrophoric	4.2	UN1854	I	4.2	-	None	181	None	Forbidden	Forbidden	D	-
-	Barium azide, *dry or wetted with less than 50 percent water, by mass*	1.1A	UN0224	II	1.1A, 6.1	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Barium azide, wetted *with not less than 50 percent water, by mass*	4.1	UN1571	I	4.1, 6.1	A2	None	182	None	Forbidden	0.5 kg	D	28

-	Barium bromate	5.1	UN2719	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	56, 58, 106
-	Barium chlorate	5.1	UN1445	II	5.1, 6.1	A9, N34, T8	None	212	242	5 kg	25 kg	A	56, 58, 106
-	Barium compounds, n.o.s	6.1	UN1564	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Barium cyanide	6.1	UN1565	I	6.1	N74, N75	None	211	242	5 kg	50 kg	A	26, 40
-	Barium hypochlorite *with more than 22 percent available chlorine*	5.1	UN2741	II	5.1, 6.1	A7, A9, N34	152	212	None	5 kg	25 kg	B	56, 58, 106
-	Barium nitrate	5.1	UN1446	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	-
-	Barium oxide	6.1	UN1884	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Barium perchlorate	5.1	UN1447	II	5.1, 6.1	T8	None	212	242	5 kg	25 kg	A	56, 58, 106
-	Barium permanganate	5.1	UN1448	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	D	56, 58, 69, 106, 107
-	Barium peroxide	5.1	UN1449	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	13, 75, 106
-	*Barium selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	*Barium selenite, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
D	Barium styphnate	1.1A	NA0473	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Batteries, containing sodium	4.3	UN3292	II	4.3	-	189	189	189	Forbidden	No limit	A	-
-	Batteries, dry, containing potassium hydroxide solid, *electric, storage*	8	UN3028	III	8	-	None	213	None	25 kg gross	230 kg gross	A	-
-	Batteries, wet, filled with acid, *electric storage*	8	UN2794	III	8	-	159	159	159	30 kg gross	No limit	A	-
-	Batteries, wet, filled with alkali, *electric storage*	8	UN2795	III	8	-	159	159	159	30 kg gross	No limit	A	-
-	Batteries, wet, filled with alkali, *electric storage*	8	UN2795	III	8	-	159	159	159	25 kg gross	No limit	A	-
-	Batteries, wet, non-spillable, *electric storage*	8	UN2800	III	8	-	159	159	159	No Limit	No Limit	A	-
-	Batteries, dry, *not subject to the requirements of this subchapter*	-	-	-	-	130	-	-	-	-	-	-	-
-	Battery fluid, acid	8	UN2796	II	8	A3, A7, B2, B15, N6, N34, T9, T27	154	202	242	1 L	30 L	B	-
-	Battery fluid, alkali	8	UN2797	II	8	B2, N6, T8	154	202	242	1 L	30 L	A	-
-	*Battery lithium type, see* Lithium batteries *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Battery-powered vehicle *or* Battery-powered equipment	9	UN3171	-	9	134	220	220	None	No limit	No limit	-	-
-	*Battery, wet, filled with acid or alkali with automobile (or named self-propelled vehicle or mechanical equipment containing internal combustion engine) see* Vehicles, self-propelled *etc*	-	-	-	-	-	-	-	-	-	-	-	-
+	Benzaldehyde	9	UN1990	III	9	T1	155	203	241	100 L	220 L	A	-
-	Benzene	3	UN1114	II	3	B101, T8	150	202	242	5 L	60 L	B	40
-	*Benzene diazonium chloride (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Benzene diazonium nitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Benzene phosphorus dichloride, see* Phenyl phosphorus dichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Benzene phosphorus thiodichloride, see* Phenyl phosphorus thiodichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Benzene sulfonyl chloride	8	UN2225	III	8	T8	154	203	241	5 L	60 L	A	40
-	*Benzene triozonide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Benzenethiol, see* Phenyl mercaptan	-	-	-	-	-	-	-	-	-	-	-	-
-	Benzidine	6.1	UN1885	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Benzol,* see Benzene	-	-	-	-	-	-	-	-	-	-	-	-
-	Benzonitrile	6.1	UN2224	II	6.1	T14	None	202	243	5 L	60 L	A	26, 40
-	Benzoquinone	6.1	UN2587	II	6.1	-	None	212	242	25 kg	100 kg	A	-

-	Benzotrichloride	8	UN2226	II	8	B2, B101, T15	154	202	242	1 L	30L	A	40
-	Benzotrifluoride	3	UN2338	II	3	T2	150	202	242	5 L	60 L	B	40
-	*Benzoxidiazoles (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Benzoyl azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Benzoyl chloride	8	UN1736	II	8	B2, T9, T26	154	202	242	1 L	30 L	C	40
-	Benzyl bromide	6.1	UN1737	II	6.1, 8	A3, A7, N33, N34, T12, T26	None	202	243	1 L	30 L	D	13, 40
-	Benzyl chloride	6.1	UN1738	II	6.1, 8	A3, A7, B70, N33, N42, T12, T26	None	202	243	1 L	30 L	D	13, 40
-	Benzyl chloride *unstabilized*	6.1	UN1738	II	6.1, 8	A3, A7, B8, B11, N33, N34, N43, T12, T26	None	202	243	1 L	30L	D	13, 40
-	Benzyl chloroformate	8	UN1739	I	8	A3, A6, B4, N41, T18, T26	None	201	243	Forbidden	2.5 L	D	40
-	Benzyl iodide	6.1	UN2653	II	6.1	T8	None	202	243	5 L	60 L	B	12, 40
-	Benzyldimethylamine	8	UN2619	II	8, 3	B2, T1	154	202	243	1 L	30 L	A	40, 48
-	Benzylidene chloride	6.1	UN1886	II	6.1	T8	None	202	243	5 L	60 L	D	40
-	Beryllium compounds, n.o.s	6.1	UN1566	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Beryllium nitrate	5.1	UN2464	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	-
-	Beryllium, powder	6.1	UN1567	II	6.1, 4.1	-	None	212	242	15 kg	50 kg	A	-
-	Bicyclo [2,2,1] hepta-2, 5-diene, inhibited *or* 2,5-Norbornadiene, inhibited	3	UN2251	II	3	-	150	202	242	5 L	60 L	D	-
-	*Biphenyl triozonide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Bipyridilium pesticides, liquid, flammable, toxic*, flash point less than 23 degrees C*	3	UN2782	I	3, 6.1	-	None	201	243	Forbidden	30 L	E	-
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Bipyridilium pesticides, liquid, toxic	6.1	UN3016	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Bipyridilium pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN3015	I	6.1, 3	T42	None	201	243	1 L	30 L	B	21, 40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	21, 40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	21, 40
-	Bipyridilium pesticides, solid, toxic	6.1	UN2781	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Bis (Aminopropyl) piperazine, see* Corrosive liquid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Bisulfate, aqueous solution	8	UN2837	II	8	A7, B2, N34, T8, T26	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	A7, N34, T7, T26	154	203	241	5 L	60 L	A	-
-	Bisulfites, aqueous solutions, n.o.s	8	UN2693	III	8	T8	154	203	241	1 L	30 L	A	26, 40
-	Black powder, compressed *or* Gunpowder, compressed *or* Black powder, in pellets *or* Gunpowder, in pellets	1.1D	UN0028	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Black powder *or* Gunpowder, *granular or as a meal*	1.1D	UN0027	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	10E, 26E
D	Black powder for small arms	4.1	NA0027	I	4.1	70	None	170	None	Forbidden	Forbidden	E	-
-	*Blasting agent, n.o.s., see* Explosives, blasting *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Blasting cap assemblies, see* Detonator assemblies, non-electric, *for blasting*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Blasting caps, electric, see* Detonators, electric *for blasting*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Blasting caps, non-electric, see* Detonators, non-electric, *for blasting*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Bleaching powder, see* Calcium hypochlorite mixtures, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
I	Blue asbestos *(Crocidolite) or* Brown asbestos *(amosite, mysorite)*	9	UN2212	II	9	-	155	216	240	Forbidden	Forbidden	A	34, 40
-	Bombs, photo-flash	1.1F	UN0037	II	1.1F	-	-	62	None	Forbidden	Forbidden	E	-
-	Bombs, photo-flash	1.1D	UN0038	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	-

-	Bombs, photo-flash	1.2G	UN0039	II	1.2G	-	-	62	None	Forbidden	Forbidden	B	-
-	Bombs, photo-flash	1.3G	UN0299	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	-
-	Bombs, smoke, non-explosive, *with corrosive liquid, without initiating device*	8	UN2028	II	8	-	None	160	None	Forbidden	50 kg	E	40
-	Bombs, *with bursting charge*	1.1F	UN0033	II	1.1F	-	-	62	None	Forbidden	Forbidden	E	-
-	Bombs, *with bursting charge*	1.1D	UN0034	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Bombs, *with bursting charge*	1.2D	UN0035	II	1.2D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Bombs, *with bursting charge*	1.2F	UN0291	II	1.2F	-	-	62	None	Forbidden	Forbidden	E	-
-	Bombs with flammable liquid, *with bursting charge*	1.1J	UN0399	II	1.1J	-	-	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Bombs with flammable liquid, *with bursting charge*	1.2J	UN0400	II	1.2J	-	-	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Boosters with detonator	1.1B	UN0225	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Boosters with detonator	1.2B	UN0268	II	1.2B	-	None	62	None	Forbidden	Forbidden	E	1E, 7E
-	Boosters, *without detonator*	1.1D	UN0042	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Boosters, *without detonator*	1.2D	UN0283	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	*Borate and chlorate mixtures, see* Chlorate and borate mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Borneol	4.1	UN1312	III	4.1	A1	None	213	240	25 kg	100 kg	A	-
+	Boron tribromide	8	UN2692	I	8, 6.1	2, A3, A7, B9, B14, B32, B74, N34, T38, T43, T45	None	227	244	Forbidden	2.5 L	C	12
-	Boron trichloride	2.3	UN1741	-	2.3, 8	3, B9, B14	None	304	314	Forbidden	Forbidden	D	25, 40
-	Boron trifluoride, compressed.	2.3	UN1008	-	2.3	2, B9, B14	None	302	314, 315	Forbidden	Forbidden	D	40
-	Boron trifluoride acetic acid complex	8	UN1742	II	8	B2, B6, T9, T27	154	202	242	1 L	30 L	A	-
-	Boron trifluoride diethyl etherate	8	UN2604	I	8, 3	A19, T8, T26	None	201	243	0.5 L	2.5 L	D	40
-	Boron trifluoride dihydrate	8	UN2851	II	8	T9, T27	154	212	240	15 kg	50 kg	B	12, 40,
-	Boron trifluoride dimethyl etherate	4.3	UN2965	I	4.3, 8, 3	A19, T12, T26	None	201	243	Forbidden	1 L	D	21, 28, 40, 49, 100
-	Boron trifluoride propionic acid complex	8	UN1743	II	8	B2, T9, T27	154	202	242	1 L	30 L	A	-
-	*Box toe gum, see* Nitrocellulose *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Bromates, inorganic, aqueous solution, n.o.s	5.1	UN3213	II	5.1	T8	152	202	242	1L	5 L	B	56, 58, 106
-	Bromates, inorganic, n.o.s	5.1	UN1450	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	*Bromine azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
+	Bromine *or* Bromine solutions	8	UN1744	I	8, 6.1	1, A3, A6, B9, B64, B85, N34, N43, T18, T41	None	226	249	Forbidden	Forbidden	-	12, 40, 66, 74, 89, 90
-	Bromine chloride	2.3	UN2901	-	2.3, 8, 5.1	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40, 89, 90
+	Bromine pentafluoride	5.1	UN1745	I	5.1, 6.1, 8	1, B9, B14, B30, B72, T38, T43, T44	None	228	244	Forbidden	Forbidden	D	25, 40, 66, 90
+	Bromine trifluoride	5.1	UN1746	I	5.1, 6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	228	244	Forbidden	Forbidden	D	25, 40, 66, 90
-	*4-Bromo-1,2-dinitrobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*4-Bromo-1,2-dinitrobenzene (unstable at 59 degrees C.)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	1-Bromo-3-methylbutane	3	UN2341	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-

-	*1-Bromo-3-nitrobenzene (unstable at 56 degrees C)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	2-Bromo-2-nitropropane-1,3-diol	4.1	UN3241	III	4.1	46	151	213	None	25 kg	50 kg	C	12, 25, 40
-	Bromoacetic acid, *solid*	8	UN1938	II	8	A7, N34, T9	154	212	240	15 kg	50 kg	A	-
-	Bromoacetic acid, *solution*	8	UN1938	II	8	B2, T9	154	202	242	1 L	30 L	A	40
+	Bromoacetone	6.1	UN1569	II	6.1, 3	2	None	193	245	Forbidden	Forbidden	D	40
-	Bromoacetyl bromide	8	UN2513	II	8	B2, T9, T26	154	202	242	1 L	30 L	C	40
-	Bromobenzene	3	UN2514	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Bromobenzyl cyanides, *liquid*	6.1	UN1694	I	6.1	T18	None	201	243	Forbidden	30 L	D	12, 40
-	Bromobenzyl cyanides, *solid*	6.1	UN1694	I	6.1	T18	None	211	242	Forbidden	50 kg	D	12, 40
-	1-Bromobutane	3	UN1126	II	3	T1	150	202	242	5L	60L	B	40
-	2-Bromobutane	3	UN2339	II	3	B1, T1	150	202	242	5 L	60 L	B	40
-	Bromochloromethane	6.1	UN1887	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	2-Bromoethyl ethyl ether	3	UN2340	II	3	T7	150	202	242	5 L	60 L	B	40
-	Bromoform	6.1	UN2515	III	6.1	T7	153	203	241	60 L	220 L	A	12, 40
-	Bromomethylpropanes	3	UN2342	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	2-Bromopentane	3	UN2343	II	3	T1	150	202	242	5 L	60 L	B	-
-	Bromopropanes	3	UN2344	II	3	T7	150	202	242	5 L	60 L	B	40
-	3-Bromopropyne	3	UN2345	II	3	T8	150	202	242	5 L	60 L	D	40
-	*Bromosilane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Bromotoluene-alpha, see* Benzyl bromide	-	-	-	-	-	-	-	-	-	-	-	-
-	Bromotrifluoroethylene	2.1	UN2419	-	2.1	-	None	304	314, 315	Forbidden	150 kg	B	40
-	Bromotrifluoromethane *or* Refrigerant gas, R 13B1.	2.2	UN1009	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Brucine	6.1	UN1570	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	Bursters, *explosive*	1.1D	UN0043	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Butadienes, inhibited	2.1	UN1010	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Butane *see also* Petroleum gases, liquefied	2.1	UN1011	-	2.1	19	306	304	314, 315	Forbidden	150 kg	E	40
-	*Butane, butane mixtures and mixtures having similar properties in cartridges each not exceeding 500 grams, see* Receptacles, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Butanedione	3	UN2346	II	3	T1	150	202	242	5 L	60 L	B	-
-	*1,2,4-Butanetriol trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Butanols	3	UN1120	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*tert-Butoxycarbonyl azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Butyl acetates	3	UN1123	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Butyl acid phosphate	8	UN1718	III	8	T7	154	203	241	5 L	60 L	A	-
-	Butyl acrylates, inhibited	3	UN2348	III	3	B1, T8, T31	150	203	242	60 L	220 L	A	-
-	*Butyl alcohols, see* Butanols	-	-	-	-	-	-	-	-	-	-	-	-
-	Butyl benzenes	3	UN2709	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*n-Butyl bromide, see* 1-Bromobutane	-	-	-	-	-	-	-	-	-	-	-	-
-	*n-Butyl chloride, see* Chlorobutanes	-	-	-	-	-	-	-	-	-	-	-	-

D	sec-Butyl chloroformate	6.1	NA2742	I	6.1, 3, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	1 L	30 L	A	12, 13, 22, 25, 40, 48, 100
-	n-Butyl chloroformate	6.1	UN2743	I	6.1, 8, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	1 L	30 L	A	12, 13, 21, 25, 40, 100
-	*Butyl ethers, see* Dibutyl ethers	-	-	-	-	-	-	-	-	-	-	-	-
-	*Butyl ethyl ether, see* Ethyl butyl ether	-	-	-	-	-	-	-	-	-	-	-	-
-	n-Butyl formate	3	UN1128	II	3	T1	150	202	242	5 L	60 L	B	-
-	*tert-Butyl hydroperoxide, with more than 90 percent with water*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	tert-Butyl hypochlorite	4.2	UN3255	I	4.2, 8	-	None	211	243	Forbidden	Forbidden	D	-
-	N-n-Butyl imidazole	6.1	UN2690	II	6.1	T8	None	202	243	5 L	60 L	A	-
-	tert-Butyl isocyanate	6.1	UN2484	I	6.1, 3	1, A7, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	n-Butyl isocyanate	6.1	UN2485	I	6.1, 3	2, A7, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	30 L	D	40
-	Butyl mercaptans	3	UN2347	II	3	A3, T8	150	202	242	5 L	60 L	D	26, 95
-	n-Butyl methacrylate, inhibited.	3	UN2227	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Butyl methyl ether	3	UN2350	II	3	T8	150	202	242	5 L	60 L	B	-
-	Butyl nitrites	3	UN2351	I	3	T8	150	201	243	1 L	30 L	E	40
-	-	-	-	II	3	T8	150	202	242	5 L	60 L	B	40
-	-	-	-	III	3	B1, T8	150	203	242	60 L	220 L	A	40
-	*tert-Butyl peroxyacetate, with more than 76 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*n-Butyl peroxydicarbonate, with more than 52 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*tert-Butyl peroxyisobutyrate, with more than 77 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Butyl phosphoric acid, see* Butyl acid phosphate	-	-	-	-	-	-	-	-	-	-	-	-
-	Butyl propionates	3	UN1914	III	3	B1,T1	150	203	242	60 L	220 L	A	-
-	5-tert-Butyl-2,4,6-trinitro-m-xylene *or* Musk xylene	4.1	UN2956	III	4.1	-	None	214	None	Forbidden	Forbidden	D	12
-	Butyl vinyl ether, inhibited	3	UN2352	II	3	B101, T7	150	202	242	5 L	60 L	B	40
-	n-Butylamine	3	UN1125	II	3, 8	B101, T8	None	202	242	1 L	5 L	B	40
-	N-Butylaniline	6.1	UN2738	II	6.1	T8	None	202	243	5 L	60 L	A	-
-	tert-Butylcyclohexylchloroformate	6.1	UN2747	III	6.1	T8	153	203	241	60 L	220 L	A	12, 13, 25
-	Butylene *see also* Petroleum gases, liquefied	2.1	UN1012	-	2.1	19	None	304	314, 315	Forbidden	150 kg	E	40
-	1,2-Butylene oxide, stabilized	3	UN3022	II	3	T8	150	202	242	5 L	60 L	B	49
-	Butyltoluenes	6.1	UN2667	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	Butyltrichlorosilane	8	UN1747	II	8, 3	A7, B2, B6, N34, T8, T26	None	202	243	Forbidden	30 L	C	40
-	1,4-Butynediol	6.1	UN2716	III	6.1	A1	None	213	240	100 kg	200 kg	A	61, 70
-	Butyraldehyde	3	UN1129	II	3	T8	150	202	242	5 L	60 L	B	-
-	Butyraldoxime	3	UN2840	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Butyric acid	8	UN2820	III	8	T1	154	203	241	5 L	60 L	A	12
-	Butyric anhydride	8	UN2739	III	8	T2	154	203	241	5 L	60 L	A	-
-	Butyronitrile	3	UN2411	II	3, 6.1	T14	None	202	243	1 L	60 L	E	40
-	Butyryl chloride	3	UN2353	II	3, 8	B100, T9, T26	None	202	243	1 L	5 L	C	40

-	Cacodylic acid	6.1	UN1572	II	6.1	-	None	212	242	25 kg	100 kg	E	26
-	Cadmium compounds	6.1	UN2570	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Caesium hydroxide	8	UN2682	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Caesium hydroxide solution	8	UN2681	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	Calcium	4.3	UN1401	II	4.3	B101, B106	151	212	241	15 kg	50 kg	E	-
-	Calcium arsenate	6.1	UN1573	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Calcium arsenate and calcium arsenite, mixtures, solid	6.1	UN1574	II	6.1	-	None	212	242	25 kg	100 kg	A	-
D	Calcium arsenite, solid	6.1	NA1574	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Calcium bisulfite solution, see* Bisulfites, inorganic, aqueous solutions, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Calcium carbide	4.3	UN1402	I	4.3	A1, A8, B55, B59, B101, B106, N34	None	211	242	Forbidden	15 kg	B	-
-	-	-	-	II	4.3	A1, A8, B55, B59, B101, B106, N34	151	212	241	15 kg	50 kg	B	-
-	Calcium chlorate	5.1	UN1452	II	5.1	N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Calcium chlorate aqueous solution	5.1	UN2429	II	5.1	A2, N41, T8	152	202	242	1 L	5 L	B	56, 58, 106
-	-	-	-	III	5.1	A2, N41, T8	152	203	241	2.5L	30 L	B	56, 68, 106
-	Calcium chlorite	5.1	UN1453	II	5.1	A9, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Calcium cyanamide *with more than 0.1 percent of calcium carbide*	4.3	UN1403	III	4.3	A1, A19, B105	151	213	241	25 kg	100 kg	A	-
-	Calcium cyanide	6.1	UN1575	I	6.1	N79, N80	None	211	242	5 kg	50 kg	A	26, 40
-	Calcium dithionite *or* Calcium hydrosulfite	4.2	UN1923	II	4.2	A19, A20	None	212	241	15 kg	50 kg	E	13
-	Calcium hydride	4.3	UN1404	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
-	Calcium hydrosulfite, *see* Calcium dithionite	-	-	-	-	-	-	-	-	-	-	-	-
-	Calcium hypochlorite, dry *or* Calcium hypochlorite mixtures dry *with more than 39 percent available chlorine (8.8 percent available oxygen)*	5.1	UN1748	II	5.1	A7, A9, N34	152	212	None	5 kg	25 kg	D	48, 56, 58, 69, 106, 118
-	Calcium hypochlorite, hydrated *or* Calcium hypochlorite, hydrated mixtures, *with not less than 5.5 percent but not more than 10 percent water*	5.1	UN2880	II	5.1	-	152	212	240	5 kg	25 kg	A	50, 56, 58, 69, 106
-	Calcium hypochlorite mixtures, dry, *with more than 10 percent but not more than 39 percent available chlorine*	5.1	UN2208	III	5.1	A1, A29, B103, N34	152	213	240	25 kg	100 kg	A	56, 58, 69, 106
-	Calcium manganese silicon	4.3	UN2844	III	4.3	A1, A19, B105, B106	151	213	241	25 kg	100 kg	A	85, 103
-	Calcium nitrate	5.1	UN1454	III	5.1	34	152	213	240	25 kg	100 kg	A	-
A	Calcium oxide	8	UN1910	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Calcium perchlorate	5.1	UN1455	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Calcium permanganate	5.1	UN1456	II	5.1	-	152	212	242	5 kg	25 kg	D	56, 58, 69, 106, 107
-	Calcium peroxide	5.1	UN1457	II	5.1	-	152	212	242	5 kg	25 kg	A	13, 75, 106
-	Calcium phosphide	4.3	UN1360	I	4.3, 6.1	A8, A19, B100, N40	None	211	242	Forbidden	15 kg	E	40, 85
-	Calcium, pyrophoric *or* Calcium alloys, pyrophoric	4.2	UN18	I	4.2	-	Non	187	Non	Forbidden	Forbidden	D	-

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-	Calcium resinate	4.1	UN1313	III	4.1	A1, A19	None	213	240	25 kg	100 kg	A	-
-	Calcium resinate, fused	4.1	UN1314	III	4.1	A1, A19	None	213	240	25 kg	100 kg	A	-
-	*Calcium selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	Calcium silicide	4.3	UN1405	II	4.3	A19, B105, B106	151	212	241	15 kg	50 kg	B	85, 103
-	-	-	-	III	4.3	A1, A19, B106, B108	151	213	241	25 kg	100 kg	B	85, 103
-	Camphor oil	3	UN1130	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Camphor, *synthetic*	4.1	UN2717	III	4.1	A1	None	213	240	25 kg	100 kg	A	-
-	*Cannon primers, see* Primers, tubular	-	-	-	-	-	-	-	-	-	-	-	-
-	Caproic acid	8	UN2829	III	8	T1	154	203	241	5 L	60 L	A	-
-	*Caps, blasting, see* Detonators, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Carbamate pesticides, liquid, flammable, toxic*, flash point less than 23 degrees C*	3	UN2758	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Carbamate pesticides, liquid, toxic	6.1	UN2992	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Carbamate pesticides, liquid, toxic, flammable*, flash point not less than 23 degrees C*	6.1	UN2991	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
-	Carbamate pesticides, solid, toxic	6.1	UN2757	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Carbolic acid, see* Phenol, solid *or* Phenol, molten	-	-	-	-	-	-	-	-	-	-	-	-
-	*Carbolic acid solutions, see* Phenol solutions	-	-	-	-	-	-	-	-	-	-	-	-
I	Carbon, activated	4.2	UN1362	III	4.2	-	None	213	241	0.5 kg	0.5 kg	A	12
I	Carbon, *animal or vegetable origin*	4.2	UN1361	II	4.2	-	None	212	242	Forbidden	Forbidden	A	12
-	-	-	-	III	4.2	-	None	213	241	Forbidden	Forbidden	A	12
-	*Carbon bisulfide, see* Carbon disulfide	-	-	-	-	-	-	-	-	-	-	-	-
-	Carbon dioxide	2.2	UN1013	-	2.2	-	306	302, 304	302, 314, 315	75 kg	150 kg	A	-
-	Carbon dioxide and nitrous oxide mixtures	2.2	UN1015	-	2.2	-	306	None	314, 315	75 kg	150 kg	A	-
-	Carbon dioxide and oxygen mixtures, compressed	2.2	UN1014	-	2.2, 5.1	77	306	304	314, 315	75 kg	150 kg	A	-
-	Carbon dioxide, refrigerated liquid	2.2	UN2187	-	2.2	-	306	304	314, 315	50 kg	500 kg	B	-
A W	Carbon dioxide, solid *or* Dry ice	9	UN1845	III	None	-	217	217	240	200 kg	200 kg	C	40
-	Carbon disulfide	3	UN1131	I	3, 6.1	B16, T18, T26, T29	None	201	243	Forbidden	Forbidden	D	18, 40, 115
-	Carbon monoxide, compressed.	2.3	UN1016	-	2.3, 2.1	4	None	302	314, 315	Forbidden	25 kg	D	40
-	Carbon monoxide and hydrogen mixture, compressed.	2.3	UN2600	-	2.3, 2.1	6	None	302	302	Forbidden	Forbidden	D	40
D	Carbon monoxide, refrigerated liquid *(cryogenic liquid)*	2.3	NA9202	-	2.3, 2.1	4	None	316	318	Forbidden	Forbidden	D	-
-	Carbon tetrabromide	6.1	UN2516	III	6.1	-	153	213	240	100 kg	200 kg	A	25

-	Carbon tetrachloride	6.1	UN1846	II	6.1	N36, T8	None	202	243	5 L	60 L	A	40
-	*Carbonyl chloride, see* Phosgene	-	-	-	-	-	-	-	-	-	-	-	-
-	Carbonyl fluoride, compressed	2.3	UN2417	-	2.3, 8	2	None	302	None	Forbidden	Forbidden	D	40
-	Carbonyl sulfide	2.3	UN2204	-	2.3, 2.1	3, B14	None	304	314, 315	Forbidden	25 kg	D	40
-	*Cartridge cases, empty primed, see* Cases, cartridge, empty, with primer	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cartridges, actuating, for aircraft ejector seat catapult, fire extinguisher, canopy removal or apparatus, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cartridges, explosive, see* Charges, demolition	-	-	-	-	-	-	-	-	-	-	-	-
-	Cartridges, flash	1.1G	UN0049	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges, flash	1.3G	UN0050	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	Cartridges for weapons, blank	1.1C	UN0326	II	1.1C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, blank	1.2C	UN0413	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, blank *or* Cartridges, small arms, blank	1.4S	UN0014	II	None	-	63	62	None	25 kg	100 kg	A	-
-	Cartridges for weapons, blank *or* Cartridges, small arms, blank	1.3C	UN0327	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, blank *or* Cartridges, small arms, blank	1.4C	UN0338	II	1.4C	-	None	62	None	Forbidden	75 kg	A	24E
-	Cartridges for weapons, inert projectile	1.2C	UN0328	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, inert projectile *or* Cartridges, small arms	1.4S	UN0012	II	None	-	63	62	None	25 kg	100 kg	A	-
-	Cartridges for weapons, inert projectile *or* Cartridges, small arms	1.4C	UN0339	II	1.4C	-	None	62	None	Forbidden	75 kg	B	-
-	Cartridges for weapons, inert projectile *or* Cartridges, small arms	1.3C	UN0417	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, *with bursting charge*	1.1F	UN0005	II	1.1F	-	None	62	None	Forbidden	Forbidden	E	-
-	Cartridges for weapons, *with bursting charge*	1.1E	UN0006	II	1.1E	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, *with bursting charge*	1.2F	UN0007	II	1.2F	-	None	62	None	Forbidden	Forbidden	E	-
-	Cartridges for weapons, *with bursting charge*	1.2E	UN0321	II	1.2E	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges for weapons, *with bursting charge*	1.4F	UN0348	II	1.4F	-	None	62	None	Forbidden	Forbidden	E	-
-	Cartridges for weapons, *with bursting charge*	1.4E	UN0412	II	1.4E	-	None	62	None	Forbidden	75 kg	A	24E
-	Cartridges, oil well	1.3C	UN0277	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	Cartridges, oil well	1.4C	UN0278	II	1.4C	-	None	62	None	Forbidden	75 kg	A	24E
-	Cartridges, power device	1.3C	UN0275	II	1.3C	-	None	62	None	Forbidden	75 kg	B	-
-	Cartridges, power device	1.4C	UN0276	II	1.4C	110	None	62	None	Forbidden	75 kg	A	24E
-	Cartridges, power device	1.4S	UN0323	II	1.4S	110,	63	62	None	25 kg	100 kg	A	-
-	Cartridges, power device	1.2C	UN0381	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	-
-	*Cartridges, safety, blank, see* Cartridges for weapons, blank *(UN 0014)*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cartridges, safety, see* Cartridges for weapons, *other than blank or* Cartridges, power device *(UN 0323)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cartridges, signal	1.3G	UN0054	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	Cartridges, signal	1.4G	UN0312	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Cartridges, signal	1.4S	UN0405	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
D	Cartridges, small arms	ORM-D	-	-	None	-	63	None	None	30 kg gross	30 kg gross	A	-
-	*Cartridges, sporting, see* Cartridges for weapons, *other than blank*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cartridges, starter, jet engine, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	Cases, cartridge, empty with primer	1.4S	UN0055	II	1.4S	50	None	62	None	25 kg	100 kg	A	-
-	Cases, cartridges, empty with primer	1.4C	UN0379	II	1.4C	50	None	62	None	Forbidden	75 kg	A	24E
-	Cases, combustible, empty, without primer	1.4C	UN04	II	1.4	-	Non	62	Non	Forbidden	75 kg	A	24E

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-	Cases, combustible, empty, without primer	1.3C	UN0447	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	*Casinghead gasoline see* Gasoline	-	-	-	-	-	-	-	-	-	-	-	-
A W	Castor beans *or* Castor meal *or* Castor pomace *or* Castor flake	9	UN2969	II	None	-	155	204	240	No limit	No limit	E	34, 40
G	Caustic alkali liquids, n.o.s	8	UN1719	II	8	B2, T14	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	*Caustic potash, see* Potassium hydroxide *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Caustic soda, (etc.) see* Sodium hydroxide *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cells, containing sodium	4.3	UN3292	II	4.3	-	189	189	189	25 kg	No limit	A	-
-	Celluloid, *in block, rods, rolls, sheets, tubes, etc., except scrap*	4.1	UN2000	III	4.1	-	None	213	240	25 kg	100 kg	A	-
-	Celluloid, scrap	4.2	UN2002	III	4.2	-	None	213	241	Forbidden	Forbidden	D	-
-	*Cement, see* Adhesives *containing flammable liquid*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cerium, *slabs, ingots, or rods*	4.1	UN1333	II	4.1	N34	None	212	240	15 kg	50 kg	A	74, 91
-	Cerium, *turnings or gritty powder*	4.3	UN3078	II	4.3	A1, B106, B109	151	212	242	15 kg	50 kg	E	-
-	Cesium *or* Caesium	4.3	UN1407	I	4.3	A19, B100, N34, N40	None	211	242	Forbidden	15 kg	D	-
-	Cesium nitrate *or* Caesium nitrate	5.1	UN1451	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
D	Charcoal *briquettes, shell, screenings, wood, etc*	4.2	NA1361	III	4.2	-	151	213	240	25 kg	100 kg	A	12
-	Charges, bursting, plastics bonded	1.1D	UN0457	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, bursting, plastics bonded	1.2D	UN0458	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, bursting, plastics bonded	1.4D	UN0459	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Charges, bursting, plastics bonded	1.4S	UN0460	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Charges, demolition	1.1D	UN0048	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, depth	1.1D	UN0056	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	3E, 7E
-	*Charges, expelling, explosive, for fire extinguishers, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	Charges, explosive, commercial *without detonator*	1.1D	UN0442	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, explosive, commercial *without detonator*	1.2D	UN0443	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, explosive, commercial *without detonator*	1.4D	UN0444	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Charges, explosive, commercial *without detonator*	1.4S	UN0445	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Charges, propelling	1.1C	UN0271	II	1.1C	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, propelling	1.3C	UN0272	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, propelling	1.2C	UN0415	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, propelling	1.4C	UN0491	II	1.4C	-	None	62	None	Forbidden	75 kg	A	1E, 5E
-	Charges, propelling, for cannon	1.3C	UN0242	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Charges, propelling, for cannon	1.1C	UN0279	II	1.1C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Charges, propelling, for cannon	1.2C	UN0414	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Charges, shaped, flexible, linear	1.4D	UN0237	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Charges, shaped, flexible, linear	1.1D	UN0288	II	1.1D	101	None	62	None	Forbidden	Forbidden	B	-
-	Charges, shaped, *without detonator*	1.1D	UN0059	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, shaped, *without detonator*	1.2D	UN0439	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	Charges, shaped, *without detonator*	1.4D	UN0440	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Charges, shaped, *without detonator*	1.4S	UN0441	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Charges, supplementary explosive	1.1D	UN0060	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
D	Chemical kit	8	NA1760	II	8	-	154	161	None	1 L	30 L	B	40

-	Chemical kits *or* First aid kits (*containing hazardous materials*)	9	UN3316	-	9	15	None	None	None	10 kg	10 kg	A	-
-	Chloral, anhydrous, inhibited	6.1	UN2075	II	6.1	B101, T14	None	202	243	5 L	60 L	D	40
-	Chlorate and borate mixtures	5.1	UN1458	II	5.1	A9, N34	152	212	240	5 kg	25 kg	A	56, 58, 106
-	-	-	-	III	5.1	A9, N34	152	213	240	25 kg	100 kg	A	56, 58, 106
-	Chlorate and magnesium chloride mixtures	5.1	UN1459	II	5.1	A9, N34, T8	152	212	240	5 kg	25 kg	A	56, 58, 106
-	-	-	-	III	5.1	A9, N34, T8	152	213	240	25 kg	100 kg	A	56, 58, 106
-	*Chlorate of potash, see* Potassium chlorate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Chlorate of soda, see* Sodium chlorate	-	-	-	-	-	-	-	-	-	-	-	-
-	Chlorates, inorganic, aqueous solution, n.o.s	5.1	UN3210	II	5.1	T8	152	202	242	1 L	5 L	B	56, 58, 106
-	Chlorates, inorganic, n.o.s	5.1	UN1461	II	5.1	A9, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Chloric acid aqueous solution, *with not more than 10 percent chloric acid*	5.1	UN2626	II	5.1	T25	None	229	None	Forbidden	Forbidden	D	56, 58, 106
-	*Chloride of phosphorus, see* Phosphorus trichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Chloride of sulfur, see* Sulfur chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Chlorinated lime, see* Calcium hypochlorite mixtures, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Chlorine	2.3	UN1017	-	2.3, 8	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40, 51, 55, 62, 68, 89, 90
-	*Chlorine azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
D	Chlorine dioxide, hydrate, frozen	5.1	NA9191	II	5.1, 6.1	-	None	229	None	Forbidden	Forbidden	E	-
-	*Chlorine dioxide (not hydrate)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Chlorine pentafluoride	2.3	UN2548	-	2.3, 5.1, 8	1, B7, B9, B14	None	304	314	Forbidden	Forbidden	D	40, 89, 90
-	Chlorite solution	8	UN1908	II	8	A3,A6, A7, B2, N34, T8	154	202	242	1 L	30 L	B	26
-	-	-	-	III	8	A3,A6, A7, B2, N34, T8	154	203	241	5 L	60 L	B	26
-	Chlorine trifluoride	2.3	UN1749	-	2.3, 5.1, 8	2, B7, B9, B14	None	304	314	Forbidden	Forbidden	D	40, 89, 90
-	Chlorites, inorganic, n.o.s	5.1	UN1462	II	5.1	A7, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	1-Chloro-3-bromopropane	6.1	UN2688	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	*1-Chloro-1,1-difluoroethane, see* Chlorodifluoroethanes	-	-	-	-	-	-	-	-	-	-	-	-
-	1-Chloro-1,1-difluoroethane *or* Refrigerant gas R 142b	2.1	UN2517	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	3-Chloro-4-methylphenyl isocyanate	6.1	UN2236	II	6.1	-	None	202	243	5 L	60 L	B	40
-	1-Chloro-1,2,2,2-tetrafluoroethane*or* Refrigerant gas R 124	2.2	UN1021	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	4-Chloro-o-toluidine hydrochloride	6.1	UN1579	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	1-Chloro-2,2,2-trifluoroethane *or* Refrigerant gas R 133a	2.2	UN1983	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Chloroacetic acid, molten	6.1	UN3250	II	6.1, 8	T9	None	202	243	Forbidden	Forbidden	C	40
-	Chloroacetic acid, solid	6.1	UN1751	II	6.1, 8	A3, A7, N34	None	212	242	15 kg	50 kg	A	40
-	Chloroacetic acid, solution	6.1	UN1750	II	6.1, 8	A7, N34, T8, T27	None	202	243	1 L	30 L	C	40
-	Chloroacetone, stabilized	6.1	UN1695	I	6.1, 3,8	2, B9, B14, B32, B74, N12, N32,	None	227	244	Forbidden	Forbidden	D	20, 40, 95

						N34, T38, T43, T45							
-	*Chloroacetone (unstabilized)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
+	Chloroacetonitrile	6.1	UN2668	II	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	60 L	A	12, 26, 40
-	Chloroacetophenone *(CN), liquid*	6.1	UN1697	II	6.1	A3, N12, N32, N33	None	202	243	Forbidden	60 L	D	12, 40
-	Chloroacetophenone *(CN), solid*	6.1	UN1697	II	6.1	A3, N12, N32, N33, N34	None	212	None	Forbidden	100 kg	D	12, 40
-	Chloroacetyl chloride	6.1	UN1752	I	6.1, 8	2, A3, A6, A7, B3, B8, B9, B14, B32, B74, B77, N34, N43, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Chloroanilines, liquid	6.1	UN2019	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	Chloroanilines, solid	6.1	UN2018	II	6.1	T14, T38	None	212	242	25 kg	100 kg	A	-
-	Chloroanisidines	6.1	UN2233	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Chlorobenzene	3	UN1134	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Chlorobenzol, see* Chlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-
-	Chlorobenzotrifluorides	3	UN2234	III	3	B1, T1	150	203	242	60 L	220 L	A	40
-	Chlorobenzyl chlorides	6.1	UN2235	III	6.1	T8	153	203	241	60 L	220 L	A	-
-	Chlorobutanes	3	UN1127	II	3	B101, T8	150	202	242	5 L	60 L	B	-
-	Chlorocresols, *liquid*	6.1	UN2669	II	6.1	T8	None	202	243	5 L	60 L	A	12
-	Chlorocresols, *solid*	6.1	UN2669	II	6.1	-	None	212	242	25 kg	100 kg	A	12
-	Chlorodifluorobromomethane *or* Refrigerant gas R 12B1	2.2	UN1974	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Chlorodifluoromethane and chloropentafluoroethane mixture *or* Refrigerant gas R 502 *with fixed boiling point, with approximately 49 percent chlorodifluoromethane*	2.2	UN1973	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Chlorodifluoromethane *or* Refrigerant gas R 22	2.2	UN1018	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
+	Chlorodinitrobenzenes	6.1	UN1577	II	6.1	T14	None	212	242	25 kg	100 kg	A	91
-	2-Chloroethanal	6.1	UN2232	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Chloroform	6.1	UN1888	III	6.1	N36, T14	153	203	241	5 L	60 L	A	40
G	Chloroformates, toxic, corrosive, flammable, n.o.s	6.1	UN2742	II	6.1, 8, 3	5	None	202	243	1 L	30 L	A	12, 13, 21, 25, 40, 100
G	Chloroformates, toxic, corrosive, n.o.s	6.1	UN3277	II	6.1, 8	T12, T26	None	202	243	1 L	30 L	A	12, 13, 25, 40
-	Chloromethyl chloroformate	6.1	UN2745	II	6.1, 8	T18	None	202	243	1 L	30 L	A	12, 13, 21, 25, 40, 100
-	Chloromethyl ethyl ether	3	UN2354	II	3, 6.1	T8	None	202	243	1 L	60 L	E	40
-	Chloronitroanilines	6.1	UN2237	III	6.1	-	153	213	240	100 kg	200 kg	A	-
+	Chloronitrobenzene, *ortho, liquid*	6.1	UN1578	II	6.1	T14	None	202	243	5 L	60 L	A	-
+	Chloronitrobenzenes *meta or para, solid*	6.1	UN1578	II	6.1	T14	None	212	242	25 kg	100 kg	A	-
-	Chloronitrotoluenes *liquid*	6.1	UN2433	III	6.1	-	153	203	241	60 L	220 L	A	-
-	Chloronitrotoluenes, *solid*	6.1	UN2433	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Chloropentafluoroethane *or* Refrigerant gas R 115	2.2	UN1020	-	2.2	-	306	304	314, 31	75 kg	150 kg	A	-

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-	Chlorophenolates, liquid *or* Phenolates, liquid	8	UN2904	III	8	-	154	203	241	5 L	60 L	A	-
-	Chlorophenolates, solid *or* Phenolates, solid	8	UN2905	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Chlorophenols, liquid	6.1	UN2021	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Chlorophenols, solid	6.1	UN2020	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Chlorophenyltrichlorosilane	8	UN1753	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
+	Chloropicrin	6.1	UN1580	I	6.1	2, B7, B9, B14, B32, B46, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Chloropicrin and methyl bromide mixtures	2.3	UN1581	-	2.3	2, B9, B14	None	193	314, 315	Forbidden	Forbidden	D	25, 40
-	Chloropicrin and methyl chloride mixtures	2.3	UN1582	-	2.3	2	None	193	245	Forbidden	Forbidden	D	25, 40
-	*Chloropicrin mixture, flammable (pressure not exceeding 14.7 psia at 115 degrees F flash point below 100 degrees F) see* Toxic liquids, flammable, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Chloropicrin mixtures, n.o.s	6.1	UN1583	I	6.1	5	None	201	243	Forbidden	Forbidden	C	40
-	-	-	-	II	6.1	-	None	202	243	Forbidden	Forbidden	C	40
-	-	-	-	III	6.1	-	153	203	241	Forbidden	Forbidden	C	40
D	Chloropivaloyl chloride	6.1	NA9263	I	6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	40
-	Chloroplatinic acid, solid	8	UN2507	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Chloroprene, inhibited	3	UN1991	I	3, 6.1	B57, T15	None	201	243	Forbidden	30 L	D	40
-	*Chloroprene, uninhibited*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	2-Chloropropane	3	UN2356	I	3	N36, T14	150	201	243	1 L	30 L	E	-
-	3-Chloropropanol-1	6.1	UN2849	III	6.1	T8	153	203	241	60 L	220 L	A	-
-	2-Chloropropene	3	UN2456	I	3	A3, N36, T20	150	201	243	1 L	30 L	E	-
-	2-Chloropropionic acid	8	UN2511	III	8	T8	154	203	241	5 L	60 L	A	8
-	2-Chloropyridine	6.1	UN2822	II	6.1	T14	None	202	243	5 L	60 L	A	40
-	Chlorosilanes, corrosive, flammable, n.o.s	8	UN2986	II	8, 3	B100, T18, T26	None	202	243	1 L	30 L	C	40
-	Chlorosilanes, corrosive, n.o.s	8	UN2987	II	8	B2, T14, T26	154	202	242	1 L	30 L	C	40
-	Chlorosilanes, flammable, corrosive, n.o.s	3	UN2985	II	3, 8	B100, T17, T26	None	201	243	1 L	5 L	B	40
-	Chlorosilanes, water-reactive, flammable, corrosive, n.o.s	4.3	UN2988	I	4.3, 3,8	A2, T18, T26	None	201	244	Forbidden	1 L	D	21, 28, 40, 49, 100
+	Chlorosulfonic acid *(with or without sulfur trioxide)*	8	UN1754	I	8, 6.1	2, A3, A6, A10, B9, B10, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	C	40
-	Chlorotoluenes	3	UN2238	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Chlorotoluidines *liquid*	6.1	UN2239	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Chlorotoluidines *solid*	6.1	UN2239	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Chlorotrifluoromethane and trifluoromethane azeotropic mixture *or* Refrigerant gas R 503 *with approximately 60 percent chlorotrifluoromethane*	2.2	UN2599	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Chlorotrifluoromethane *or* Refrigerant gas R 13	2.2	UN1022	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
D	Chromic acid, solid	5.1	NA1463	II	5.1, 8	-	None	212	242	5 kg	25 kg	A	-
-	Chromic acid solution	8	UN1755	II	8	B2, T9, T27	154	202	242	1 L	30 L	C	40
-	-	-	-	III	8	T8, T26	154	203	241	5 L	60 L	C	40
-	*Chromic anhydride, see* Chromium trioxide, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Chromic fluoride, solid	8	UN17	II	8	-	154	212	240	15 kg	50 kg	A	26

			56										
-	Chromic fluoride, solution	8	UN1757	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	Chromium nitrate	5.1	UN2720	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Chromium oxychloride	8	UN1758	I	8	A3, A6, A7, B10, N34, T12, T26	None	201	243	0.5 L	2.5 L	C	40, 66, 74, 89, 90
-	Chromium trioxide, anhydrous	5.1	UN1463	II	5.1, 8	B106	None	212	242	5 kg	25 kg	A	-
-	Chromosulfuric acid	8	UN2240	I	8	A3, A6, A7, B4, B6, N34, T12, T27	None	201	243	0.5 L	2.5 L	B	40, 66, 74, 89, 90
-	*Chromyl chloride, see* Chromium oxychloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cigar and cigarette lighters, charged with fuel, see* Lighters for cigars, cigarettes, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Coal briquettes, hot*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Coal gas, compressed	2.3	UN1023	-	2.3, 2.1	3	None	302	314, 315	Forbidden	25 kg	D	40
-	Coal tar distillates, flammable	3	UN1136	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Coal tar dye, corrosive, liquid, n.o.s, see* Dyes, liquid *or* solid, n.o.s. *or* Dye intermediates, liquid *or* solid, n.o.s., *corrosive*	-	-	-	-	-	-	-	-	-	-	-	-
-	Coating solution (*includes surface treatments or coatings used for industrial or other purposes such as vehicle undercoating, drum or barrel lining*)	3	UN1139	I	3	T42	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T7,T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1,T7,T30	150	203	242	60 L	220 L	A	-
-	Cobalt naphthenates, powder	4.1	UN2001	III	4.1	A19	151	213	240	25 kg	100 kg	A	-
-	Cobalt resinate, precipitated	4.1	UN1318	III	4.1	A1, A19	151	213	240	25 kg	100 kg	A	-
-	*Coke, hot*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Collodion, see* Nitrocellulose *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D G	Combustible liquid, n.o.s	Combustible liquid	NA1993	III	None	T1	150	203	241	60 L	220 L	A	-
G	Components, explosive train, n.o.s	1.2B	UN0382	II	1.2B	101	None	62	None	Forbidden	Forbidden	B	1E, 6E
G	Components, explosive train, n.o.s	1.4B	UN0383	II	1.4B	101	None	62	None	Forbidden	75 kg	A	24E
G	Components, explosive train, n.o.s	1.4S	UN0384	II	1.4S	101	None	62	None	25 kg	100 kg	A	-
G	Components, explosive train, n.o.s	1.1B	UN0461	II	1.1B	101	None	62	None	Forbidden	Forbidden	B	1E, 6E
-	*Composition B, see* Hexolite, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D G	Compounds, cleaning liquid	8	NA1760	I	8	A7, B10, T42	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, N37, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	N37, T7	154	203	241	5 L	60 L	A	40
D G	Compounds, cleaning liquid	3	NA1993	I	3	T42	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	203	242	60 L	220 L	A	-
D G	Compounds, tree killing, liquid *or* Compounds, weed killing, liquid	8	NA1760	I	8	A7, B10, T42	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, N37, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	N37, T7	154	203	241	5 L	60 L	A	40
D G	Compounds, tree killing, liquid *or* Compounds, weed killing, liquid	3	NA1993	I	3	T42	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	203	242	60 L	220 L	A	-
D G	Compounds, tree killing, liquid *or* Compounds, weed killing, liquid	6.1	NA2810	I	6.1	-	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	-	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	-	153	203	241	60 L	220 L	A	40
G	Compressed gas, flammable, n.o.s	2.1	UN1954	-	2.1	-	306	302, 305	314, 315	Forbidden	150 kg	D	40

G	Compressed gas, n.o.s	2.2	UN1956	-	2.2	-	306, 307	302, 305	314, 315	75 kg	150 kg	A	-
G	Compressed gas, oxidizing, n.o.s	2.2	UN3156	-	2.2, 5.1	-	306	302	314, 315	75 kg	150 kg	D	-
GI	Compressed gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3304	-	2.3, 8	1	None	192	245	Forbidden	Forbidden	D	40
GI	Compressed gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3304	-	2.3, 8	2	None	302, 305	314, 315	Forbidden	Forbidden	D	40
GI	Compressed gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3304	-	2.3, 8	3	None	302, 305	314, 315	Forbidden	Forbidden	D	40
GI	Compressed gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3304	-	2.3, 8	4	None	302, 305	314, 315	Forbidden	Forbidden	D	40
GI	Compressed gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3305	-	2.3, 2.1, 8	1	None	192	245	Forbidden	Forbidden	D	17, 40
GI	Compressed gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3305	-	2.3, 2.1, 8	2	None	302, 305	314, 315	Forbidden	Forbidden	D	17, 40
GI	Compressed gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3305	-	2.3, 2.1, 8	3	None	302, 305	314, 315	Forbidden	Forbidden	D	17, 40
GI	Compressed gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3305	-	2.3, 2.1, 8	4	None	302, 305	314, 315	Forbidden	Forbidden	D	17, 40
G	Compressed gas, toxic, flammable, n.o.s. *Inhalation hazard Zone A*	2.3	UN1953	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40, 95
G	Compressed gas, toxic, flammable, n.o.s. *Inhalation hazard Zone B*	2.3	UN1953	-	2.3, 2.1	2, B9, B14	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone C*	2.3	UN1953	-	2.3, 2.1	3, B14	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone D*	2.3	UN1953	-	2.3, 2.1	4	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, n.o.s. *Inhalation Hazard Zone A*	2.3	UN1955	-	2.3	1	None	192	245	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, n.o.s. *Inhalation Hazard Zone B*	2.3	UN1955	-	2.3	2, B9, B14	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, n.o.s. *Inhalation Hazard Zone C*	2.3	UN1955	-	2.3	3, B14	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, n.o.s. *Inhalation Hazard Zone D*	2.3	UN1955	-	2.3	4	None	302, 305	314, 315	Forbidden	Forbidden	D	40
GI	Compressed gas, toxic, oxdizing, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3306	-	2.3, 5.1, 8	1	None	192	244	Forbidden	Forbidden	D	40, 89, 90
GI	Compressed gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3306	-	2.3, 5.1, 8	2	None	302, 305	314, 315	Forbidden	Forbidden	D	40, 89, 90
GI	Compressed gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3306	-	2.3, 5.1, 8	3	None	302, 305	314, 315	Forbidden	Forbidden	D	40, 89, 90
GI	Compressed gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3306	-	2.3, 5.1, 8	4	None	302, 305	314, 315	Forbidden	Forbidden	D	40, 89, 90
G	Compressed gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3303	-	2.3, 5.1	1	None	192	245	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3303	-	2.3, 5.1	2	None	302, 30	314, 31	Forbidden	Forbidden	D	40

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G	Compressed gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3303	-	2.3, 5.1	3	None	302, 305	314, 315	Forbidden	Forbidden	D	40
G	Compressed gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3303	-	2.3, 5.1	4	None	302, 305	314, 315	Forbidden	Forbidden	D	40
D	Consumer commodity	ORM-D	-	-	None	-	156, 306	156, 306	None	30 kg gross	30 kg gross	A	-
-	Contrivances, water-activated, *with burster, expelling charge or propelling charge*	1.2L	UN0248	II	1.2L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
-	Contrivances, water-activated, *with burster, expelling charge or propelling charge*	1.3L	UN0249	II	1.3L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
-	Copper acetoarsenite	6.1	UN1585	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Copper acetylide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Copper amine azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Copper arsenite	6.1	UN1586	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Copper based pesticides, liquid, flammable, toxic*, flash point less than 23 degrees C*	3	UN2776	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Copper based pesticides, liquid, toxic	6.1	UN3010	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Copper based pesticides, liquid, toxic, flammable *flashpoint not less than 23 degrees C*	6.1	UN3009	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
-	Copper based pesticides, solid, toxic	6.1	UN2775	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Copper chlorate	5.1	UN2721	II	5.1	A1	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Copper chloride	8	UN2802	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Copper cyanide	6.1	UN1587	II	6.1	-	None	204	242	25 kg	100 kg	A	26
-	*Copper selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	*Copper selenite, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	*Copper tetramine nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
A W	Copra	4.2	UN1363	III	4.2	-	None	213	241	Forbidden	Forbidden	A	13, 19, 48, 119
-	Cord, detonating, *flexible*	1.1D	UN0065	II	1.1D	102	63(a)	62	None	Forbidden	Forbidden	B	-
-	Cord, detonating, *flexible*	1.4D	UN0289	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Cord detonating *or* Fuse detonating *metal clad*	1.2D	UN0102	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	Cord, detonating *or* Fuse, detonating *metal clad*	1.1D	UN0290	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Cord, detonating, mild effect *or* Fuse, detonating, mild effect *metal clad*	1.4D	UN0104	II	1.4D	-	None	62	None	Forbidden	75 kg	A	24E
-	Cord, igniter	1.4G	UN0066	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	*Cordeau detonant fuse, see* Cord, detonating, *etc;* Cord, detonating, *flexible*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Cordite, see* Powder, smokeless	-	-	-	-	-	-	-	-	-	-	-	-
G	Corrosive liquid, acidic, inorganic, n.o.s	8	UN3264	I	8	B10	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	40

G	Corrosive liquid, acidic, organic, n.o.s	8	UN3265	I	8	B10	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	40
G	Corrosive liquid, basic, inorganic, n.o.s	8	UN3266	I	8	B10	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	40
G	Corrosive liquid, basic, organic, n.o.s	8	UN3267	I	8	B10	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	40
G	Corrosive liquid, self-heating, n.o.s	8	UN3301	I	8, 4.2	B10	None	201	243	0.5 L	2.5 L	D	-
-	-	-	-	II	8, 4.2	B2	154	202	242	1 L	30 L	D	-
G	Corrosive liquids, flammable, n.o.s	8	UN2920	I	8, 3	B10, T42	None	201	243	0.5 L	2.5 L	C	25, 40
-	-	-	-	II	8, 3	B2, T15, T26	None	202	243	1 L	30 L	C	25, 40
G	Corrosive liquids, n.o.s	8	UN1760	I	8	A7, B10, T42	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8	B2, T14	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	40
G	Corrosive liquids, oxidizing, n.o.s	8	UN3093	I	8, 5.1	-	None	201	243	Forbidden	2.5 L	C	89
-	-	-	-	II	8, 5.1	-	None	202	243	1 L	30 L	C	89
G	Corrosive liquids, toxic, n.o.s	8	UN2922	I	8, 6.1	A7, B10, T18, T27	None	201	243	0.5 L	2.5 L	B	40
-	-	-	-	II	8, 6.1	B3, T18, T26	None	202	243	1 L	30 L	B	40
-	-	-	-	III	8, 6.1	T8	154	203	241	5 L	60 L	B	40
G	Corrosive liquids, water-reactive, n.o.s	8	UN3094	I	8, 4.3	-	None	201	243	Forbidden	1 L	E	-
-	-	-	-	II	8, 4.3	-	None	202	243	1 L	5 L	E	-
G	Corrosive solid, acidic, inorganic, n.o.s	8	UN3260	I	8	-	None	211	242	1 kg	25 kg	B	-
-	-	-	-	II	8	-	154	212	240	15 kg	50 kg	B	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Corrosive solid, acidic, organic, n.o.s	8	UN3261	I	8	-	None	211	242	1 kg	25 kg	B	-
-	-	-	-	II	8	-	154	212	240	15 kg	50 kg	B	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Corrosive solid, basic, inorganic, n.o.s	8	UN3262	I	8	-	None	211	242	1kg	25 kg	B	-
-	-	-	-	II	8	-	154	212	240	15 kg	50 kg	B	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Corrosive solid, basic, organic, n.o.s	8	UN3263	I	8	-	None	211	242	1 kg	25 kg	B	-
-	-	-	-	II	8	-	154	212	240	15 kg	50 kg	B	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Corrosive solids, flammable, n.o.s	8	UN2921	I	8, 4.1	B106	None	211	242	1 kg	25 kg	B	12, 25
-	-	-	-	II	8, 4.1	-	None	212	242	15 kg	50 kg	B	12, 25
G	Corrosive solids, n.o.s	8	UN1759	I	8	-	None	211	242	1 kg	25 kg	B	-
-	-	-	-	II	8	128	154	212	240	15 kg	50 kg	A	-
-	-	-	-	III	8	128	154	213	240	25 kg	100 kg	A	-
G	Corrosive solids, oxidizing, n.o.s	8	UN3084	I	8, 5.1	B100	None	211	242	1 kg	25 kg	C	-
-	-	-	-	II	8, 5.1	B100	None	212	242	15 kg	50 kg	C	-
G	Corrosive solids, self-heating, n.o.s	8	UN3095	I	8, 4.2	B100	None	211	243	1 kg	25 kg	C	-
-	-	-	-	II	8, 4.2	-	None	212	242	15 kg	50 kg	C	-
G	Corrosive solids, toxic, n.o.s	8	UN2923	I	8, 6.1	-	None	211	242	1 kg	25 kg	B	40
-	-	-	-	II	8, 6.1	-	None	212	240	15 kg	50 kg	B	40
-	-	-	-	III	8, 6.1	-	154	213	240	25 kg	100 kg	B	40, 95
G	Corrosive solids, water-reactive, n.o.s	8	UN30	I	8,	B105	Non	211	243	1 kg	25 kg	D	-

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-	-	-	-	II	8, 4.3	B105	None	212	242	15 kg	50 kg	D	-
D, W	Cotton	9	NA1365	-	9	137, W41	None	None	None	No limit	No limit	A	-
A, W	Cotton waste, oily	4.2	UN1364	III	4.2	-	None	213	None	Forbidden	Forbidden	A	54
AI W	Cotton, wet	4.2	UN1365	III	4.2	-	None	204	241	Forbidden	Forbidden	A	-
-	Coumarin derivative pesticides, liquid, flammable, toxic, *flashpoint less than 23 degrees C*	3	UN3024	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Coumarin derivative pesticides, liquid, toxic	6.1	UN3026	I	6.1	-	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	-	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	-	153	203	241	60 L	220 L	A	40
-	Coumarin derivative pesticides, liquid, toxic, flammable *flashpoint not less than 23 degrees C*	6.1	UN3025	I	6.1, 3	-	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	-	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1	153	203	242	60 L	220 L	A	40
-	Coumarin derivative pesticides, solid, toxic	6.1	UN3027	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Cresols	6.1	UN2076	II	6.1, 8	B110, T8	None	202	243	1 L	30 L	B	-
-	Cresylic acid	6.1	UN2022	II	6.1, 8	B110, T8	None	202	243	1 L	30 L	B	-
-	Crotonaldehyde, stabilized	6.1	UN1143	I	6.1, 3	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	30 L	B	40
-	Crotonic acid *liquid*	8	UN2823	III	8	-	154	203	241	5 L	60 L	A	12
-	Crotonic acid, *solid*	8	UN2823	III	8	-	154	213	240	25 kg	100 kg	A	12
-	Crotonylene	3	UN1144	I	3	T20	150	201	243	1 L	30 L	E	-
-	Cupriethylenediamine solution	8	UN1761	II	8, 6.1	T8, T26	None	202	243	1 L	30 L	A	95
-	-	-	-	III	8, 6.1	T7	154	203	242	5 L	60 L	A	95
-	Cutters, cable, explosive	1.4S	UN0070	II	1.4 S	-	None	62	None	25 kg	100 kg	A	-
-	*Cyanide or cyanide mixtures, dry, see* Cyanides, inorganic, solid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyanide solutions, n.o.s	6.1	UN1935	I	6.1	B37, T18, T26	None	201	243	1 L	30 L	B	40, 52
-	-	-	-	II	6.1	T18, T26	None	202	243	5 L	60 L	A	40, 52
-	-	-	-	III	6.1	T18, T26	153	203	241	60 L	220 L	A	40, 52
-	Cyanides, inorganic, solid, n.o.s	6.1	UN1588	I	6.1	N74, N75	None	211	242	5 kg	50 kg	A	52
-	-	-	-	II	6.1	N74, N75	None	212	242	25 kg	100 kg	A	52
-	-	-	-	III	6.1	N74, N75	153	213	240	100 kg	200 kg	A	52
-	Cyanogen bromide	6.1	UN1889	I	6.1, 8	A6, A8	None	211	242	1 kg	15 kg	D	40
-	Cyanogen chloride, inhibited	2.3	UN1589	-	2.3, 8	1	None	192	245	Forbidden	Forbidden	D	40
-	Cyanogen	2.3	UN1026	-	2.3, 2.1	2	None	192	245	Forbidden	Forbidden	D	40
-	Cyanuric chloride	8	UN2670	II	8	-	None	212	240	15 kg	50 kg	A	12, 40
-	*Cyanuric triazide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Cyclobutane	2.1	UN2601	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Cyclobutyl chloroformate	6.1	UN2744	II	6.1, 8, 3	T18	None	202	243	1 L	30 L	A	12, 13, 21, 25, 40, 100
-	1,5,9-Cyclododecatriene	6.1	UN2518	III	6.1	T7	153	203	241	60 L	220 L	A	40
-	Cycloheptane	3	UN2241	II	3	T1	150	202	242	5 L	60 L	B	40

-	Cycloheptatriene	3	UN2603	II	3, 6.1	T14	None	202	243	1 L	60 L	E	40
-	Cycloheptene	3	UN2242	II	3	B1, T7	150	202	242	5 L	60 L	B	-
-	Cyclohexane	3	UN1145	II	3	B101, T8	150	202	242	5 L	60 L	E	-
-	Cyclohexanone	3	UN1915	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Cyclohexene	3	UN2256	II	3	B101, T7	150	202	242	5 L	60 L	E	-
-	Cyclohexenyltrichlorosilane	8	UN1762	II	8	A7, B2, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Cyclohexyl acetate	3	UN2243	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Cyclohexyl isocyanate	6.1	UN2488	I	6.1, 3	2,B9, B14,B32, B74,B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
-	Cyclohexyl mercaptan	3	UN3054	III	3	B1, T1	150	203	242	60 L	220 L	A	40, 95
-	Cyclohexylamine	8	UN2357	II	8, 3	B101, T8, T26	None	202	243	1 L	30 L	A	40
-	Cyclohexyltrichlorosilane	8	UN1763	II	8	A7, B2, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Cyclonite and cyclotetramethylenetetranitramine mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclonite and HMX mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclonite and octogen mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclonite, *see* Cyclotrimethylenetrinitramine, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclooctadiene phosphines, *see* 9-Phosphabicyclononanes	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclooctadienes	3	UN2520	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Cyclooctatetraene	3	UN2358	II	3	T8	150	202	242	5 L	60 L	B	-
-	Cyclopentane	3	UN1146	II	3	B101, T14	150	202	242	5 L	60 L	E	-
-	*Cyclopentane, methyl, see* Methylcyclopentane	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclopentanol	3	UN2244	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Cyclopentanone	3	UN2245	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Cyclopentene	3	UN2246	II	3	B101, T13	150	202	242	5 L	60 L	E	-
-	Cyclopropane	2.1	UN1027	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
-	*Cyclotetramethylene tetranitramine (dry or unphlegmatized) (HMX)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Cyclotetramethylenetetranitramine, desensitized *or* Octogen, desensitized *or* HMX, desensitized	1.1D	UN0484	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Cyclotetramethylenetetranitramine, wetted *or* HMX, wetted *or* Octogen, wetted *with not less than 15 percent water, by mass*	1.1D	UN0226	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Cyclotrimethylenenitramine and octogen, mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclotrimethylenetrinitramine and cyclotetramethylenetetranitramine mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted or desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclotrimethylenetrinitramine and HMX mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Cyclotrimethylenetrinitramine, desensitized *or* Cyclonite, desensitized *or* Hexogen, desensitized *or* RDX, desensitized	1.1D	UN0483	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Cyclotrimethylenetrinitramine, wetted *or* Cyclonite, wetted *or* Hexogen, wetted *or* RDX, wetted *with not less than 15 percent water by mass*	1.1D	UN0072	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Cymenes	3	UN2046	III	3	B1, T1	150	203	242	60 L	220 L	A	-
D	Dangerous Goods in Machinery *or* Dangerous Goods in Apparatus	-	NA8001	-	-	136	None	222	None	No limit	No limit	A	-
-	Decaborane	4.1	UN1868	II	4.1, 6.1	A19, A20	None	212	None	Forbidden	50 kg	A	-
-	Decahydronaphthalene	3	UN1147	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	n-Decane	3	UN22	III	3	B1, T1	150	203	242	60 L	220 L	A	-

			47										
-	Deflagrating metal salts of aromatic nitroderivatives, n.o.s	1.3C	UN0132	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Delay electric igniter, see* Igniters	-	-	-	-	-	-	-	-	-	-	-	-
D	Denatured alcohol	3	NA1986	I	3, 6.1	T8, T31	None	201	243	Forbidden	30 L	E	40
-	-	-	-	II	3, 6.1	T8, T31	None	202	243	1 L	60 L	E	40
-	-	-	-	III	3, 6.1	B1, T8, T31	150	203	242	60 L	220 L	E	40
D	Denatured alcohol	3	NA1987	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Depth charges, see* Charges, depth	-	-	-	-	-	-	-	-	-	-	-	-
-	*Detonating relays, see* Detonators,*etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Detonator assemblies, non-electric for blasting	1.1B	UN0360	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Detonator assemblies, non-electric, *for blasting*	1.4B	UN0361	II	1.4B	103	63(f), 63(g)	62	None	Forbidden	75 kg	A	24E
-	Detonator, assemblies, non-electric *for blasting*	1.4S	UN0500	II	1.4S	-	63(f), 63(g)	62	None	25 kg	100 kg	A	-
-	Detonators, electric, *for blasting*	1.1B	UN0030	II	1.1B	-	63(f), 63(g)	62	None	Forbidden	Forbidden	B	2E, 6E
-	Detonators, electric, *for blasting*	1.4B	UN0255	II	1.4B	103	63(f), 63(g)	62	None	Forbidden	75 kg	A	24E
-	Detonators, electric *for blasting*	1.4S	UN0456	II	1.4S	-	63(f), 63(g)	62	None	25 kg	100 kg	A	-
-	Detonators for ammunition	1.1B	UN0073	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Detonators for ammunition	1.2B	UN0364	II	1.2B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Detonators for ammunition	1.4B	UN0365	II	1.4B	103	None	62	None	Forbidden	75 kg	A	24E
-	Detonators for ammunition	1.4S	UN0366	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Detonators, non-electric, *for blasting*	1.1B	UN0029	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Detonators, non-electric, *for blasting*	1.4B	UN0267	II	1.4B	103	63(f), 63(g)	62	None	Forbidden	75 kg	A	24E
-	Detonators, non-electric *for blasting*	1.4S	UN0455	II	1.4S	104	63(f), 63(g)	62	None	25 kg	100 kg	A	-
-	Deuterium, compressed	2.1	UN1957	-	2.1	-	306	302	None	Forbidden	150 kg	E	40
-	Devices, small, hydrocarbon gas powered *or* Hydrocarbon gas refills for small devices *with release device*	2.1	UN3150	-	2.1	-	306	304	None	Forbidden	150 kg	B	40
-	Di-n-amylamine	3	UN2841	III	3, 6.1	B1, T8	150	203	242	60 L	220 L	A	-
-	*Di-n-butyl peroxydicarbonate, with more than 52 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Di-n-butylamine	8	UN2248	II	8, 3	T8	None	202	243	1 L	30 L	A	-
-	*2,2-Di-(tert-butylperoxy) butane, with more than 55 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Di-(tert-butylperoxy) phthalate, with more than 55 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,2-Di-(4,4-di-tert-butylperoxycyclohexyl) propane, with more than 42 percent with inert solid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Di-2,4-dichlorobenzoyl peroxide, with more than 75 percent with water*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	1,2-Di-(dimethylamino)ethane	3	UN2372	II	3	T8	150	202	242	5 L	60 L	B	-
-	*Di-2-ethylhexyl phosphoric acid, see* Diisooctyl acid phosphate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Di-(1-hydroxytetrazole) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Di-(1-naphthoyl) peroxide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*a,a'-Di-(nitroxy) methylether*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

-	*Di-(beta-nitroxyethyl) ammonium nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diacetone alcohol	3	UN1148	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Diacetone alcohol peroxides, with more than 57 percent in solution with more than 9 percent hydrogen peroxide, less than 26 percent diacetone alcohol and less than 9 percent water; total active oxygen content more than 9 percent by mass*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diacetyl, see* Butanedione	-	-	-	-	-	-	-	-	-	-	-	-
-	*Diacetyl peroxide, solid, or with more than 25 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diallylamine	3	UN2359	II	3, 6.1, 8	T8	None	202	243	1 L	5 L	B	21, 40, 100
-	Diallylether	3	UN2360	II	3, 6.1	N12, T8	None	202	243	1 L	60 L	E	40
-	4,4'-Diaminodiphenyl methane	6.1	UN2651	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*p-Diazidobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,2-Diazidoethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,1'-Diazoaminonaphthalene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diazoaminotetrazole (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diazodinitrophenol (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diazodinitrophenol, wetted *with not less than 40 percent water or mixture of alcohol and water, by mass*	1.1A	UN0074	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	*Diazodiphenylmethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diazonium nitrates (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diazonium perchlorates (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,3-Diazopropane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Dibenzyl peroxydicarbonate, with more than 87 percent with water*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dibenzyldichlorosilane	8	UN2434	II	8	B2, T8, T26	154	202	242	1 L	30 L	C	40
-	Diborane, compressed	2.3	UN1911	-	2.3, 2.1	1	None	302	None	Forbidden	Forbidden	D	40, 57
D	Diborane mixtures	2.1	NA1911	-	2.1	5	None	302	245	Forbidden	Forbidden	D	40, 57
-	*Dibromoacetylene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	1,2-Dibromobutan-3-one	6.1	UN2648	II	6.1	-	None	202	243	5 L	60 L	B	40
-	Dibromochloropropane	6.1	UN2872	III	6.1	T7	153	203	241	60 L	220 L	A	-
A	Dibromodifluoromethane, *R12B2*	9	UN1941	III	None	T22	155	203	241	100 L	220 L	A	25
-	*1,2-Dibromoethane, see* Ethylene dibromide	-	-	-	-	-	-	-	-	-	-	-	-
-	Dibromomethane	6.1	UN2664	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Dibutyl ethers	3	UN1149	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Dibutylaminoethanol	6.1	UN2873	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	*N,N'-Dichlorazodicarbonamidine (salts of) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	1,1-Dichloro-1-nitroethane	6.1	UN2650	II	6.1	T8	None	202	243	5 L	60 L	A	12, 40
D	3,5-Dichloro-2,4,6-trifluoropyridine	6.1	NA9264	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	A	40, 95
-	Dichloroacetic acid	8	UN1764	II	8	A3, A6, A7, B2, N34, T9, T27	154	202	242	1 L	30 L	A	-
-	1,3-Dichloroacetone	6.1	UN2649	II	6.1	-	None	212	242	25 kg	100 kg	B	12, 40
-	Dichloroacetyl chloride	8	UN1765	II	8	A3, A6, A7, B2, B6, N34, T8, T26	154	202	242	1 L	30 L	D	40
-	*Dichloroacetylene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
+	Dichloroanilines, liquid	6.1	UN1590	II	6.1	T14	None	202	243	5 L	60 L	A	40
+	Dichloroanilines, solid	6.1	UN1590	II	6.1	T14	None	212	242	25 kg	100 kg	A	40
+	o-Dichlorobenzene	6.1	UN1591	III	6.1	T7	153	203	241	60 L	220 L	A	-
D	Dichlorobutene	8	NA2920	I	8, 3	-	None	201	243	0.5 L	2.5 L	C	12, 21, 25, 40, 48

-	2,2'-Dichlorodiethyl ether	6.1	UN1916	II	6.1, 3	N33, N34, T8	None	202	243	5 L	60 L	A	-
-	Dichlorodifluoromethane and difluoroethane azeotropic mixture *or* Refrigerant gas R 500 *with approximately 74 percent dichlorodifluoromethane*	2.2	UN2602	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Dichlorodifluoromethane *or* Refrigerant gas R 12	2.2	UN1028	-	2.2	-	306	304	314, 315	75 kg	150kg	A	-
-	Dichlorodimethyl ether, symmetrical	6.1	UN2249	I	6.1	T25	None	201	243	Forbidden	Forbidden	D	40
-	1,1-Dichloroethane	3	UN2362	II	3	B101, T7	150	202	242	5 L	60 L	B	40
-	*1,2-Dichloroethane, see* Ethylene dichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Dichloroethyl sulfide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	1,2-Dichloroethylene	3	UN1150	II	3	T14	150	202	242	5 L	60 L	B	-
-	Dichlorofluoromethane*or* refrigerant gas R21	2.2	UN1029	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Dichloroisocyanuric acid, dry *or* Dichloroisocyanuric acid salts	5.1	UN2465	II	5.1	28	152	212	240	5 kg	25 kg	A	13
-	Dichloroisopropyl ether	6.1	UN2490	II	6.1	T8	None	202	243	5 L	60L	B	-
-	Dichloromethane	6.1	UN1593	III	6.1	N36, T13	153	203	241	60 L	220 L	A	-
-	Dichloropentanes	3	UN1152	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Dichlorophenyl isocyanates	6.1	UN2250	II	6.1	-	None	212	242	25 kg	100 kg	B	25, 40, 48
-	Dichlorophenyltrichlorosilane	8	UN1766	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	1,2-Dichloropropane	3	UN1279	II	3	N36,T1	150	202	242	5 L	60 L	B	-
-	1,3-Dichloropropanol-2	6.1	UN2750	II	6.1	T8	None	202	243	5 L	60 L	A	12, 40
-	*Dichloropropene and propylene dichloride mixture, see* Propylene dichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Dichloropropenes	3	UN2047	II	3	T8	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T8	150	203	242	60 L	220 L	A	-
-	Dichlorosilane	2.3	UN2189	-	2.3, 2.1, 8	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	17, 40
-	1,2-Dichloro-1,1,2,2-Tetrafluoroethane *or* Refrigerant gas R 114	2.2	UN1958	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	*Dichlorovinylchloroarsine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dicycloheptadiene, *see* 2,5-Norbornadiene	-	-	-	-	-	-	-	-	-	-	-	-
-	Dicyclohexylamine	8	UN2565	III	8	T8	154	203	241	5 L	60 L	A	-
-	Dicyclohexylammonium nitrite	4.1	UN2687	III	4.1	-	151	213	240	25 kg	100 kg	A	48
-	Dicyclopentadiene	3	UN2048	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Didymium nitrate	5.1	UN1465	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
D	Dieldrin	6.1	NA2761	II	6.1	-	None	212	242	0.5 kg	5 kg	A	40
D	Diesel fuel	3	NA1993	III	None	B1	150	203	242	60 L	220 L	A	-
-	*Diethanol nitrosamine dinitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diethoxymethane	3	UN2373	II	3	T8	150	202	242	5 L	60 L	E	-
-	3,3-Diethoxypropene	3	UN2374	II	3	T1	150	202	242	5 L	60 L	B	-
-	Diethyl carbonate	3	UN2366	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Diethyl cellosolve, see* Ethylene glycol diethyl ether	-	-	-	-	-	-	-	-	-	-	-	-
-	Diethyl ether *or* Ethyl ether	3	UN1155	I	3	T21	150	201	243	1 L	30 L	E	40
-	Diethyl ketone	3	UN1156	II	3	T1	150	202	242	5 L	60 L	B	-
-	*Diethyl peroxydicarbonate, with more than 27 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

-	Diethyl sulfate	6.1	UN1594	II	6.1	B101, T14	None	202	243	5 L	60 L	C	-
-	Diethyl sulfide	3	UN2375	II	3	B101, T14	None	202	243	1 L	60 L	E	-
-	Diethylamine	3	UN1154	II	3, 8	B101, N34, T8	None	202	243	1 L	5 L	E	40
-	2-Diethylaminoethanol	8	UN2686	II	8,3	B2,T15, T26	None	202	243	1 L	30 L	A	-
-	Diethylaminopropylamine	3	UN2684	III	3, 8	B1, T8	150	203	242	5 L	60 L	A	-
+	N, N-Diethylaniline	6.1	UN2432	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	Diethylbenzene	3	UN2049	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Diethyldichlorosilane	8	UN1767	II	8, 3	A7, B6, B100, N34, T8, T26	None	202	243	Forbidden	30 L	C	40
-	*Diethylene glycol dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diethyleneglycol dinitrate, desensitized *with not less than 25 percent non-volatile water-insoluble phlegmatizer, by mass*	1.1D	UN0075	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 4E, 21E
-	Diethylenetriamine	8	UN2079	II	8	B2, T8	154	202	242	1 L	30 L	A	40
-	N,N-Diethylethylenediamine	8	UN2685	II	8, 3	T8	None	202	243	1 L	30 L	A	-
-	*Diethylgold bromide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diethylthiophosphoryl chloride	8	UN2751	II	8	B2, T8	None	212	240	15 kg	50 kg	C	40
-	Diethylzinc	4.2	UN1366	I	4.2, 4.3	B11, T28, T40	None	181	244	Forbidden	Forbidden	D	18
-	*Difluorochloroethanes, see* 1-Chloro-1,1-difluoroethanes	-	-	-	-	-	-	-	-	-	-	-	-
-	1,1-Difluoroethane *or* Refrigerant gas R 152a	2.1	UN1030	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	1,1-Difluoroethylene *or* Refrigerant gas R 1132a	2.1	UN1959	-	2.1	-	306	304	None	Forbidden	150 kg	E	40
-	Difluoromethane *or* Refrigerant gas R 32	2.1	UN3252	-	2.1	-	306	302	314, 315	Forbidden	150 kg	D	40
-	Difluorophosphoric acid, anhydrous	8	UN1768	II	8	A6, A7, B2, N5, N34, T9, T27	None	202	242	1 L	30 L	A	40
-	2,3-Dihydropyran	3	UN2376	II	3	T7	150	202	242	5 L	60 L	B	-
-	*1,8-Dihydroxy-2,4,5,7-tetranitroanthraquinone (chrysamminic acid)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Diiodoacetylene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diisobutyl ketone	3	UN1157	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Diisobutylamine	3	UN2361	III	3, 8	B1, T1	150	203	242	5 L	60 L	A	-
-	Diisobutylene, isomeric compounds	3	UN2050	II	3	T1	150	202	242	5 L	60 L	B	-
-	Diisooctyl acid phosphate	8	UN1902	III	8	T7	154	203	241	5 L	60 L	A	-
-	Diisopropyl ether	3	UN1159	II	3	B101, T8	150	202	242	5 L	60 L	E	40
-	Diisopropylamine	3	UN1158	II	3, 8	B101, T8	None	202	243	1 L	5 L	B	-
-	*Diisopropylbenzene hydroperoxide, with more than 72 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Diketene, inhibited	6.1	UN2521	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40, 49
-	1,2-Dimethoxyethane	3	UN2252	II	3	T1	150	202	242	5 L	60 L	B	-
-	1,1-Dimethoxyethane	3	UN2377	II	3	T13	150	202	242	5 L	60 L	B	-
-	Dimethyl carbonate	3	UN1161	II	3	T8	150	202	242	5 L	60 L	B	-
-	*Dimethyl chlorothiophosphate, see* Dimethyl thiophosphoryl chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*2,5-Dimethyl-2,5-dihydroperoxy hexane, with more than 82 percent with water*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dimethyl disulfide	3	UN2381	II	3	T8	150	202	242	5 L	60 L	B	40
-	Dimethyl ether	2.1	UN1033	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Dimethyl-N-propylamine	3	UN22	II	3, 8	T14, T26	Non	202	243	1 L	5 L	B	40

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-	Dimethyl sulfate	6.1	UN1595	I	6.1, 8	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Dimethyl sulfide	3	UN1164	II	3	B100, T14	None	202	242	5 L	60 L	E	40
-	Dimethyl thiophosphoryl chloride	6.1	UN2267	II	6.1, 8	T7	None	202	243	1 L	30 L	B	25
-	Dimethylamine, anhydrous	2.1	UN1032	-	2.1	-	None	304	314, 315	Forbidden	150 kg	D	40
-	Dimethylamine solution	3	UN1160	II	3, 8	T8, T34	None	202	243	1 L	5 L	B	-
-	2-Dimethylaminoacetonitrile	3	UN2378	II	3, 6.1	T8	None	202	243	1 L	60 L	A	26, 40
-	2-Dimethylaminoethanol	8	UN2051	II	8, 3	B2, T8	154	202	243	1 L	30 L	A	-
-	2-Dimethylaminoethyl acrylate	6.1	UN3302	II	6.1	T8	None	202	243	5 L	60 L	D	25
-	2-Dimethylaminoethyl methacrylate	6.1	UN2522	II	6.1	T8	None	202	243	5 L	60 L	B	40
-	N,N-Dimethylaniline	6.1	UN2253	II	6.1	T8	None	202	243	5 L	60 L	A	-
-	2,3-Dimethylbutane	3	UN2457	II	3	T13	150	202	242	5 L	60L	E	-
-	1,3-Dimethylbutylamine	3	UN2379	II	3, 8	T8	None	202	243	1 L	5 L	B	-
-	Dimethylcarbamoyl chloride	8	UN2262	II	8	B2, T8	154	202	242	1 L	30 L	A	40
-	Dimethylcyclohexanes	3	UN2263	II	3	T1	150	202	242	5 L	60 L	B	-
-	Dimethylcyclohexylamine	8	UN2264	II	8, 3	B2, T8	154	202	243	1 L	30 L	A	40
-	Dimethyldichlorosilane	3	UN1162	II	3, 8	B77, T15, T26	None	202	243	Forbidden	Forbidden	B	40
-	Dimethyldiethoxysilane	3	UN2380	II	3	T8	150	202	242	5 L	60 L	B	-
-	Dimethyldioxanes	3	UN2707	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	N,N-Dimethylformamide	3	UN2265	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Dimethylhexane dihydroperoxide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dimethylhydrazine, symmetrical	6.1	UN2382	I	6.1, 3	2, A7, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Dimethylhydrazine, unsymmetrical	6.1	UN1163	I	6.1, 3, 8	2, B7, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	21, 38, 40, 100
-	2,2-Dimethylpropane	2.1	UN2044	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
-	Dimethylzinc	4.2	UN1370	I	4.2, 4.3	B11, B16, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	18
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	Dinitro-o-cresol, *solid*	6.1	UN1598	II	6.1	T14	None	212	242	25 kg	100 kg	A	-
-	Dinitro-o-cresol, *solution*	6.1	UN1598	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	*1,3-Dinitro-5,5-dimethyl hydantoin*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Dinitro-7,8-dimethylglycoluril (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,3-Dinitro-4,5-dinitrosobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,4-Dinitro-1,1,4,4-tetramethylolbutanetetranitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,4-Dinitro-1,3,5-trimethylbenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitroanilines	6.1	UN1596	II	6.1	T14	None	212	242	25 kg	100 kg	A	91
-	Dinitrobenzenes, *liquid*	6.1	UN1597	II	6.1	11, T14	None	202	243	5 L	60 L	A	91
-	Dinitrobenzenes, *solid*	6.1	UN1597	II	6.1	11	None	212	242	25 kg	100 kg	A	91
-	*Dinitrochlorobenzene, see* Chlorodinitrobenzene	-	-	-	-	-	-	-	-	-	-	-	-
-	*1,2-Dinitroethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,1-Dinitroethane (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitrogen tetroxide	2.3	UN10	-	2.3,	1, B7, B14, B45,	Non	336	314	Forbidden	Forbidden	D	40,

			67		5.1, 8	B46, B61, B66, B67, B77	e						89, 90
-	Dinitroglycoluril *or* Dingu	1.1D	UN0489	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Dinitromethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitrophenol, *dry or wetted with less than 15 percent water, by mass*	1.1D	UN0076	II	1.1D, 6.1	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Dinitrophenol solutions	6.1	UN1599	II	6.1	T8	None	202	243	5 L	60 L	A	36
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	36
-	Dinitrophenol, wetted *with not less than 15 percent water, by mass*	4.1	UN1320	I	4.1, 6.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	E	28, 36
-	Dinitrophenolates *alkali metals, dry or wetted with less than 15 percent water, by mass*	1.3C	UN0077	II	1.3C, 6.1	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Dinitrophenolates, wetted *with not less than 15 percent water, by mass*	4.1	UN1321	I	4.1, 6.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	E	28, 36
-	*Dinitropropylene glycol*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitroresorcinol, *dry or wetted with less than 15 percent water, by mass*	1.1D	UN0078	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*2,4-Dinitroresorcinol (heavy metal salts of) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*4,6-Dinitroresorcinol (heavy metal salts of) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitroresorcinol, wetted *with not less than 15 percent water, by mass*	4.1	UN1322	I	4.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	E	28, 36
-	*3,5-Dinitrosalicylic acid (lead salt) (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitrosobenzene	1.3C	UN0406	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Dinitrosobenzylamidine and salts of (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,2-Dinitrostilbene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dinitrotoluenes, *liquid*	6.1	UN2038	II	6.1	T8	None	202	243	5 L	60 L	A	-
-	Dinitrotoluenes, molten	6.1	UN1600	II	6.1	B100, T14	None	202	243	Forbidden	Forbidden	C	-
-	Dinitrotoluenes, *solid*	6.1	UN2038	II	6.1	T8	None	212	242	25 kg	100kg	A	-
-	*1,9-Dinitroxy pentamethylene-2,4, 6,8-tetramine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Dioxane	3	UN1165	II	3	T8	150	202	242	5 L	60 L	B	-
-	Dioxolane	3	UN1166	II	3	T8	150	202	242	5 L	60 L	B	40
-	Dipentene	3	UN2052	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Diphenylamine chloroarsine	6.1	UN1698	I	6.1	-	None	201	None	Forbidden	Forbidden	D	40
-	Diphenylchloroarsine, liquid	6.1	UN1699	I	6.1	A8, B14, B32, N33, N34	None	201	243	Forbidden	30 L	D	40
-	Diphenylchloroarsine, solid	6.1	UN1699	I	6.1	A8, B14, B32, N33, N34	None	211	242	Forbidden	15 kg	D	40
-	Diphenyldichlorosilane	8	UN1769	II	8	A7, B2, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Diphenylmethyl bromide	8	UN1770	II	8	-	154	212	240	15 kg	50 kg	D	40
-	Dipicryl sulfide, *dry or wetted with less than 10 percent water, by mass*	1.1D	UN0401	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Dipicryl sulfide, wetted *with not less than 10 percent water, by mass*	4.1	UN2852	I	4.1	A2, N41	None	211	None	Forbidden	0.5 kg	D	28
-	Dipicrylamine, *see* Hexanitrodiphenylamine	-	-	-	-	-	-	-	-	-	-	-	-
-	*Dipropionyl peroxide, with more than 28 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Di-n-propyl ether	3	UN2384	II	3	T1	150	202	242	5 L	60 L	B	-
-	Dipropyl ketone	3	UN2710	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Dipropylamine	3	UN2383	II	3, 8	T8	None	202	243	1 L	5 L	B	-
G	Disinfectant, liquid, corrosive, n.o.s	8	UN1903	I	8	A7, B10, T42	None	201	243	0.5 L	2.5 L	B	-
G	Disinfectants, liquid, corrosive n.o.s	8	UN1903	II	8	B2	154	202	242	1 L	30 L	B	-
-	-	-	-	III	8	-	154	203	241	5 L	60 L	A	-
G	Disinfectants, liquid, toxic, n.o.s	6.1	UN3142	I	6.1	A4, T42	None	201	243	1 L	30 L	A	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	A	40
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	40
G	Disinfectants, solid, toxic, n.o.s	6.1	UN1601	II	6.1	-	None	212	242	25 kg	100 kg	A	40

-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Disodium trioxosilicate	8	UN3253	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Dispersant gases, n.o.s. *see* Refrigerant gases, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Divinyl ether, inhibited	3	UN1167	I	3	T14	None	201	243	1 L	60 L	E	40
D	Dodecylbenzenesulfonic acid	8	NA2584	II	8	B2	154	202	242	1 L	30 L	B	9
-	Dodecyltrichlorosilane	8	UN1771	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Dry ice, *see* Carbon dioxide, solid	-	-	-	-	-	-	-	-	-	-	-	-
G	Dyes, liquid, corrosive, n.o.s. or Dye intermediates, liquid, corrosive, n.o.s.	8	UN2801	I	8	11, B10	None	201	243	0.5 L	2.5 L	A	-
-	-	-	-	II	8	11, B2, T14	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	11, T7	154	203	241	5 L	60 L	A	-
G	Dyes, liquid, toxic, n.o.s *or* Dye intermediates, liquid, toxic, n.o.s	6.1	UN1602	II	6.1	-	None	202	243	5 L	60 L	A	-
-	-	-	-	III	6.1	-	153	203	241	60 L	220 L	A	-
G	Dyes, solid, corrosive, n.o.s. *or* Dye intermediates, solid, corrosive, n.o.s	8	UN3147	I	8	-	None	211	242	1 kg	25 kg	A	-
G	Dyes, solid, corrosive, n.o.s. *or* Dye intermediates, solid, corrosive, n.o.s	8	UN3147	II	8	-	154	212	240	15 kg	50 kg	A	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
G	Dyes, solid, toxic, n.o.s. *or* Dye intermediates, solid, toxic, n.o.s	6.1	UN3143	I	6.1	A5	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*Dynamite, see* Explosive, blasting, type A	-	-	-	-	-	-	-	-	-	-	-	-
-	*Electrolyte (acid or alkali) for batteries, see* Battery fluid, acid *or* Battery fluid, alkali	-	-	-	-	-	-	-	-	-	-	-	-
-	Elevated temperature liquid, flammable, n.o.s.*, with flash point above 37.8 C, at or above its flash point*	3	UN3256	III	3	T1	None	None	247	Forbidden	Forbidden	A	-
-	Elevated temperature liquid, n.o.s., *at or above 100 C and below its flash point (including molten metals, molten salts, etc.)*	9	UN3257	III	9	T1	None	None	247	Forbidden	Forbidden	A	85
-	Elevated temperature solid, n.o.s., *at or above 240 C, see section 173.247(h)(4)*	9	UN3258	III	9	-	247(h)(4)	None	247	Forbidden	Forbidden	A	85
-	Engines, internal combustion, *flammable gas powered*	9	UN3166	-	9	135	220	220	220	Forbidden	No limit	A	-
-	Engines, internal combustion, *flammable liquid powered*	9	UN3166	-	9	135	220	220	220	No limit	No limit	A	-
G	Environmentally hazardous substances, liquid, n.o.s	9	UN3082	III	9	8, T1	155	203	241	No limit	No limit	A	-
G	Environmentally hazardous substances, solid, n.o.s	9	UN3077	III	9	8, B54, N20	155	213	240	No limit	No limit	A	s
-	Epibromohydrin	6.1	UN2558	I	6.1, 3	T18, T26	None	201	243	Forbidden	Forbidden	D	40
+	Epichlorohydrin	6.1	UN2023	II	6.1, 3	T14	None	202	243	5 L	60 L	A	40
-	1,2-Epoxy-3-ethoxypropane	3	UN2752	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Esters, n.o.s	3	UN3272	II	3	T8	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7	150	203	242	60 L	220 L	A	-
-	*Etching acid, liquid, n.o.s., see* Hydrofluoric acid, solution *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethane	2.1	UN1035	-	2.1	-	306	304	302	Forbidden	150 kg	E	40
D	Ethane-Propane mixture, refrigerated liquid	2.1	NA1961	-	2.1	-	None	316	314, 315	Forbidden	Forbidden	D	40
-	Ethane, refrigerated liquid	2.1	UN1961	-	2.1	-	None	None	315	Forbidden	Forbidden	D	40
-	*Ethanol amine dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ethanol *or* Ethyl alcohol *or* Ethanol solutions *or* Ethyl alcohol solutions	3	UN1170	II	3	24, T1	150	202	242	5 L	60 L	A	-
-	-	-	-	III	3	24, B1, T1	150	203	242	60 L	220 L	A	-
-	Ethanolamine *or* Ethanolamine solutions	8	UN2491	III	8	T7	154	203	241	5 L	60 L	A	-
-	*Ether, see* Diethyl ether	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethers, n.o.s	3	UN3271	II	3	T8	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7	150	203	242	60 L	220 L	A	-

-	Ethyl acetate	3	UN1173	II	3	T2	150	202	242	5 L	60 L	B	-
-	Ethyl acrylate, inhibited	3	UN1917	II	3	T8	150	202	242	5 L	60 L	B	40
-	Ethyl alcohol, *see* Ethanol	-	-	-	-	-	-	-	-	-	-	-	-
-	*Ethyl aldehyde, see* Acetaldehyde	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethyl amyl ketone	3	UN2271	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	N-Ethyl-N-benzylaniline	6.1	UN2274	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	Ethyl borate	3	UN1176	II	3	T8	150	202	242	5 L	60 L	B	-
-	Ethyl bromide	6.1	UN1891	II	6.1	B100, T17	None	202	243	5 L	60 L	B	40, 85
-	Ethyl bromoacetate	6.1	UN1603	II	6.1, 3	T14	None	202	243	Forbidden	Forbidden	D	40
-	Ethyl butyl ether	3	UN1179	II	3	B1, B101, T1	150	202	242	5 L	60 L	B	-
-	Ethyl butyrate	3	UN1180	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethyl chloride	2.1	UN1037	-	2.1	B43, B77	None	322	314, 315	Forbidden	150 kg	B	40
-	Ethyl chloroacetate	6.1	UN1181	II	6.1, 3	T14	None	202	243	5 L	60 L	A	-
-	Ethyl chloroformate	6.1	UN1182	I	6.1, 3, 8	2, A3, A6, A7, B9, B14, B32, B74, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	21, 40, 100
-	Ethyl 2-chloropropionate	3	UN2935	III	3	B1, T1	150	203	242	60 L	220 L	A	-
+	Ethyl chlorothioformate	8	UN2826	II	8, 6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	A	40
-	Ethyl crotonate	3	UN1862	II	3	T1	150	202	242	5 L	60 L	B	-
-	Ethyl ether, *see* Diethyl ether	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethyl fluoride *or* Refrigerant gas R161	2.1	UN2453	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
-	Ethyl formate	3	UN1190	II	3	T8	150	202	242	5 L	60 L	E	-
-	*Ethyl hydroperoxide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ethyl isobutyrate	3	UN2385	II	3	T1	150	202	242	5 L	60 L	B	-
+	Ethyl isocyanate	3	UN2481	I	3, 6.1	1, A7, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	Ethyl lactate	3	UN1192	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethyl mercaptan	3	UN2363	I	3	T21	None	201	243	Forbidden	30 L	E	95, 102
-	Ethyl methacrylate	3	UN2277	II	3	T1	150	202	242	5 L	60 L	B	-
-	Ethyl methyl ether	2.1	UN1039	-	2.1	B43	None	201	314, 315	Forbidden	150 kg	B	40
-	Ethyl methyl ketone *or* Methyl ethyl ketone	3	UN1193	II	3	T8	150	202	242	5 L	60 L	B	-
-	Ethyl nitrite solutions	3	UN1194	I	3, 6.1	-	None	201	None	Forbidden	Forbidden	E	40, 105
-	Ethyl orthoformate	3	UN2524	III	3	B1, T7	150	203	242	60 L	220 L	A	-
-	Ethyl oxalate	6.1	UN2525	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	*Ethyl perchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
D	Ethyl phosphonothioic dichloride, anhydrous	6.1	NA2927	I	6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
D	Ethyl phosphonous dichloride, anhydrous *pyrophoric liquid*	6.1	NA2845	I	6.1, 4.2	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	18
D	Ethyl phosphorodichloridate	6.1	NA2927	I	6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
-	Ethyl propionate	3	UN1195	II	3	T1	150	202	242	5 L	60 L	B	-

-	Ethyl propyl ether	3	UN2615	II	3	B101, T8	150	202	242	5 L	60 L	E	-
-	*Ethyl silicate, see* Tetraethyl silicate	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethylacetylene, inhibited	2.1	UN2452	-	2.1	-	None	304	314, 315	Forbidden	150 kg	B	40
-	Ethylamine	2.1	UN1036	-	2.1	B77	None	321	314, 315	Forbidden	150 kg	D	40
-	Ethylamine, aqueous solution *with not less than 50 percent but not more than 70 percent ethylamine*	3	UN2270	II	3, 8	T14	None	202	243	1 L	5 L	B	40
-	N-Ethylaniline	6.1	UN2272	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	2-Ethylaniline	6.1	UN2273	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	Ethylbenzene	3	UN1175	II	3	T1	150	202	242	5 L	60 L	B	-
-	N-Ethylbenzyltoluidines liquid	6.1	UN2753	III	6.1	T14	153	203	241	60 L	220 L	A	-
-	N-Ethylbenzyltoluidines solid	6.1	UN2753	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	2-Ethylbutanol	3	UN2275	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethylbutyl acetate	3	UN1177	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	2-Ethylbutyraldehyde	3	UN1178	II	3	B1, T1	150	202	242	5 L	60 L	B	-
-	Ethyldichloroarsine	6.1	UN1892	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Ethyldichlorosilane	4.3	UN1183	I	4.3, 8, 3	A2, A3, A7, N34, T18, T26	None	201	244	Forbidden	1 L	D	21, 28, 40, 49, 100
-	Ethylene, acetylene and propylene in mixture, refrigerated liquid *with at least 71.5 percent ethylene with not more than 22.5 percent acetylene and not more than 6 percent propylene*	2.1	UN3138	-	2.1	-	None	304	314, 315	Forbidden	Forbidden	D	40
-	Ethylene chlorohydrin	6.1	UN1135	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Ethylene, compressed	2.1	UN1962	-	2.1	-	306	304	302	Forbidden	150 kg	E	40
-	*Ethylene diamine diperchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ethylene dibromide	6.1	UN1605	I	6.1	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	*Ethylene dibromide and methyl bromide liquid mixtures, see* Methyl bromide and ethylene dibromide, liquid mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Ethylene dichloride	3	UN1184	II	3, 6.1	T14	None	202	243	1 L	60 L	B	40
-	Ethylene glycol diethyl ether	3	UN1153	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Ethylene glycol dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Ethylene glycol monoethyl ether	3	UN1171	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethylene glycol monoethyl ether acetate	3	UN1172	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethylene glycol monomethyl ether	3	UN1188	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethylene glycol monomethyl ether acetate	3	UN1189	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Ethylene oxide and carbon dioxide mixture *with more than 87 percent ethylene oxide*	2.3	UN3300	-	2.3, 2.1	4	None	304	314, 315	Forbidden	Forbidden	D	40
-	Ethylene oxide and carbon dioxide mixtures *with more than 9 percent but not more than 87 percent ethylene oxide*	2.1	UN1041	-	2.1	-	306	304	314, 315	Forbidden	25 kg	B	40
-	Ethylene oxide and carbon dioxide mixtures *with not more than 9 percent ethylene oxide*	2.2	UN1952	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Ethylene oxide and chlorotetrafluoroethane mixture *with not more than 8.8 percent ethylene oxide*	2.2	UN3297	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-

-	Ethylene oxide and dichlorodifluoromethane mixture, *with not more than 12.5 percent ethylene oxide*	2.2	UN3070	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Ethylene oxide and pentafluoroethane mixture *with not more than 7.9 percent ethylene oxide*	2.2	UN3298	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Ethylene oxide and propylene oxide mixtures*, with not more than 30 percent ethylene oxide*	3	UN2983	I	3, 6.1	5, A11, N4, N34, T24, T29	None	201	243	Forbidden	30 L	E	40
-	Ethylene oxide and tetrafluoroethane mixture *with not more than 5.6 percent ethylene oxide*	2.2	UN3299	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Ethylene oxide *or* Ethylene oxide with nitrogen *up to a total pressure of 1MPa (10 bar) at 50 degrees C*	2.3	UN1040	-	2.3, 2.1	4	None	323	323	Forbidden	25 kg	D	40
-	Ethylene, refrigerated liquid *(cryogenic liquid)*	2.1	UN1038	-	2.1	-	None	316	318, 319	Forbidden	Forbidden	D	40
-	Ethylenediamine	8	UN1604	II	8, 3	T14	154	202	243	1 L	30 L	A	40
-	Ethyleneimine, inhibited	6.1	UN1185	I	6.1, 3	1, B9, B14, B30, B72, B77, N25, N32, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	*Ethylhexaldehyde, see* Octyl aldehydes *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	2-Ethylhexyl chloroformate	6.1	UN2748	II	6.1, 8	T12	None	202	243	1 L	30 L	A	12, 13, 21, 25, 40, 100
-	2-Ethylhexylamine	3	UN2276	III	3, 8	B1, T2	150	203	242	5 L	60 L	A	40
-	Ethylphenyldichlorosilane	8	UN2435	II	8	A7, B2, N34, T8, T26	None	202	242	Forbidden	30 L	C	-
-	1-Ethylpiperidine	3	UN2386	II	3, 8	T8	None	202	243	1 L	5 L	B	-
-	N-Ethyltoluidines	6.1	UN2754	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	Ethyltrichlorosilane	3	UN1196	II	3, 8	A7, B100, N34, T15, T26	None	202	243	1 L	5 L	B	40
-	*Etiologic agent, see* Infectious substances, *etc*)	-	-	-	-	-	-	-	-	-	-	-	-
-	*Explosive articles, see* Articles, explosive , n.o.s. *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Explosive, blasting, type A	1.1D	UN0081	II	1.1 D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 21E
-	Explosive, blasting, type B	1.1D	UN0082	II	1.1 D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Explosive, blasting, type B *or* Agent blasting, Type B	1.5D	UN0331	II	1.5 D	105, 106	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Explosive, blasting, type C	1.1D	UN0083	II	1.1 D	123	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Explosive, blasting, type D	1.1D	UN0084	II	1.1 D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Explosive, blasting, type E	1.1D	UN0241	II	1.1 D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 19E
-	Explosive, blasting, type E *or* Agent blasting, Type E	1.5D	UN0332	II	1.5 D	105, 106	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Explosive, forbidden. See Sec. 173.54*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Explosive substances, see* Substances, explosive, n.o.s. *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Explosives, slurry, see* Explosive, blasting, type E	-	-	-	-	-	-	-	-	-	-	-	-
-	*Explosives, water gels, see* Explosive, blasting, type E	-	-	-	-	-	-	-	-	-	-	-	-
-	Extracts, aromatic, liquid	3	UN1169	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Extracts, flavoring, liquid	3	UN1197	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Fabric with animal or vegetable oil, see* Fibers *or* fabrics, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Ferric arsenate	6.1	UN1606	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Ferric arsenite	6.1	UN1607	II	6.1	-	None	212	242	25 kg	100kg	A	-
-	Ferric chloride, anhydrous	8	UN1773	III	8	-	154	213	240	25 kg	100 kg	A	-

-	Ferric chloride, solution	8	UN2582	III	8	B15, T8	154	203	241	5 L	60 L	A	-
-	Ferric nitrate	5.1	UN1466	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Ferrocerium	4.1	UN1323	II	4.1	59, A19	151	212	240	15 kg	50 kg	A	-
-	Ferrosilicon*, with 30 percent or more but less than 90 percent silicon*	4.3	UN1408	III	4.3, 6.1	A1, A19	151	213	240	25 kg	100 kg	A	13, 40, 85, 103
-	Ferrous arsenate	6.1	UN1608	II	6.1	-	None	212	242	25 kg	100 kg	A	-
D	Ferrous chloride, solid	8	NA1759	II	8	-	154	212	240	15 kg	50 kg	A	-
D	Ferrous chloride, solution	8	NA1760	II	8	B3	154	202	242	1 L	30 L	B	40
-	Ferrous metal borings *or* Ferrous metal shavings *or* Ferrous metal turnings *or* Ferrous metal cuttings *in a form liable to self-heating*	4.2	UN2793	III	4.2	A1, A19, B101	None	213	241	25 kg	100 kg	A	-
-	Fertilizer ammoniating solution *with free ammonia*	2.2	UN1043	-	2.2	-	306	304	314, 315	Forbidden	150 kg	E	40
A, W	Fibers *or* Fabrics, animal *or* vegetable *or* Synthetic, n.o.s. *with animal or vegetable oil*	4.2	UN1373	III	4.2	137	None	213	241	Forbidden	Forbidden	A	-
-	Fibers *or* Fabrics impregnated with weakly nitrated nitrocellulose, n.o.s	4.1	UN1353	III	4.1	A1	None	213	240	25 kg	100 kg	D	-
-	*Films, nitrocellulose base, from which gelatine has been removed; film scrap, see* Celluloid scrap	-	-	-	-	-	-	-	-	-	-	-	-
-	Films, nitrocellulose base, *gelatine coated (except scrap)*	4.1	UN1324	III	4.1	-	None	183	None	25 kg	100 kg	D	91
-	Fire extinguisher charges, *corrosive liquid*	8	UN1774	II	8	N41	154	202	None	1 L	30 L	A	-
-	*Fire extinguisher charges, expelling, explosive, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	Fire extinguishers *containing compressed or liquefied gas*	2.2	UN1044	-	2.2	18	309	309	None	75 kg	150 kg	A	-
-	Firelighters, solid *with flammable liquid*	4.1	UN2623	III	4.1	A1, A19	None	213	None	25 kg	100 kg	A	-
-	Fireworks	1.1G	UN0333	II	1.1G	108	None	62	None	Forbidden	Forbidden	B	-
-	Fireworks	1.2G	UN0334	II	1.2G	108	None	62	None	Forbidden	Forbidden	B	-
-	Fireworks	1.3G	UN0335	II	1.3G	108	None	62	None	Forbidden	Forbidden	B	-
-	Fireworks	1.4G	UN0336	II	1.4G	108	None	62	None	Forbidden	75 kg	A	24E
-	Fireworks	1.4S	UN0337	II	1.4S	108	None	62	None	25 kg	100 kg	A	-
W	Fish meal, stabilized *or* Fish scrap, stabilized	9	UN2216	III	None	-	155	218	218	No limit	No limit	A	88
-	Fish meal, unstablized *or* Fish scrap, unstabilized	4.2	UN1374	II	4.2	A1, A19	None	212	241	15 kg	50 kg	A	119, 120
-	*Fissile radioactive materials, see* Radioactive material, fissile, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	*Flammable compressed gas, see* Compressed *or* Liquefied gas, flammable, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Flammable compressed gas (small receptacles not fitted with a dispersion device, not refillable), see* Receptacles, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Flammable gas in lighters, see* Lighters *or* lighter refills, *cigarettes, containing flammable gas*	-	-	-	-	-	-	-	-	-	-	-	-
G	Flammable liquid, toxic, corrosive, n.o.s	3	UN3286	I	3, 6.1, 8	-	None	201	243	Forbidden	2.5 L	E	21, 40, 100
-	-	-	-	II	3, 6.1, 8	T14	None	202	243	1 L	5 L	B	21, 40, 100
G	Flammable liquids, corrosive, n.o.s	3	UN2924	I	3, 8	T42	None	201	243	0.5 L	2.5 L	E	40
-	-	-	-	II	3, 8	T15, T26	None	202	243	1 L	5 L	B	40
-	-	-	-	III	3, 8	B1, T15, T26	150	203	242	5 L	60 L	A	40
G	Flammable liquids, n.o.s	3	UN1993	I	3	T42	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	203	242	60 L	220 L	A	-
G	Flammable liquids, toxic, n.o.s	3	UN1992	I	3, 6.1	T42	None	201	243	Forbidden	30L	E	40
-	-	-	-	II	3, 6.1	T18	None	202	243	1 L	60 L	B	40
-	-	-	-	III	3,	B1, T18	150	203	242	60 L	220 L	A	-

					6.1								
G	Flammable solid, corrosive, inorganic, n.o.s	4.1	UN3180	II	4.1, 8	A1, B106	151	212	242	15 kg	50 kg	D	40
-	-	-	-	III	4.1, 8	A1, B106	151	213	242	25 kg	100 kg	D	40
G	Flammable solid, inorganic, n.o.s	4.1	UN3178	II	4.1	A1	151	212	240	15 kg	50 kg	B	-
-	-	-	-	III	4.1	A1	151	213	240	25 kg	100 kg	B	-
G	Flammable solid, organic, molten, n.o.s	4.1	UN3176	II	4.1	T9	151	212	240	Forbidden	Forbidden	C	-
-	-	-	-	III	4.1	T9	151	213	240	Forbidden	Forbidden	C	-
G	Flammable solid, oxidizing, n.o.s	4.1	UN3097	II	4.1, 5.1	131	None	214	214	Forbidden	Forbidden	E	40
G	-	-	-	III	4.1, 5.1	131	None	214	214	Forbidden	Forbidden	D	40
G	Flammable solid, toxic, inorganic, n.o.s	4.1	UN3179	II	4.1, 6.1	A1, B106	151	212	242	15 kg	50 kg	B	40
-	-	-	-	III	4.1, 6.1	A1, B106	151	213	242	25 kg	100 kg	B	40
G	Flammable solids, corrosive, organic, n.o.s	4.1	UN2925	II	4.1, 8	A1, B106	None	212	242	15 kg	50 kg	D	40
-	-	-	-	III	4.1, 8	A1, B106	151	213	242	25 kg	100 kg	D	40
G	Flammable solids, organic, n.o.s	4.1	UN1325	II	4.1	A1	151	212	240	15 kg	50 kg	B	-
-	-	-	-	III	4.1	A1	151	213	240	25 kg	100 kg	B	-
G	Flammable solids, toxic, organic, n.o.s	4.1	UN2926	II	4.1, 6.1	A1, B106	None	212	242	15 kg	50 kg	B	40
-	-	-	-	III	4.1, 6.1	A1, B106	151	213	242	25 kg	100 kg	B	40
-	Flares, aerial	1.3G	UN0093	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	Flares, aerial	1.4G	UN0403	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Flares, aerial	1.4S	UN0404	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Flares, aerial	1.1G	UN0420	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Flares, aerial	1.2G	UN0421	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	*Flares, airplane, see* Flares, aerial	-	-	-	-	-	-	-	-	-	-	-	-
-	*Flares, signal, see* Cartridges, signal	-	-	-	-	-	-	-	-	-	-	-	-
-	Flares, surface	1.3G	UN0092	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	Flares, surface	1.1G	UN0418	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Flares, surface	1.2G	UN0419	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	*Flares, water-activated, see* Contrivances, water-activated, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Flash powder	1.1G	UN0094	II	1.1G	-	None	62	None	Forbidden	Forbidden	E	1E, 5E
-	Flash powder	1.3G	UN0305	II	1.3G	-	None	62	None	Forbidden	Forbidden	E	1E, 5E
-	*Flue dusts, poisonous, see* Arsenical dust	-	-	-	-	-	-	-	-	-	-	-	-
-	*Fluoric acid, see* Hydrofluoric acid, solution, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Fluorine, compressed	2.3	UN1045	-	2.3, 5.1, 8	1	None	302	None	Forbidden	Forbidden	D	40, 89, 90
-	Fluoroacetic acid	6.1	UN2642	I	6.1	B100	None	211	242	1 kg	15kg	E	-
-	Fluoroanilines	6.1	UN2941	III	6.1	T8	153	203	241	60 L	220 L	A	-
-	Fluorobenzene	3	UN2387	II	3	B101, T8	150	202	242	5 L	60 L	B	-
-	Fluoroboric acid	8	UN1775	II	8	A6, A7, B2, B15, N3, N34, T15, T27	154	202	242	1 L	30 L	A	-
-	Fluorophosphoric acid anhydrous	8	UN1776	II	8	A6, A7, B2, N3, N34, T9, T27	None	202	242	1 L	30 L	A	-
-	Fluorosilicates, n.o.s	6.1	UN2856	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	Fluorosilicic acid	8	UN1778	II	8	A6, A7, B2, B15, N3, N34, T12, T27	None	202	242	1 L	30 L	A	-
-	Fluorosulfonic acid	8	UN1777	I	8	A3, A6, A7, A10, B6, B10, N3, T9, T27	None	201	243	0.5 L	2.5 L	D	40
-	Fluorotoluenes	3	UN23	II	3	T8	150	202	242	5 L	60 L	B	40

			88										
-	*Forbidden materials. See 173.21*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Formaldehyde, solutions, flammable	3	UN1198	III	3, 8	B1, T8	150	203	242	5 L	60 L	A	40
-	Formaldehyde, solutions, *with not less than 25 percent formaldehyde*	8	UN2209	III	8	T1	154	203	241	5 L	60 L	A	-
-	*Formalin, see* Formaldehyde, solutions	-	-	-	-	-	-	-	-	-	-	-	-
-	Formic acid	8	UN1779	II	8	B2, B28, T8	154	202	242	1 L	30 L	A	40
-	Fracturing devices, explosive, *without detonators for oil wells*	1.1D	UN0099	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Fuel, aviation, turbine engine	3	UN1863	I	3	T7	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
D	Fuel oil *(No. 1, 2, 4, 5, or 6)*	3	NA1993	III	3	B1	150	203	242	60 L	220 L	A	-
-	*Fulminate of mercury (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminate of mercury, wet, see* Mercury fulminate, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminating gold*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminating mercury*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminating platinum*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminating silver*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Fulminic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Fumaryl chloride	8	UN1780	II	8	B2, T8, T26	154	202	242	1 L	30 L	C	8, 40
-	Furaldehydes	6.1	UN1199	II	6.1, 3	T15	None	202	243	5 L	60 L	A	-
-	Furan	3	UN2389	I	3	T18	None	201	243	1 L	30 L	E	40
-	*Fumigated lading, see* §§172.302(g), 173.9 and 176.76(h)	-	-	-	-	-	-	-	-	-	-	-	-
-	Furfuryl alcohol	6.1	UN2874	III	6.1	T2	153	203	241	60 L	220 L	A	26, 74
-	Furfurylamine	3	UN2526	III	3, 8	B1, T1	150	203	242	5 L	60 L	A	40
-	Fuse, detonating, *metal clad, see* Cord, detonating, *metal clad*	-	-	-	-	-	-	-	-	-	-	-	-
-	Fuse, detonating, mild effect, *metal clad, see* Cord, detonating, mild effect, *metal clad*	-	-	-	-	-	-	-	-	-	-	-	-
-	Fuse, igniter *tubular metal clad*	1.4G	UN0103	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Fuse, non-detonating *instantaneous or quickmatch*	1.3G	UN0101	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Fuse, safety	1.4S	UN0105	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
D	Fusee (*railway or highway*)	4.1	NA1325	II	4.1	-	None	184	None	15 kg	50 kg	B	-
-	Fusel oil	3	UN1201	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Fuses, tracer, see* Tracers for ammunition	-	-	-	-	-	-	-	-	-	-	-	-
-	*Fuzes, combination, percussion and time, see* Fuzes, detonating *(UN 0257, UN 0367);* Fuzes, igniting (UN 0317, UN 0368)	-	-	-	-	-	-	-	-	-	-	-	-
-	Fuzes, detonating	1.1B	UN0106	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Fuzes, detonating	1.2B	UN0107	II	1.2B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Fuzes, detonating	1.4B	UN0257	II	1.4B	116	None	62	None	Forbidden	75 kg	A	24E
-	Fuzes, detonating	1.4S	UN0367	II	1.4S	116	None	62	None	25 kg	100 kg	A	-
-	Fuzes, detonating, *with protective features*	1.1D	UN0408	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Fuzes, detonating, *with protective features*	1.2D	UN0409	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	Fuzes, detonating, *with protective features*	1.4D	UN0410	II	1.4D	116	None	62	None	Forbidden	75 kg	A	24E
-	Fuzes, igniting	1.3G	UN0316	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Fuzes, igniting	1.4G	UN0317	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Fuzes, igniting	1.4S	UN0368	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	*Galactsan trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

-	Gallium	8	UN2803	III	8	-	None	162	240	20 kg	20 kg	B	48
-	Gas cartridges, *(flammable) without a release device, non-re-fillable*	2.1	UN2037	-	2.1	-	306	304	None	1 kg	15 kg	B	40
-	Gas generator assemblies (aircraft), *containing a non-flammable non-toxic gas and a propellant cartridge*	2.2	-	-	2.2	-	None	335	None	75 kg	150 kg	A	-
D	Gas identification set	2.3	NA9035	-	2.3	6	None	194	None	Forbidden	Forbidden	D	-
-	Gas oil *or* Diesel fuel *or* Heating oil, light	3	UN1202	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
G	Gas, refrigerated liquid, flammable, n.o.s. *(cryogenic liquid)*	2.1	UN3312	-	2.1	-	None	316	318	Forbidden	Forbidden	D	40
G	Gas, refrigerated liquid, n.o.s. *(cryogenic liquid)*	2.2	UN3158	-	2.2	-	320	316	318	50 kg	500 kg	D	-
G	Gas, refrigerated liquid, oxidizing, n.o.s. *(cryogenic liquid)*	2.2	UN3311	-	2.2, 5.1	-	320	316	318	Forbidden	Forbidden	D	-
-	Gas sample, non-pressurized, flammable, n.o.s., *not refrigerated liquid*	2.1	UN3167	-	2.1	-	306	302, 304	None	1 L	5 L	D	-
-	Gas sample, non-pressurized, toxic, flammable, n.o.s., *not refrigerated liquid*	2.3	UN3168	-	2.3, 2.1	-	306	302	None	Forbidden	1 L	D	-
-	Gas sample, non-pressurized, toxic, n.o.s., *not refrigerated liquid*	2.3	UN3169	-	2.3	-	306	302, 304	None	Forbidden	1 L	D	-
D	Gasohol *gasoline mixed with ethyl alcohol, with not more than 20 percent alcohol*	3	NA1203	II	3	-	150	202	242	5 L	60 L	E	-
-	Gasoline	3	UN1203	II	3	B33, B101, T8	150	202	242	5 L	60 L	E	-
-	*Gasoline, casinghead, see* Gasoline	-	-	-	-	-	-	-	-	-	-	-	-
-	*Gelatine, blasting, see* Explosive, blasting, type A	-	-	-	-	-	-	-	-	-	-	-	-
-	*Gelatine dynamites, see* Explosive, blasting, type A	-	-	-	-	-	-	-	-	-	-	-	-
-	Germane	2.3	UN2192	-	2.3, 2.1	2	None	192	245	Forbidden	Forbidden	D	40
-	*Glycerol-1,3-dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Glycerol gluconate trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Glycerol lactate trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Glycerol alpha-monochlorohydrin	6.1	UN2689	III	6.1	T2	153	203	241	60 L	220 L	A	-
-	*Glyceryl trinitrate, see* Nitroglycerin, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Glycidaldehyde	3	UN2622	II	3, 6.1	T8	150	202	243	1 L	60 L	A	40
D	Grenades, empty primed	1.4S	NA0349	II	None	-	None	62	None	25 kg	100 kg	A	-
-	Grenades, *hand or rifle, with bursting charge*	1.1D	UN0284	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	-
-	Grenades, *hand or rifle, with bursting charge*	1.2D	UN0285	II	1.2D	-	-	62	None	Forbidden	Forbidden	B	-
-	Grenades, *hand or rifle, with bursting charge*	1.1F	UN0292	II	1.1F	-	-	62	None	Forbidden	Forbidden	E	-
-	Grenades, *hand or rifle, with bursting charge*	1.2F	UN0293	II	1.2F	-	-	62	None	Forbidden	Forbidden	E	-
-	*Grenades, illuminating, see* Ammunition, illuminating, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Grenades, practice, *hand or rifle*	1.4S	UN0110	II	1.4S	-	-	62	None	25 kg	100 kg	A	-
-	Grenades, practice, *hand or rifle*	1.3G	UN0318	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	-
-	Grenades, practice, *hand or rifle*	1.2G	UN0372	II	1.2G	-	-	62	None	Forbidden	Forbidden	B	-
-	Grenades practice *Hand or rifle*	1.4G	UN0452	II	1.4G	-	-	62	None	Forbidden	75 kg	A	24E
-	*Grenades, smoke, see* Ammunition, smoke, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Guanidine nitrate	5.1	UN1467	III	5.1	A1	152	213	240	25 kg	100 kg	A	73
-	*Guanyl nitrosaminoguanylidene hydrazine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Guanyl nitrosaminoguanylidene hydrazine, wetted *with not less than 30 percent water, by mass*	1.1A	UN0113	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	*Guanyl nitrosaminoguanyltetrazene (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Guanyl nitrosaminoguanyltetrazene, wetted *or* Tetrazene, wetted *with not less than 30 percent water or mixture of alcohol and water, by mass*	1.1A	UN0114	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Gunpowder, compressed *or* Gunpowder in pellets, *see* Black powder *(UN 0028)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Gunpowder, *granular or as a meal, see* Black powder *(UN 0027)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hafnium powder, dry	4.2	UN25	I	4.2	B100	Non	211	242	Forbidden	Forbidden	D	-

			45				e						
-	-	-	-	II	4.2	A19, A20, B101, B106, N34	None	212	241	15 kg	50 kg	D	-
-	-	-	-	III	4.2	B100	None	213	241	25 kg	100 kg	D	-
-	Hafnium powder, wetted *with not less than 25 percent water (a visible excess of water must be present) (a) mechanically produced, particle size less than 53 microns; (b) chemically produced, particle size less than 840 microns*	4.1	UN1326	II	4.1	A6, A19, A20, N34	None	212	241	15 kg	50 kg	E	-
-	*Hand signal device, see* Signal devices, hand	-	-	-	-	-	-	-	-	-	-	-	-
-	*Hazardous substances, liquid or solid, n.o.s., see* Environmentally hazardous substances, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
G D	Hazardous waste, liquid, n.o.s	9	NA3082	III	9	-	155	203	241	No limit	No limit	A	-
G D	Hazardous waste, solid, n.o.s	9	NA3077	III	9	B54	155	213	240	No limit	No limit	A	-
-	Helium, compressed	2.2	UN1046	-	2.2	-	306	302	302, 314	75 kg	150 kg	A	85
-	*Helium-oxygen mixture, see* Rare gases and oxygen mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Helium, refrigerated liquid *(cryogenic liquid)*	2.2	UN1963	-	2.2	-	320	316	318	50 kg	500 kg	B	-
-	Heptafluoropropane *or* Refrigerant gas R 227	2.2	UN3296	-	2.2	-	306	304	314, 315	75 kg	150kg	A	-
-	n-Heptaldehyde	3	UN3056	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Heptanes	3	UN1206	II	3	T2	150	202	242	5 L	60 L	B	-
-	n-Heptene	3	UN2278	II	3	B101, T8	150	202	242	5 L	60 L	B	-
-	Hexachloroacetone	6.1	UN2661	III	6.1	T8	153	203	241	60 L	220 L	B	12, 40
-	Hexachlorobenzene	6.1	UN2729	III	6.1	-	153	203	241	60 L	220 L	A	-
-	Hexachlorobutadiene	6.1	UN2279	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Hexachlorocyclopentadiene	6.1	UN2646	I	6.1	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Hexachlorophene	6.1	UN2875	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Hexadecyltrichlorosilane	8	UN1781	II	8	A7, B2, B6, N34, T8	None	202	242	Forbidden	30 L	C	40
-	Hexadienes	3	UN2458	II	3	B101, T7	None	202	242	5 L	60 L	B	-
-	Hexaethyl tetraphosphate and compressed gas mixtures	2.3	UN1612	-	2.3	3	None	334	None	Forbidden	Forbidden	D	40
-	Hexaethyl tetraphosphate *liquid*	6.1	UN1611	II	6.1	N76	None	202	243	5 L	60 L	E	40
-	Hexaethyl tetraphosphate, *solid*	6.1	UN1611	II	6.1	N76	None	212	242	25 kg	100 kg	E	40
-	Hexafluoroacetone	2.3	UN2420	-	2.3, 8	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	Hexafluoroacetone hydrate	6.1	UN2552	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	Hexafluoroethane, compressed *or* Refrigerant gas R 116	2.2	UN2193	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Hexafluorophosphoric acid	8	UN1782	II	8	A6, A7, B2, N3, N34, T9, T27	None	202	242	1 L	30 L	A	-
-	Hexafluoropropylene compressed *or* Refrigerant gas R 1216	2.2	UN1858	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Hexaldehyde	3	UN1207	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Hexamethylene diisocyanate	6.1	UN2281	II	6.1	B101, T14	None	202	243	5 L	60 L	C	13, 40
-	*Hexamethylene triperoxide diamine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hexamethylenediamine, solid	8	UN2280	III	8	-	154	213	240	25 kg	100 kg	A	12
-	Hexamethylenediamine solution	8	UN1783	II	8	T8	None	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-

-	Hexamethyleneimine	3	UN2493	II	3, 8	B101, T8	None	202	243	1 L	5 L	B	40
-	Hexamethylenetetramine	4.1	UN1328	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
-	*Hexamethylol benzene hexanitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hexanes	3	UN1208	II	3	B101, T8	150	202	242	5 L	60 L	E	-
-	*2,2',4,4',6,6'- Hexanitro-3,3'-dihydroxyazobenzene (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hexanitroazoxy benzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*N,N'-(hexanitrodiphenyl) ethylene dinitramine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hexanitrodiphenyl urea*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,2',3',4,4',6-Hexanitrodiphenylamine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hexanitrodiphenylamine *or* Dipicrylamine *or* Hexyl	1.1D	UN0079	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*2,3',4,4',6,6'-Hexanitrodiphenylether*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hexanitroethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hexanitrooxanilide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hexanitrostilbene	1.1D	UN0392	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Hexanoic acid, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexanols	3	UN2282	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	1-Hexene	3	UN2370	II	3	B101, T8	150	202	242	5 L	60 L	E	-
-	Hexogen and cyclotetramethylenetetranitramine mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexogen and HMX mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexogen and octogen mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexogen, *see* Cyclotrimethylenetrinitramine, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexolite, *or* Hexotol *dry or wetted with less than 15 percent water, by mass*	1.1D	UN0118	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Hexotonal	1.1D	UN0393	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Hexyl, *see* Hexanitrodiphenylamine	-	-	-	-	-	-	-	-	-	-	-	-
-	Hexyltrichlorosilane	8	UN1784	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	*High explosives, see individual explosives' entries*	-	-	-	-	-	-	-	-	-	-	-	-
-	HMX, *see* Cyclotetramethylenete tranitramine, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrazine, anhydrous *or* Hydrazine aqueous solutions *with more than 64 percent hydrazine, by mass*	8	UN2029	I	8, 3, 6.1	A3, A6, A7, A10, B7, B16, B53, T25	None	201	243	Forbidden	2.5 L	D	21, 40, 42, 100
-	Hydrazine, aqueous solution *with not more than 37 percent hydrazine, by mass*	6.1	UN3293	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	*Hydrazine azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hydrazine chlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hydrazine dicarbonic acid diazide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hydrazine hydrate *or* Hydrazine aqueous solutions, *with not less than 37 percent but not more than 64 percent hydrazine, by mass*	8	UN2030	II	8, 6.1	B16, B53, B110, T15	None	202	243	Forbidden	30 L	D	40, 42, 82
-	*Hydrazine perchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hydrazine selenate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Hydriodic acid, anhydrous, see* Hydrogen iodide, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydriodic acid	8	UN1787	II	8	A3, A6, B2, N41, T9, T27	154	202	242	1 L	30 L	C	-
-	-	-	-	III	8	T8, T26	154	203	241	5 L	60 L	C	8
-	*Hydrobromic acid, anhydrous, see* Hydrogen bromide, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrobromic acid, *with more than 49 percent hydrobromic acid*	8	UN1788	II	8	B2, B15, N41, T9, T27	154	202	242	Forbidden	Forbidden	C	-
-	-	-	-	III	8	T8, T26	154	203	241	Forbidden	Forbidden	C	8
-	Hydrobromic acid, *with not more than 49 percent hydrobromic acid*	8	UN1788	II	8	A3, A6, B2, B15, N41, T9, T27	154	202	242	1 L	30 L	C	-
-	-	-	-	III	8	T8, T26	154	203	241	5 L	30 L	C	8
-	Hydrocarbon gas mixture, compressed, n.o.s	2.1	UN1964	-	2.1	-	306	302	314, 315	Forbidden	150 kg	E	40
-	Hydrocarbon gas mixture, liquefied, n.o.s	2.1	UN19	-	2.1	-	306	304	314	Forbidden	150 kg	E	40

			65						, 315				
-	Hydrocarbons, liquid, n.o.s	3	UN3295	I	3	T8, T31	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Hydrochloric acid, anhydrous, see* Hydrogen chloride, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrochloric acid	8	UN1789	II	8	A3, A6, B3, B15, N41, T9, T27	154	202	242	1 L	30 L	C	-
-	-	-	-	III	8	T8, T26	154	203	241	5 L	60 L	C	8
-	*Hydrocyanic acid, anhydrous, see* Hydrogen cyanide *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrocyanic acid, aqueous solutions *or* Hydrogen cyanide, aqueous solutions *with not more than 20 percent hydrogen cyanide*	6.1	UN1613	I	6.1	2, B61, B65, B77, B82	None	195	244	Forbidden	Forbidden	D	40
D	Hydrocyanic acid, aqueous solutions *with less than 5 percent hydrogen cyanide*	6.1	NA1613	II	6.1	T18, T26	None	195	243	Forbidden	5 L	D	40
-	*Hydrocyanic acid, liquefied, see* Hydrogen cyanide, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Hydrocyanic acid (prussic), unstabilized*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hydrofluoric acid and Sulfuric acid mixtures	8	UN1786	I	8, 6.1	A6, A7, B15, B23, N5, N34, T18, T27	None	201	243	Forbidden	2.5 L	D	40, 95
-	*Hydrofluoric acid, anhydrous, see* Hydrogen fluoride, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrofluoric acid, *with more than 60 percent strength*	8	UN1790	I	8, 6.1	A6, A7, B4, B15, B23, N5, N34, T18, T27	None	201	243	0.5 L	2.5 L	D	12, 40
-	Hydrofluoric acid, *with not more than 60 percent strength*	8	UN1790	II	8, 6.1	A6, A7, B15, B110, N5, N34, T18, T27	None	202	243	1 L	30 L	D	12, 40
-	*Hydrofluoroboric acid, see* Fluoroboric acid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Hydrofluorosilicic acid, see* Fluorosilicic acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrogen and Methane mixtures, compressed	2.1	UN2034	-	2.1	-	306	302	302, 314, 315	Forbidden	150 kg	E	40
-	Hydrogen bromide, anhydrous	2.3	UN1048	-	2.3, 8	3, B14	None	304	314, 315	Forbidden	25 kg	D	40
-	Hydrogen chloride, anhydrous	2.3	UN1050	-	2.3, 8	3	None	304	None	Forbidden	Forbidden	D	40
-	Hydrogen chloride, refrigerated liquid	2.3	UN2186	-	2.3, 8	3, B6	None	None	314, 315	Forbidden	Forbidden	B	40
-	Hydrogen, compressed	2.1	UN1049	-	2.1	-	306	302	302, 314	Forbidden	150 kg	E	40, 57
-	Hydrogen cyanide, solution in alcohol *with not more than 45 percent hydrogen cyanide*	6.1	UN3294	I	6.1, 3	2, 25, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Hydrogen cyanide, stabilized *with less than 3 percent water*	6.1	UN1051	I	6.1, 3	1, B35, B61, B65, B77, B82	None	195	244	Forbidden	Forbidden	D	40
-	Hydrogen cyanide, stabilized, *with less than 3 percent water and absorbed in a porous inert material*	6.1	UN1614	I	6.1	5	None	195	None	Forbidden	Forbidden	D	25, 40
-	Hydrogen fluoride, anhydrous	8	UN1052	I	8, 6.1	3, B7, B46, B71, B77, T24, T27	None	163	243	Forbidden	Forbidden	D	40
-	Hydrogen iodide, anhydrous	2.3	UN2197	-	2.3	3, B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	*Hydrogen iodide solution, see* Hydriodic acid, solution	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrogen peroxide and peroxyacetic acid mixtures, stabilized *with acids, water and not more than 5 percent peroxyacetic acid*	5.1	UN3149	II	5.1, 8	A2, A3, A6, B53, B104, B110, T14	None	202	243	1 L	5 L	D	25, 66, 75, 106
-	Hydrogen peroxide, aqueous solutions *with more than 40 percent but not more than 60 percent hydrogen peroxide (stabilized as necessary)*	5.1	UN2014	II	5.1, 8	12, A3, A6, B53, B80, B81, B85, B104, B110, T14, T37	None	202	243	Forbidden	Forbidden	D	25, 66, 75, 106
-	Hydrogen peroxide, aqueous solutions *with not less than 8 percent but less than 20 percent hydrogen peroxide (stabilized as necessary)*	5.1	UN2984	III	5.1	A1, B104, T8, T37	152	203	241	2.5 L	30 L	B	25, 75, 106
-	Hydrogen peroxide, aqueous solutions *with not less than 20 percent but not more than 40 percent hydrogen*	5.1	UN2014	II	5.1, 8	A2, A3, A6, B53, B104, B110, T14,	None	202	243	1 L	5 L	D	25, 66,

	peroxide (stabilized as necessary)					T37							75, 106
-	Hydrogen peroxide, stabilized *or* Hydrogen peroxide aqueous solutions, stabilized *with more than 60 percent hydrogen peroxide*	5.1	UN2015	I	5.1, 8	12, A3, A6, B53, B80, B81, B85, T15, T37	None	201	243	Forbidden	Forbidden	D	25, 66, 75, 106
-	Hydrogen, refrigerated liquid *(cryogenic liquid)*	2.1	UN1966	-	2.1	-	None	316	318, 319	Forbidden	Forbidden	D	40
-	Hydrogen selenide, anhydrous	2.3	UN2202	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40
-	*Hydrogen sulfate, see* Sulfuric acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Hydrogen sulfide	2.3	UN1053	-	2.3, 2.1	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	Hydrogendifluorides, n.o.s. *solid*	8	UN1740	II	8	N3, N34	None	212	240	15 kg	50 kg	A	25, 26, 40
-	-	-	-	III	8	N3, N34	154	213	240	25 kg	100 kg	A	25, 26, 40
-	Hydrogendifluorides, n.o.s. *solutions*	8	UN1740	II	8	N3, N34	None	202	242	1 L	30 L	A	25, 26, 40
-	-	-	-	III	8	N3, N34	154	203	241	5 L	60 L	A	25, 26, 40
-	Hydroquinone	6.1	UN2662	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*Hydrosilicofluoric acid, see* Fluorosilicic acid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Hydroxyl amine iodide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Hydroxylamine sulfate	8	UN2865	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Hypochlorite solutions	8	UN1791	II	8	A7, B2, B15, N34, T7	154	202	242	1 L	30 L	B	26
-	-	-	-	III	8	B104, N34, T7	154	203	241	5 L	60 L	B	26
-	Hypochlorites, inorganic, n.o.s	5.1	UN3212	II	5.1	-	152	212	240	5 kg	25 kg	D	48, 56, 58, 69, 106, 116, 118
-	*Hyponitrous acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Igniter fuse, metal clad, see* Fuse, igniter, tubular, metal clad	-	-	-	-	-	-	-	-	-	-	-	-
-	Igniters	1.1G	UN0121	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Igniters	1.2G	UN0314	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	Igniters	1.3G	UN0315	II	1.3G	-	None	62	None	Forbidden	Forbidden	A	-
-	Igniters	1.4G	UN0325	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Igniters	1.4S	UN0454	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	3,3'-Iminodipropylamine	8	UN2269	III	8	T8	154	203	241	5 L	60 L	A	-
G	Infectious substances, affecting animals *only*	6.2	UN2900	-	6.2	-	134	196	None	50 mL or 50 g	4 L or 4 kg	B	-
G	Infectious substances, affecting humans	6.2	UN2814	-	6.2	-	134	196	None	50 mL or 50 g	4 L or 4 kg	B	-
-	*Inflammable, see Flammable*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Initiating explosives (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Inositol hexanitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
GD	Insecticide gases *flammable* n.o.s	2.1	NA1954	-	2.1	-	306	304	314, 315	75 kg	150 kg	D	-
G	Insecticide gases, n.o.s	2.2	UN1968	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
G	Insecticide gases, flammable, n.o.s	2.1	UN3354	-	2.1	-	306	304	314, 315	Forbidden	150 kg	D	40
G	Insecticide gases, toxic, flammable, n.o.s. *Inhalation hazard Zone A*	2.3	UN3355	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40
G	Insecticide gases, toxic, flammable, n.o.s. *Inhalation hazard Zone B*	2.3	UN3355	-	2.3, 2.1	2, B9, B14	None	302, 30	314, 31	Forbidden	Forbidden	D	40

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G	Insecticide gases, toxic, flammable, n.o.s. *Inhalation hazard Zone C*	2.3	UN3355	-	2.3, 2.1	3, B14	None	302, 305	314, 315	Forbidden	Forbidden	D	-
G	Insecticide gases toxic, flammable, n.o.s. *Inhalation hazard Zone D*	2.3	UN3355	-	2.3, 2.1	4	None	302, 305	314, 315	Forbidden	Forbidden	D	-
G	Insecticide gases, toxic, n.o.s	2.3	UN1967	-	2.3	3	None	193, 334	245	Forbidden	Forbidden	D	40
-	*Inulin trinitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Iodine azide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Iodine monochloride	8	UN1792	II	8	B6, N41, T8, T26	None	212	240	Forbidden	50 kg	D	40, 66, 74, 89, 90
-	Iodine pentafluoride	5.1	UN2495	I	5.1, 6.1, 8	-	None	205	243	Forbidden	2.5 L	D	25, 40, 66, 90
-	2-Iodobutane	3	UN2390	II	3	T8	150	202	242	5 L	60 L	B	-
-	Iodomethylpropanes	3	UN2391	II	3	T8	150	202	242	5 L	60 L	B	-
-	Iodopropanes	3	UN2392	III	3	B1, T8	150	203	242	60 L	220 L	A	-
-	*Iodoxy compounds (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Iridium nitratopentamine iridium nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Iron chloride, see* Ferric chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Iron oxide, spent, *or* Iron sponge, spent *obtained from coal gas purification*	4.2	UN1376	III	4.2	B18	None	213	240	Forbidden	Forbidden	E	-
-	Iron pentacarbonyl	6.1	UN1994	I	6.1, 3	1, B9, B14, B30, B72, B77, T38, T43, T44	None	192	244	Forbidden	Forbidden	D	40
-	*Iron sesquichloride, see* Ferric chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Irritating material, see* Tear gas substances, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Isobutane *see also* Petroleum gases, liquefied	2.1	UN1969	-	2.1	19	306	304	314, 315	Forbidden	150 kg	E	40
-	Isobutanol *or* Isobutyl alcohol	3	UN1212	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isobutyl acetate	3	UN1213	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isobutyl acrylate, inhibited	3	UN2527	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isobutyl alcohol, *see* Isobutanol	-	-	-	-	-	-	-	-	-	-	-	-
-	Isobutyl aldehyde, *see* Isobutyraldehyde	-	-	-	-	-	-	-	-	-	-	-	-
D	Isobutyl chloroformate	6.1	NA2742	I	6.1, 3, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	1 L	30 L	A	12, 13, 22, 25, 40, 48, 100
-	Isobutyl formate	3	UN2393	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isobutyl isobutyrate	3	UN2528	III	3	B1, T1	150	203	242	60 L	220 L	A	-
+	Isobutyl isocyanate	3	UN2486	I	3, 6.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	Isobutyl methacrylate, inhibited	3	UN2283	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isobutyl propionate	3	UN2394	III	3	B1, T1	150	203	242	60 L	220 L	B	-
-	Isobutylamine	3	UN1214	II	3, 8	B101, T8	None	202	243	1 L	5 L	B	40
-	Isobutylene *see also* Petroleum gases, liquefied	2.1	UN1055	-	2.1	19	306	304	314, 315	Forbidden	150 kg	E	40
-	Isobutyraldehyde *or* Isobutyl aldehyde	3	UN2045	II	3	T8	150	202	242	5L	60 L	E	40
-	Isobutyric acid	3	UN2529	III	3, 8	B1, T1	150	203	242	5 L	60 L	A	-
-	Isobutyric anhydride	3	UN25	III	3, 8	B1, T1	150	203	242	5 L	60 L	A	-

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-	Isobutyronitrile	3	UN2284	II	3, 6.1	T17	None	202	243	1 L	60 L	E	40
-	Isobutyryl chloride	3	UN2395	II	3, 8	B100, T9, T26	None	202	243	1 L	5 L	C	40
G	Isocyanates, flammable, toxic, n.o.s *or* Isocyanate solutions, flammable, toxic, n.o.s. *flashpoint less than 23 degrees C*	3	UN2478	II	3, 6.1	5, A3, A7, T15	None	202	243	1 L	60 L	D	40
G	Isocyanates, toxic, flammable, n.o.s. *or* Isocyanate solutions, toxic, flammable, n.o.s., *flash point not less than 23 degrees C but not more than 61 degrees C and boiling point less than 300 degrees C*	6.1	UN3080	II	6.1, 3	T15	None	202	243	5 L	60 L	B	25, 40, 48
G	Isocyanates, toxic, n.o.s. *or* Isocyanate solutions, toxic, n.o.s., *flash point more than 61 degrees C and boiling point less than 300 degrees C*	6.1	UN2206	II	6.1	T15	None	202	243	5 L	60 L	E	25, 40, 48
G	Isocyanates, toxic, n.o.s. *or* Isocyanate solutions, toxic, n.o.s., *flash point more than 61 degrees C and boiling point less than 300 degrees C*	6.1	UN2206	III	6.1	T8	153	203	241	60 L	220 L	E	25, 40, 48
-	Isocyanatobenzotrifluorides	6.1	UN2285	II	6.1, 3	5, B101, T14	None	202	243	5 L	60 L	D	25, 40, 48
-	Isoheptenes	3	UN2287	II	3	T7	150	202	242	5 L	60 L	B	-
-	Isohexenes	3	UN2288	II	3	T7	150	202	242	5 L	60 L	E	-
-	*Isooctane, see* Octanes	-	-	-	-	-	-	-	-	-	-	-	-
-	Isooctenes	3	UN1216	II	3	T8	150	202	242	5 L	60 L	B	-
-	*Isopentane, see* Pentane	-	-	-	-	-	-	-	-	-	-	-	-
-	*Isopentanoic acid, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Isopentenes	3	UN2371	I	3	T20	150	201	243	1 L	30 L	E	-
-	Isophorone diisocyanate	6.1	UN2290	III	6.1	T7	153	203	241	60 L	220 L	B	40
-	Isophoronediamine	8	UN2289	III	8	T8	154	203	241	5 L	60 L	A	-
-	Isoprene, inhibited	3	UN1218	I	3	T20	150	201	243	1 L	30 L	E	-
-	Isopropanol *or* Isopropyl alcohol	3	UN1219	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isopropenyl acetate	3	UN2403	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isopropenylbenzene	3	UN2303	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isopropyl acetate	3	UN1220	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isopropyl acid phosphate	8	UN1793	III	8	T7	154	213	240	25 kg	100 kg	A	-
-	Isopropyl alcohol, *see* Isopropanol	-	-	-	-	-	-	-	-	-	-	-	-
-	Isopropyl butyrate	3	UN2405	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isopropyl chloroacetate	3	UN2947	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isopropyl chloroformate	6.1	UN2407	I	6.1, 3, 8	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	40
-	Isopropyl 2-chloropropionate	3	UN2934	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Isopropyl isobutyrate	3	UN2406	II	3	T1	150	202	242	5 L	60 L	B	-
+	Isopropyl isocyanate	3	UN2483	I	3, 6.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	*Isopropyl mercaptan, see* Propanethiols	-	-	-	-	-	-	-	-	-	-	-	-
-	Isopropyl nitrate	3	UN1222	II	3	T25	150	202	None	5 L	60 L	D	-
-	*Isopropyl phosphoric acid, see* Isopropyl acid phosphate	-	-	-	-	-	-	-	-	-	-	-	-
-	Isopropyl propionate	3	UN2409	II	3	T1	150	202	242	5 L	60 L	B	-
-	Isopropylamine	3	UN1221	I	3, 8	T20	None	201	243	0.5 L	2.5 L	E	-
-	Isopropylbenzene	3	UN1918	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Isopropylcumyl hydroperoxide, with more than 72 percent in solution*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Isosorbide dinitrate mixture *with not less than 60 percent lactose, mannose, starch or calcium hydrogen phosphate*	4.1	UN2907	II	4.1	-	None	212	None	15 kg	50 kg	E	-
-	Isosorbide-5-mononitrate	4.1	UN3251	III	4.1	66	151	213	240	Forbidden	Forbidden	D	12
-	*Isothiocyanic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

-	*Jet fuel, see* Fuel aviation, turbine engine	-	-	-	-	-	-	-	-	-	-	-	-
D	Jet perforating guns, charged oil well, with detonator	1.1D	NA0124	II	1.1D	55, 56	None	62	None	Forbidden	Forbidden	A	24E
D	Jet perforating guns, charged oil well, with detonator	1.4D	NA0494	II	1.4D	55, 56	None	62	None	Forbidden	Forbidden	B	-
-	Jet perforating guns, charged *oil well, without detonator*	1.1D	UN0124	II	1.1D	55	None	62	None	Forbidden	Forbidden	B	-
-	Jet perforating guns, charged, *oil well, without detonator*	1.4D	UN0494	II	1.4D	55, 114	None	62	None	Forbidden	300 kg	A	24E
-	*Jet perforators, see* Charges, shaped, commercial *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Jet tappers, without detonator, see* Charges, shaped commercial, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Jet thrust igniters, for rocket motors or Jato, see* Igniters	-	-	-	-	-	-	-	-	-	-	-	-
-	*Jet thrust unit (Jato), see* Rocket motors	-	-	-	-	-	-	-	-	-	-	-	-
-	Kerosene	3	UN1223	III	3	B1, T1	150	203	242	60 L	220 L	A	-
G	Ketones, liquid, n.o.s	3	UN1224	I	3	T8, T31	None	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Krypton, compressed	2.2	UN1056	-	2.2	-	306	302	None	75 kg	150 kg	A	-
-	Krypton, refrigerated liquid *(cryogenic liquid)*	2.2	UN1970	-	2.2	-	320	None	None	50 kg	500 kg	B	-
-	*Lacquer base or lacquer chips, nitrocellulose, dry, see* Nitrocellulose, *etc. (UN 2557)*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Lacquer base or lacquer chips, plastic, wet with alcohol or solvent, see* Nitrocellulose *(UN 2059, UN 2060, UN 2555, UN2556) or* Paint *etc. (UN1263)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Lead acetate	6.1	UN1616	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Lead arsenates	6.1	UN1617	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Lead arsenites	6.1	UN1618	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Lead azide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Lead azide, wetted *with not less than 20 percent water or mixture of alcohol and water, by mass*	1.1A	UN0129	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Lead compounds, soluble, n.o.s	6.1	UN2291	III	6.1	138	153	213	240	100 kg	200 kg	A	-
-	Lead cyanide	6.1	UN1620	II	6.1	-	None	212	242	25 kg	100 kg	A	26
-	Lead dioxide	5.1	UN1872	III	5.1	A1	152	213	240	25 kg	100 kg	A	34
-	*Lead dross, see* Lead sulfate, *with more than 3 percent free acid*	-	-	-	-	-	-	-	-	-	-	-	-
D	Lead mononitroresorcinate	1.1A	NA0473	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Lead nitrate	5.1	UN1469	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	-
-	*Lead nitroresorcinate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Lead perchlorate, solid	5.1	UN1470	II	5.1, 6.1	T8	None	212	242	5 kg	25 kg	A	56, 58, 106
-	Lead perchlorate, solution	5.1	UN1470	II	5.1, 6.1	T8	None	202	243	1 L	5 L	A	56, 58, 106
-	*Lead peroxide, see* Lead dioxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Lead phosphite, dibasic	4.1	UN2989	II	4.1	-	None	212	240	5 kg	25 kg	B	34
-	-	-	-	III	4.1	-	151	213	240	15 kg	50 kg	B	34
-	*Lead picrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Lead styphnate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Lead styphnate, wetted *or* Lead trinitroresorcinate, wetted *with not less than 20 percent water or mixture of alcohol and water, by mass*	1.1A	UN0130	II	1.1A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Lead sulfate *with more than 3 percent free acid*	8	UN1794	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Lead trinitroresorcinate, *see* Lead styphnate, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Life-saving appliances, not self inflating *containing dangerous goods as equipment*	9	UN3072	-	None	-	None	219	None	No limit	No limit	A	-
-	Life-saving appliances, self inflating	9	UN2990	-	None	-	None	219	None	No limit	No limit	A	-
-	*Lighter replacement cartridges containing liquefied petroleum gases (and similar devices, each not exceeding 65 grams), see* Lighters *or* lighter refills*etc. containing flammable gas*	-	-	-	-	-	-	-	-	-	-	-	-

D	Lighters for cigars, cigarettes, *etc., with lighter fluids*	3	NA1226	II	3	N10	None	21	None	Forbidden	Forbidden	B	-
-	Lighters, fuse	1.4S	UN0131	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Lighters *or* Lighter refills *cigarettes, containing flammable gas*	2.1	UN1057	-	2.1	N10	None	21, 308	None	1 kg	15 kg	B	40
-	*Lime, unslaked, see* Calcium oxide	-	-	-	-	-	-	-	-	-	-	-	-
G	Liquefied gas, flammable, n.o.s	2.1	UN3161	-	2.1	-	306	304	314, 315	Forbidden	150 kg	D	40
G	Liquefied gas, n.o.s	2.2	UN3163	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
G	Liquefied gas, oxidizing, n.o.s	2.2	UN3157	-	2.2, 5.1	-	306	304	314, 315	75 kg	150 kg	D	-
GI	Liquefied gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3308	-	2.3, 8	1	None	192	245	Forbidden	Forbidden	D	40
GI	Liquefied gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3308	-	2.3, 8	2	None	304	314, 315	Forbidden	Forbidden	D	40
GI	Liquefied gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3308	-	2.3, 8	3	None	304	314, 315	Forbidden	Forbidden	D	40
GI	Liquefied gas, toxic, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3308	-	2.3, 8	4	None	304	314, 315	Forbidden	Forbidden	D	40
GI	Liquefied gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3309	-	2.3, 2.1, 8	1	None	192	245	Forbidden	Forbidden	D	17, 40
GI	Liquefied gas toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3309	-	2.3, 2.1, 8	2	None	304	314, 315	Forbidden	Forbidden	D	17, 40
GI	Liquefied gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3309	-	2.3, 2.1, 8	3	None	304	314, 315	Forbidden	Forbidden	D	17, 40
GI	Liquefied gas, toxic, flammable, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3309	-	2.3, 2.1, 8	4	None	304	314, 315	Forbidden	Forbidden	D	17, 40
G	Liquefied gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3160	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3160	-	2.3, 2.1	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3160	-	2.3, 2.1	3, B14	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, flammable, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3160	-	2.3, 2.1	4	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3162	-	2.3	1	None	192	245	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3162	-	2.3	2, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3162	-	2.3	3, B14	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3162	-	2.3	4	None	304	314, 315	Forbidden	Forbidden	D	40
GI	Liquefied gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3310	-	2.3, 5.1, 8	1	None	192	245	Forbidden	Forbidden	D	40, 89, 90
GI	Liquefied gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone B*	2.3	UN3310	-	2.3, 2.1, 8	2	None	304	314, 315	Forbidden	Forbidden	D	40, 89, 90

GI	Liquefied gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3310	-	2.3, 2.1, 8	3	None	304	314, 315	Forbidden	Forbidden	D	40, 89, 90
GI	Liquefied gas, toxic, oxidizing, corrosive, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3310	-	2.3, 2.1, 8	4	None	304	314, 315	Forbidden	Forbidden	D	40, 89, 90
G	Liquefied gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone A*	2.3	UN3307	-	2.3, 5.1	1	None	192	245	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, oxidizing, n.o.s *Inhalation Hazard Zone B*	2.3	UN3307	-	2.3, 5.1	2	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone C*	2.3	UN3307	-	2.3, 5.1	3	None	304	314, 315	Forbidden	Forbidden	D	40
G	Liquefied gas, toxic, oxidizing, n.o.s. *Inhalation Hazard Zone D*	2.3	UN3307	-	2.3, 5.1	4	None	304	314, 315	Forbidden	Forbidden	D	40
-	Liquefied gases, *non-flammable charged with nitrogen, carbon dioxide or air*	2.2	UN1058	-	2.2	-	306	304	None	75 kg	150 kg	A	-
-	*Liquefied hydrocarbon gas, see* Hydrocarbon gases, liquefied, n.o.s., *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Liquefied natural gas, see* Methane, *etc. (UN 1972)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Liquefied petroleum gas *see* Petroleum gases, liquefied	-	-	-	-	-	-	-	-	-	-	-	-
-	Lithium	4.3	UN1415	I	4.3	A7, A19, B100, N45	None	211	244	Forbidden	15 kg	E	-
-	*Lithium acetylide ethylenediamine complex, see* Water reactive solid *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Lithium alkyls	4.2	UN2445	I	4.2, 4.3	B11, T28, T40	None	181	244	Forbidden	Forbidden	D	-
-	Lithium aluminum hydride	4.3	UN1410	I	4.3	A19, B100,	None	211	242	Forbidden	15 kg	E	-
-	Lithium aluminum hydride, ethereal	4.3	UN1411	I	4.3, 3	A2, A3, A11, N34	None	201	244	Forbidden	1 L	D	40
-	Lithium batteries, contained in equipment	9	UN3091	II	9	29	185(i)	185	None	5 kg	5 kg	A	-
-	Lithium batteries packed with equipment	9	UN3091	II	9	29	185	185	None	5 kg gross	35 kg gross	A	-
-	Lithium battery	9	UN3090	II	9	29	185	185	None	5 kg	35 kg gross	A	-
-	Lithium borohydride	4.3	UN1413	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
-	Lithium ferrosilicon	4.3	UN2830	II	4.3	A19, B105, B106	151	212	241	15 kg	50 kg	E	40, 85, 103
-	Lithium hydride	4.3	UN1414	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
-	Lithium hydride, fused solid	4.3	UN2805	II	4.3	A8, A19, A20, B101, B106	151	212	241	15 kg	50 kg	E	-
-	Lithium hydroxide, monohydrate *or* Lithium hydroxide, solid	8	UN2680	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Lithium hydroxide, solution	8	UN2679	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T8	154	203	241	5 L	60 L	A	96
-	Lithium hypochlorite, dry *or* Lithium hypochlorite mixtures, dry	5.1	UN1471	II	5.1	A9, N34	152	212	240	5 kg	25 kg	A	48, 56, 58, 69, 106, 116
-	*Lithium in cartridges, see* Lithium	-	-	-	-	-	-	-	-	-	-	-	-
-	Lithium nitrate	5.1	UN2722	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
-	Lithium nitride	4.3	UN2806	I	4.3	A19, B101, B106, N40	None	211	242	Forbidden	15 kg	E	-
-	Lithium peroxide	5.1	UN1472	II	5.1	A9, N34	152	212	None	5 kg	25 kg	A	13, 75, 106
-	Lithium silicon	4.3	UN1417	II	4.3	A19, A20, B105, B106	151	212	241	15 kg	50 kg	A	85, 103
-	*LNG, see* Methane *etc. (UN 1972)*	-	-	-	-	-	-	-	-	-	-	-	-
-	London purple	6.1	UN1621	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*LPG, see* Petroleum gases, liquefied	-	-	-	-	-	-	-	-	-	-	-	-
-	*Lye, see* Sodium hydroxide, solutions	-	-	-	-	-	-	-	-	-	-	-	-
-	Magnesium alkyls	4.2	UN3053	I	4.2, 4.3	B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	18

-	Magnesium aluminum phosphide	4.3	UN1419	I	4.3, 6.1	A19, B100, N34, N40	None	211	242	Forbidden	15 kg	E	40, 85
+	Magnesium arsenate	6.1	UN1622	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Magnesium bisulfite solution, see* Bisulfites, aqueous solutions, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Magnesium bromate	5.1	UN1473	II	5.1	A1	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Magnesium chlorate	5.1	UN2723	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Magnesium diamide	4.2	UN2004	II	4.2	A8, A19, A20	None	212	241	15 kg	50 kg	C	-
-	Magnesium diphenyl	4.2	UN2005	I	4.2	-	None	187	244	Forbidden	Forbidden	C	-
-	*Magnesium dross, wet or hot*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Magnesium fluorosilicate	6.1	UN2853	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	Magnesium granules, coated *particle size not less than 149 microns*	4.3	UN2950	III	4.3	A1, A19, B108	151	213	240	25 kg	100 kg	A	-
-	Magnesium hydride	4.3	UN2010	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
-	Magnesium *or* Magnesium alloys *with more than 50 percent magnesium in pellets, turnings or ribbons*	4.1	UN1869	III	4.1	A1	151	213	240	25 kg	100 kg	A	39
-	Magnesium nitrate	5.1	UN1474	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
-	Magnesium perchlorate	5.1	UN1475	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Magnesium peroxide	5.1	UN1476	II	5.1	-	152	212	242	5 kg	25 kg	A	13, 75, 106
-	Magnesium phosphide	4.3	UN2011	I	4.3, 6.1	A19, N40	None	211	None	Forbidden	15 kg	E	40, 85
-	Magnesium, powder *or* Magnesium alloys, powder	4.3	UN1418	I	4.3, 4.2	A19, B56	None	211	244	Forbidden	15 kg	A	39
-	-	-	-	II	4.3, 4.2	A19, B56, B101, B106	None	212	241	15 kg	50 kg	A	39
-	-	-	-	III	4.3, 4.2	A19, B56, B106, B108	None	213	241	25 kg	100 kg	A	39
-	*Magnesium scrap, see* Magnesium, *etc. (UN 1869)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Magnesium silicide	4.3	UN2624	II	4.3	A19, A20, B105, B106	151	212	241	15 kg	50 kg	B	85, 103
-	*Magnetized material, see section 173.21*	-	-	-	-	-	-	-	-	-	-	-	-
D	Maleic acid	8	NA2215	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Maleic anhydride	8	UN2215	III	8	T7	154	213	240	25 kg	100 kg	A	-
-	Malononitrile	6.1	UN2647	II	6.1	-	None	212	242	25 kg	100 kg	A	12
-	*Mancozeb (manganese ethylenebisdithiocarbamate complex with zinc) see* Maneb	-	-	-	-	-	-	-	-	-	-	-	-
-	Maneb *or* Maneb preparations *with not less than 60 percent maneb*	4.2	UN2210	III	4.2, 4.3	57, A1, A19, B105	None	213	242	25 kg	100 kg	A	34
-	Maneb stabilized *or* Maneb preparations, stabilized *against self-heating*	4.3	UN2968	III	4.3	54, A1, A19, B108	151	213	242	25 kg	100 kg	B	34
-	Manganese nitrate	5.1	UN2724	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
-	Manganese resinate	4.1	UN1330	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
-	*Mannitan tetranitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Mannitol hexanitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Mannitol hexanitrate, wetted *or* Nitromannite, wetted *with not less than 40 percent water, or mixture of alcohol and water, by mass*	1.1D	UN0133	II	1.1D	121	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Marine pollutants, liquid or solid, n.o.s., see* Environmentally hazardous substances, liquid *or* solid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	*Matches, block, see* Matches, `strike anywhere'	-	-	-	-	-	-	-	-	-	-	-	-
-	Matches, fusee	4.1	UN2254	III	4.1	-	186	186	None	Forbidden	Forbidden	A	-
-	Matches, safety *(book, card or strike on box)*	4.1	UN1944	III	4.1	-	186	186	None	25 kg	100 kg	A	-
-	Matches, strike anywhere	4.1	UN1331	III	4.1	-	186	186	None	Forbidden	Forbidden	B	-
-	Matches, wax, Vesta	4.1	UN1945	III	4.1	-	186	186	None	25 kg	100 kg	B	-
-	*Matting acid, see* Sulfuric acid	-	-	-	-	-	-	-	-	-	-	-	-

-	Medicine, liquid, flammable, toxic, n.o.s	3	UN3248	II	3, 6.1	36	None	202	None	1 L	5 L	B	40
-	-	-	-	III	3, 6.1	36	150	203	None	5 L	5 L	A	-
-	Medicine, liquid, toxic, n.o.s	6.1	UN1851	II	6.1	-	153	202	243	5 L	5 L	C	40
-	-	-	-	III	6.1	-	153	203	241	5 L	5 L	C	40
-	Medicine, solid, toxic, n.o.s	6.1	UN3249	II	6.1	36	153	212	None	5 kg	5 kg	C	40
-	-	-	-	III	6.1	36	153	213	None	5 kg	5 kg	C	40
D	Medicines, *corrosive, liquid,* n.o.s	8	NA1760	II	8	B3	154	202	242	1 L	30 L	B	40
-	-	-	-	III	8	-	154	203	241	5 L	60 L	A	40
D	Medicines, *corrosive, solid,* n.o.s	8	NA1759	II	8	-	154	212	240	15 kg	50 kg	A	-
-	-	-	-	III	8	-	154	213	240	25 kg	100 kg	A	-
D	Medicines, *flammable, liquid,* n.o.s	3	NA1993	I	3	-	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	-	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1	150	203	242	60 L	220 L	A	-
D	Medicines, *flammable, solid,* n.o.s	4.1	NA1325	II	4.1	-	151	212	240	15 kg	50 kg	B	-
D	Medicines, *oxidizing substance, solid,* n.o.s	5.1	NA1479	II	5.1	-	152	212	242	5 kg	25 kg	B	56, 58, 69, 106
-	*Memtetrahydrophthalic anhydride, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Mercaptans, liquid, flammable, n.o.s. *or* Mercaptan mixture, liquid, flammable, n.o.s.	3	UN3336	I	3	T23	150	201	243	1 L	30 L	E	95
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	95
-	-	-	-	III	3	B1, B52, T7, T30	150	203	241	60 L	220 L	B	95
-	Mercaptans, liquid, flammable, toxic, n.o.s. *or* Mercaptan mixtures, liquid, flammable, toxic, n.o.s	3	UN1228	II	3, 6.1	T13	None	202	243	Forbidden	60 L	B	40, 95
-	-	-	-	III	3, 6.1	B1, T8	150	203	242	5 L	220 L	A	40, 95
-	Mercaptans, liquid, toxic, flammable, n.o.s. *or* Mercaptan mixtures, liquid, toxic, flammable, n.o.s.*, flash point not less than 23 degrees C*	6.1	UN3071	II	6.1, 3	T14	None	202	243	5 L	60 L	C	40, 121
-	5-Mercaptotetrazol-1-acetic acid	1.4C	UN0448	II	1.4C	-	None	62	None	Forbidden	75 kg	A	1E, 5E, 24E
-	Mercuric arsenate	6.1	UN1623	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercuric chloride	6.1	UN1624	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Mercuric compounds, see* Mercury compounds, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Mercuric nitrate	6.1	UN1625	II	6.1	N73	None	212	242	25 kg	100kg	A	-
+	Mercuric potassium cyanide	6.1	UN1626	I	6.1	N74, N75	None	211	242	5 kg	50 kg	A	26
-	*Mercuric sulfocyanate, see* Mercury thiocyanate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Mercurol, see* Mercury nucleate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Mercurous azide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Mercurous compounds, see* Mercury compounds, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Mercurous nitrate	6.1	UN1627	II	6.1	-	None	212	242	25 kg	100 kg	A	-
A, W	Mercury	8	UN2809	III	8	-	164	164	240	35 kg	35 kg	B	40, 97
-	Mercury acetate	6.1	UN1629	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Mercury acetylide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Mercury ammonium chloride	6.1	UN1630	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury based pesticides, liquid, flammable, toxic*, flash point less than 23 degrees C*	3	UN2778	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Mercury based pesticides, liquid, toxic	6.1	UN3012	I	6.1	T42	None	201	243	1L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Mercury based pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN3011	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40

-	-	-	-	III	6.1, 3	T14	153	203	242	60 L	220 L	A	40
-	Mercury based pesticides, solid, toxic	6.1	UN2777	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Mercury benzoate	6.1	UN1631	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury bromides	6.1	UN1634	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury compounds, liquid, n.o.s	6.1	UN2024	I	6.1	-	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	-	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	-	153	203	241	60 L	220 L	B	40
-	Mercury compounds, solid, n.o.s	6.1	UN2025	I	6.1	-	None	211	242	5 kg	50kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
A	Mercury *contained in manufactured articles*	8	UN2809	III	8	-	None	164	None	No limit	No limit	B	40, 97
-	Mercury cyanide	6.1	UN1636	II	6.1	N74, N75	None	212	242	25 kg	100 kg	A	26
-	Mercury fulminate, wetted *with not less than 20 percent water, or mixture of alcohol and water, by mass*	1.1A	UN0135	II	1.1 A	111, 117	None	62	None	Forbidden	Forbidden	E	2E, 6E
-	Mercury gluconate	6.1	UN1637	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury iodide, *solid*	6.1	UN1638	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Mercury iodide aquabasic ammonobasic (Iodide of Millon's base)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Mercury iodide, *solution*	6.1	UN1638	II	6.1	-	None	202	243	5 L	60 L	A	-
-	*Mercury nitride*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Mercury nucleate	6.1	UN1639	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury oleate	6.1	UN1640	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury oxide	6.1	UN1641	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Mercury oxycyanide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Mercury oxycyanide, desensitized	6.1	UN1642	II	6.1	-	None	212	242	25 kg	100 kg	A	26, 91
-	Mercury potassium iodide	6.1	UN1643	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury salicylate	6.1	UN1644	II	6.1	-	None	212	242	25 kg	100 kg	A	-
+	Mercury sulfates	6.1	UN1645	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mercury thiocyanate	6.1	UN1646	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Mesityl oxide	3	UN1229	III	3	B1, T1	None	203	242	60 L	220 L	A	-
-	Metal alkyl halides, water-reactive n.o.s. *or* Metal aryl halides, water-reactive, n.o.s.	4.2	UN3049	I	4.2, 4.3	B9, B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	-
-	Metal alkyl hydrides, water-reactive, n.o.s. *or* Metal aryl hydrides, water-reactive, n.o.s.	4.2	UN3050	I	4.2, 4.3	B9, B11, T28, T29, T40	None	181	244	Forbidden	Forbidden	D	-
-	Metal alkyls, water-reactive, n.o.s. *or* Metal aryls, water-reactive n.o.s.	4.2	UN2003	I	4.2, 4.3	B11, T42	None	181	244	Forbidden	Forbidden	D	-
D	Metal alkyl, solution, n.o.s	3	NA9195	II	3	-	150	202	242	1 L	4 L	B	-
-	Metal carbonyls, n.o.s	6.1	UN3281	I	6.1	5	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	40
-	Metal catalyst, dry	4.2	UN2881	I	4.2	N34	None	187	None	Forbidden	Forbidden	C	-
-	-	-	-	II	4.2	N34	None	187	242	Forbidden	50 kg	C	-
-	-	-	-	III	4.2	N34	241	187	None	25 kg	100 kg	C	-
-	Metal catalyst, wetted *with a visible excess of liquid*	4.2	UN1378	II	4.2	A2, A8, N34	None	212	None	Forbidden	50 kg	C	-
-	Metal hydrides, flammable, n.o.s	4.1	UN3182	II	4.1	A1	151	212	240	15 kg	50 kg	E	-
-	-	-	-	III	4.1	A1	151	213	240	25 kg	100 kg	E	-
-	Metal hydrides, water reactive, n.o.s	4.3	UN1409	I	4.3	A19, B100, N34, N40	None	211	242	Forbidden	15 kg	D	-

-	-	-	-	II	4.3	A19, B101, B106, N34, N40	151	212	242	15 kg	50 kg	D	-
-	Metal powder, self-heating, n.o.s	4.2	UN3189	II	4.2	-	None	212	241	15 kg	50 kg	C	-
-	-	-	-	III	4.2	-	None	213	241	25 kg	100 kg	C	-
-	Metal powders, flammable, n.o.s	4.1	UN3089	II	4.1	-	151	212	240	15 kg	50 kg	B	-
-	-	-	-	III	4.1	-	151	213	240	25 kg	100 kg	B	-
-	*Metal salts of methyl nitramine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
G	Metal salts of organic compounds, flammable, n.o.s	4.1	UN3181	II	4.1	A1	151	212	240	15 kg	50 kg	B	40
-	-	-	-	III	4.1	A1	151	213	240	25 kg	100 kg	B	40
-	Metaldehyde	4.1	UN1332	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
G	Metallic substance, water-reactive, n.o.s	4.3	UN3208	I	4.3	B101, B106	None	211	242	Forbidden	15 kg	E	40
-	-	-	-	II	4.3	B101, B106	151	212	242	15 kg	50 kg	E	40
-	-	-	-	III	4.3	B105, B108	151	213	241	25 kg	100 kg	E	40
G	Metallic substance, water-reactive, self-heating, n.o.s	4.3	UN3209	I	4.3, 4.2	B100	None	211	242	Forbidden	15 kg	E	40
-	-	-	-	II	4.3, 4.2	B101, B106	None	212	242	15 kg	50 kg	E	40
-	-	-	-	III	4.3, 4.2	B101, B106	None	213	242	25 kg	100 kg	E	40
-	Methacrylaldehyde, inhibited	3	UN2396	II	3, 6.1	45, T8	None	202	243	1 L	60 L	E	40
-	Methacrylic acid, inhibited	8	UN2531	III	8	T8, T47	154	203	241	5 L	60 L	A	-
+	Methacrylonitrile, inhibited	3	UN3079	I	3, 6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	30 L	D	12, 40, 48
-	Methallyl alcohol	3	UN2614	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Methane and hydrogen, mixtures, see* Hydrogen and methane, mixtures, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Methane, compressed *or* Natural gas, compressed *(with high methane content)*	2.1	UN1971	-	2.1	-	306	302	302	Forbidden	150 kg	E	40
-	Methane, refrigerated liquid *(cryogenic liquid) or* Natural gas, refrigerated liquid *(cryogenic liquid), with high methane content)*	2.1	UN1972	-	2.1	-	None	None	318	Forbidden	Forbidden	D	40
-	Methanesulfonyl chloride	6.1	UN3246	I	6.1, 8	2, 25, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
I	Methanol	3	UN1230	II	3, 6.1	T8	150	202	242	1 L	60 L	B	40
D	Methanol	3	UN1230	II	3	T8	150	202	242	1 L	60 L	B	40
-	*Methazoic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	4-Methoxy-4-methylpentan-2-one	3	UN2293	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	1-Methoxy-2-propanol	3	UN3092	III	3	B1, T1	150	203	242	60 L	220 L	A	-
+	Methoxymethyl isocyanate	3	UN2605	I	3, 6.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	Methyl acetate	3	UN1231	II	3	B101, T8	150	202	242	5 L	60 L	B	-
-	Methyl acetylene and propadiene mixtures, stabilized	2.1	UN1060	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Methyl acrylate, inhibited	3	UN1919	II	3	T8	150	202	242	5 L	60 L	B	-
-	*Methyl alcohol, see* Methanol	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl allyl chloride	3	UN2554	II	3	B101, T8	150	202	242	5 L	60 L	E	-
-	*Methyl amyl ketone, see* Amyl methyl ketone	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl bromide	2.3	UN1062	-	2.3	3, B14	None	193	314, 315	Forbidden	25 kg	D	40
-	*Methyl bromide and chloropicrin mixtures with more than 2 percent chloropicrin, see* Chloropicrin and methyl bromide mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl bromide and chloropicrin mixtures with not more than 2 percent chloropicrin, see* Methyl bromide	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl bromide and ethylene dibromide mixtures, liquid	6.1	UN1647	I	6.1	2, B9, B14, B32, B74, N65, T38, T43, T45	None	227	244	Forbidden	30 L	C	40
-	Methyl bromoacetate	6.1	UN26	II	6.1	B100, T8	Non	202	243	5 L	60 L	D	40

			43				e						
-	2-Methyl-1-butene	3	UN2459	I	3	T14	None	201	243	1 L	30 L	E	-
-	2-Methyl-2-butene	3	UN2460	II	3	T14	None	202	242	5 L	60 L	E	-
-	3-Methyl-1-butene	3	UN2561	I	3	T20	None	201	243	1 L	30 L	E	-
-	Methyl tert-butyl ether	3	UN2398	II	3	B101, T14	150	202	242	5 L	60 L	E	-
-	Methyl butyrate	3	UN1237	II	3	T1	150	202	242	5 L	60 L	B	-
-	Methyl chloride, *or* Refrigerant gas R 40	2.1	UN1063	-	2.1	-	306	304	314, 315	5 kg	100 kg	D	40
-	*Methyl chloride and chloropicrin mixtures, see* Chloropicrin and methyl chloride mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl chloride and methylene chloride mixtures	2.1	UN1912	-	2.1	-	306	304	314, 315	Forbidden	150 kg	D	40
-	Methyl chloroacetate	6.1	UN2295	I	6.1, 3	T42	None	201	243	1 L	30 L	D	-
-	*Methyl chlorocarbonate, see* Methyl chloroformate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl chloroform, see* 1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl chloroformate	6.1	UN1238	I	6.1, 3, 8	1, B9, B14, B30, B72, N34, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	21, 40, 100
-	Methyl chloromethyl ether	6.1	UN1239	I	6.1, 3	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	Methyl 2-chloropropionate	3	UN2933	III	3	B1, T7	150	203	242	60 L	220 L	A	-
-	Methyl dichloroacetate	6.1	UN2299	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	*Methyl ethyl ether, see* Ethyl methyl ether	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl ethyl ketone, *see* Ethyl methyl ketone	-	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl ethyl ketone peroxide, in solution with more than 9 percent by mass active oxygen*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	2-Methyl-5-ethylpyridine	6.1	UN2300	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Methyl fluoride, *or* Refrigerant gas R 41	2.1	UN2454	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
-	Methyl formate	3	UN1243	I	3	T20	150	201	243	1 L	30 L	E	-
-	2-Methyl-2-heptanethiol	6.1	UN3023	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40, 102
-	Methyl iodide	6.1	UN2644	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	A	12, 40
-	Methyl isobutyl carbinol	3	UN2053	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Methyl isobutyl ketone	3	UN1245	II	3	T1	150	202	242	5 L	60 L	B	-
-	*Methyl isobutyl ketone peroxide, in solution with more than 9 percent by mass active oxygen*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Methyl isocyanate	6.1	UN2480	I	6.1, 3	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	26, 40
-	Methyl isopropenyl ketone, inhibited	3	UN1246	II	3	T7	150	202	242	5 L	60 L	B	-
-	Methyl isothiocyanate	6.1	UN2477	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	A	-
-	Methyl isovalerate	3	UN2400	II	3	T1	150	202	242	5 L	60 L	B	-
-	Methyl magnesium bromide, in ethyl ether	4.3	UN1928	I	4.3, 3	-	None	201	243	Forbidden	1 L	D	-
-	Methyl mercaptan	2.3	UN1064	-	2.3, 2.1	3, B7, B9, B14	None	304	314, 315	Forbidden	25 kg	D	40
-	*Methyl mercaptopropionaldehyde, see* Thia-4-pentanal	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl methacrylate monomer, inhibited	3	UN1247	II	3	T8	150	202	242	5 L	60 L	B	40
-	*Methyl nitramine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-

-	*Methyl nitrite*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl norbornene dicarboxylic anhydride, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl orthosilicate	6.1	UN2606	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	30 L	E	40
D	Methyl parathion *liquid*	6.1	NA3018	II	6.1	N76, T14	None	202	243	Forbidden	1 L	A	40
D	Methyl parathion *solid*	6.1	NA2783	II	6.1	N77	None	212	242	25 kg	100 kg	A	40
D	Methyl phosphonic dichloride	6.1	NA9206	I	6.1, 8	2, A3, B9, B14, B32, B74, N34, N43, T38, T43, T45	None	227	244	Forbidden	Forbidden	C	-
-	*Methyl phosphonothioic dichloride, anhydrous, see* Corrosive liquid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
D	Methyl phosphonous dichloride,*pyrophoric liquid*	6.1	NA2845	I	6.1, 4.2	2, B9, B14, B16, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	18
-	*Methyl picric acid (heavy metal salts of)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Methyl propionate	3	UN1248	II	3	B101, T2	150	202	242	5 L	60 L	B	-
-	Methyl propyl ether	3	UN2612	II	3	T14	150	202	242	5 L	60 L	E	40
-	Methyl propyl ketone	3	UN1249	II	3	T1	150	202	242	5 L	60 L	B	-
-	*Methyl sulfate, see* Dimethyl sulfate	-	-	-	-	-	-	-	-	-	-	-	-
-	*Methyl sulfide, see* Dimethyl sulfide	-	-	-	-	-	-	-	-	-	-	-	-
-	Methyl trichloroacetate	6.1	UN2533	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	*Methyl trimethylol methane trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Methyl vinyl ketone, stabilized	6.1	UN1251	I	6.1, 3, 8	1, 25, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	B	40
-	Methylal	3	UN1234	II	3	T14	None	202	242	5 L	60 L	E	-
-	Methylamine, anhydrous	2.1	UN1061	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Methylamine, aqueous solution	3	UN1235	II	3, 8	B1, T8	150	202	243	1 L	5 L	E	41
-	*Methylamine dinitramine and dry salts thereof*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Methylamine nitroform*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Methylamine perchlorate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Methylamyl acetate	3	UN1233	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	N-Methylaniline	6.1	UN2294	III	6.1	T7	153	203	241	60 L	220L	A	-
-	alpha-Methylbenzyl alcohol	6.1	UN2937	III	6.1	T1	153	203	241	60 L	220 L	A	-
-	3-Methylbutan-2-one	3	UN2397	II	3	T1	150	202	242	5 L	60 L	B	-
-	N-Methylbutylamine	3	UN2945	II	3, 8	T8	None	202	243	1 L	5 L	B	40
-	Methylchlorosilane	2.3	UN2534	-	2.3, 2.1, 8	2, A2, A3, A7, B9, B14, N34	None	226	314, 315	Forbidden	Forbidden	D	17, 40
-	Methylcyclohexane	3	UN2296	II	3	B1, T1	150	202	242	5 L	60 L	B	-
-	Methylcyclohexanols, *flammable*	3	UN2617	III	3	B1, T2	150	203	242	60 L	220 L	A	-
-	Methylcyclohexanone	3	UN2297	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Methylcyclopentane	3	UN2298	II	3	T8	150	202	242	5 L	60 L	B	-
D	Methyldichloroarsine	6.1	NA1556	I	6.1	2	None	192	None	Forbidden	Forbidden	D	40, 95
-	Methyldichlorosilane	4.3	UN1242	I	4.3, 8, 3	A2, A3, A7, B6, B77, N34, T16, T26	None	201	243	Forbidden	1 L	D	21, 28, 40, 49, 100
-	*Methylene chloride, see* Dichloromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*Methylene glycol dinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	2-Methylfuran	3	UN2301	II	3	T7	150	202	242	5 L	60 L	E	-

-	*a-Methylglucoside tetranitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*a-Methylglycerol trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	5-Methylhexan-2-one	3	UN2302	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Methylhydrazine	6.1	UN1244	I	6.1, 3, 8	1, B7, B9, B14, B30, B72, B77, N34, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	21, 40, 49, 100
-	4-Methylmorpholine *or* n-methylmorpholine	3	UN2535	II	3, 8	B6, T8	None	202	243	1 L	5 L	B	40
-	Methylpentadienes	3	UN2461	II	3	T7	150	202	242	5 L	60 L	E	-
-	2-Methylpentan-2-ol	3	UN2560	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Methylpentanes, see* Hexanes	-	-	-	-	-	-	-	-	-	-	-	-
-	Methylphenyldichlorosilane	8	UN2437	II	8	T8, T26	154	202	242	1 L	30 L	C	40
-	1-Methylpiperidine	3	UN2399	II	3, 8	T8	None	202	243	1 L	5 L	B	-
-	Methyltetrahydrofuran	3	UN2536	II	3	B101, T7	150	202	242	5 L	60 L	B	-
-	Methyltrichlorosilane	3	UN1250	I	3, 8	A7, B6, B77, N34, T14, T26	None	201	243	Forbidden	2.5 L	B	40
-	alpha-Methylvaleraldehyde	3	UN2367	II	3	B1, T1	150	202	242	5 L	60 L	B	-
-	*Mine rescue equipment containing carbon dioxide, see* Carbon dioxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Mines *with bursting charge*	1.1F	UN0136	II	1.1F	-	-	62	None	Forbidden	Forbidden	E	-
-	Mines *with bursting charge*	1.1D	UN0137	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Mines *with bursting charge*	1.2D	UN0138	II	1.2D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Mines *with bursting charge*	1.2F	UN0294	II	1.2F	-	-	62	None	Forbidden	Forbidden	E	-
-	*Mixed acid, see* Nitrating acid, mixtures *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Mobility aids, see* Wheel chair, electric	-	-	-	-	-	-	-	-	-	-	-	-
D	Model rocket motor	1.4C	NA0276	II	1.4C	51	None	62	None	Forbidden	75 kg	A	24E
D	Model rocket motor	1.4S	NA0323	II	1.4S	51	None	62	None	25 kg	100 kg	A	9E
-	Molybdenum pentachloride	8	UN2508	III	8	T8, T26	154	213	240	25 kg	100 kg	C	40
-	*Monochloroacetone (unstabilized)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Monochloroethylene, see* Vinyl chloride, inhibited	-	-	-	-	-	-	-	-	-	-	-	-
-	*Monoethanolamine, see* Ethanolamine, solutions	-	-	-	-	-	-	-	-	-	-	-	-
-	*Monoethylamine, see* Ethylamine	-	-	-	-	-	-	-	-	-	-	-	-
-	Morpholine	3	UN2054	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Morpholine, aqueous, mixture, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Motor fuel anti-knock compounds *see* Motor fuel anti-knock mixtures	-	-	-	-	-	-	-	-	-	-	-	-
+	Motor fuel anti-knock mixtures	6.1	UN1649	I	6.1, 3	14, B9, B90, T26, T39	None	201	244	Forbidden	30 L	D	25, 40
-	Motor spirit, *see* Gasoline	-	-	-	-	-	-	-	-	-	-	-	-
-	*Muriatic acid, see* Hydrochloric acid solution	-	-	-	-	-	-	-	-	-	-	-	-
-	Musk xylene, *see* 5-tert-Butyl2,4,6-trinitro-m-xylene	-	-	-	-	-	-	-	-	-	-	-	-
-	*Naphtha see* Petroleum distillates n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Naphthalene, crude *or* Naphthalene, refined	4.1	UN1334	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
-	*Naphthalene diozonide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Naphthalene, molten	4.1	UN2304	III	4.1	A1, T8	151	213	241	Forbidden	Forbidden	C	-
-	beta-Naphthylamine	6.1	UN1650	II	6.1	T12, T26	None	212	242	25 kg	100 kg	A	-
-	alpha-Naphthylamine	6.1	UN2077	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	*Naphthylamineperchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Naphthylthiourea	6.1	UN1651	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Naphthylurea	6.1	UN1652	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Natural gases (with high methane content), see* Methane, *etc. (UN 1971, UN 1972)*	-	-	-	-	-	-	-	-	-	-	-	-

-	*Neohexane, see* Hexanes	-	-	-	-	-	-	-	-	-	-	-	-
-	Neon, compressed	2.2	UN1065	-	2.2	-	306	302	302	75 kg	150 kg	A	-
-	Neon, refrigerated liquid *(cryogenic liquid)*	2.2	UN1913	-	2.2	-	320	316	None	50 kg	500 kg	B	-
-	*New explosive or explosive device, see sections 173.51 and 173.56*	-	-	-	-	-	-	-	-	-	-	-	-
-	Nickel carbonyl	6.1	UN1259	I	6.1, 3	1	None	198	None	Forbidden	Forbidden	D	18, 40
-	Nickel cyanide	6.1	UN1653	II	6.1	N74, N75	None	212	242	25 kg	100 kg	A	26
-	Nickel nitrate	5.1	UN2725	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
-	Nickel nitrite	5.1	UN2726	III	5.1	A1	152	213	240	25 kg	100 kg	A	56, 58
-	*Nickel picrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nicotine	6.1	UN1654	II	6.1	-	None	202	243	5 L	60 L	A	-
-	Nicotine compounds, liquid, n.o.s. *or* Nicotine preparations, liquid, n.o.s	6.1	UN3144	I	6.1	A4, T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	B	40
-	Nicotine compounds, solid, n.o.s. *or* Nicotine preparations, solid, n.o.s	6.1	UN1655	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Nicotine hydrochloride *or* Nicotine hydrochloride solution	6.1	UN1656	II	6.1	-	None	202	243	5 L	60 L	A	-
-	Nicotine salicylate	6.1	UN1657	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Nicotine sulfate, *solid*	6.1	UN1658	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Nicotine sulfate, *solution*	6.1	UN1658	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	Nicotine tartrate	6.1	UN1659	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Nitrated paper (unstable)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrates, inorganic, aqueous solution, n.o.s	5.1	UN3218	II	5.1	58, T8	152	202	242	1 L	5 L	B	46
-	-	-	-	III	5.1	58, T8	152	203	241	2.5 L	30 L	B	46
-	Nitrates, inorganic, n.o.s	5.1	UN1477	II	5.1	-	152	212	240	5 kg	25 kg	A	46
-	-	-	-	III	5.1	-	152	213	240	25 kg	100 kg	A	46
-	*Nitrates of diazonium compounds*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrating acid mixtures, spent *with more than 50 percent nitric acid*	8	UN1826	I	8, 5.1	T12, T27	None	158	243	Forbidden	2.5 L	D	40, 66
-	Nitrating acid mixtures spent *with not more than 50 percent nitric acid*	8	UN1826	II	8	B2, B100, T12, T27	None	158	242	Forbidden	30 L	D	40
-	Nitrating acid mixtures *with more than 50 percent nitric acid*	8	UN1796	I	8, 5.1	T12, T27	None	158	243	Forbidden	2.5 L	D	40, 66
-	Nitrating acid mixtures *with not more than 50 percent nitric acid*	8	UN1796	II	8	B2, T12, T27	None	158	242	Forbidden	30 L	D	40
-	Nitric acid *other than red fuming, with more than 70 percent nitric acid*	8	UN2031	I	8, 5.1	B47, B53, T9, T27	None	158	243	Forbidden	2.5 L	D	44, 66, 89, 90, 110, 111
-	Nitric acid *other than red fuming, with not more than 70 percent nitric acid*	8	UN2031	II	8	B2, B47, B53, T9, T27	None	158	242	Forbidden	30 L	D	44, 66, 89, 90, 110, 111
+	Nitric acid, red fuming	8	UN2032	I	8, 5.1, 6.1	2, B9, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40, 66, 74, 89, 90
-	Nitric oxide, compressed	2.3	UN1660	-	2.3, 5.1, 8	1, B37, B46, B50, B60, B77	None	337	None	Forbidden	Forbidden	D	40, 89, 90
-	Nitric oxide and dinitrogen tetroxide mixtures *or* Nitric oxide and nitrogen dioxide mixtures	2.3	UN1975	-	2.3, 5.1, 8	1, B7, B9, B14, B45, B46, B61, B66, B67, B77	None	337	None	Forbidden	Forbidden	D	40, 89, 90
G	Nitriles, flammable, toxic, n.o.s	3	UN3273	I	3, 6.1	-	None	201	243	Forbidden	30 L	E	40, 52
-	-	-	-	II	3, 6.1	T14	None	202	243	1 L	60 L	B	40, 52
G	Nitriles, toxic, flammable, n.o.s	6.1	UN32	I	6.1,	5	Non	201	243	1 L	30 L	B	40

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-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
G	Nitriles, toxic, n.o.s	6.1	UN3276	I	6.1	5	None	201	243	1 L	30 L	B	-
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	-
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Nitrites, inorganic, aqueous solution, n.o.s	5.1	UN3219	II	5.1	T8	152	202	242	1L	5 L	B	46, 56, 58
-	-	-	-	III	5.1	T8	152	203	241	2.5 L	30 L	B	46, 56, 58
-	Nitrites, inorganic, n.o.s	5.1	UN2627	II	5.1	33	152	212	None	5 kg	25 kg	A	46, 56, 58
-	3-Nitro-4-chlorobenzotrifluoride	6.1	UN2307	II	6.1	T8	None	202	243	5 L	60 L	A	40
-	*6-Nitro-4-diazotoluene-3-sulfonic acid (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Nitro isobutane triol trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*N-Nitro-N-methylglycolamide nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2-Nitro-2-methylpropanol nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitro urea	1.1D	UN0147	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*N-Nitroaniline*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
+	Nitroanilines (*o-; m-; p-;*)	6.1	UN1661	II	6.1	T14	None	212	242	25 kg	100 kg	A	-
+	Nitroanisole	6.1	UN2730	III	6.1	T8	153	213	240	100 kg	200 kg	A	-
+	Nitrobenzene	6.1	UN1662	II	6.1	T14	None	202	243	5 L	60 L	A	40
-	*m-Nitrobenzene diazonium perchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrobenzenesulfonic acid	8	UN2305	II	8	-	154	202	242	1 L	30 L	A	-
-	*Nitrobenzol, see* Nitrobenzene	-	-	-	-	-	-	-	-	-	-	-	-
-	5-Nitrobenzotriazol	1.1D	UN0385	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 19E
-	Nitrobenzotrifluorides	6.1	UN2306	II	6.1	T8	None	202	243	5 L	60 L	A	40
-	Nitrobromobenzenes *liquid*	6.1	UN2732	III	6.1	T8, T38	153	203	241	60 L	220 L	A	-
-	Nitrobromobenzenes *solid*	6.1	UN2732	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Nitrocellulose, *dry or wetted with less than 25 percent water (or alcohol), by mass*	1.1D	UN0340	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	4E, 27E
-	Nitrocellulose membrane filters	4.1	UN3270	II	4.1	43, A1	151	212	240	1 kg	15 kg	D	-
-	Nitrocellulose, plasticized *with not less than 18 percent plasticizing substance, by mass*	1.3C	UN0343	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Nitrocellulose, solution, flammable *with not more than 12.6 percent nitrogen, by mass, and not more than 55 percent nitrocellulose*	3	UN2059	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Nitrocellulose, *unmodified or plasticized with less than 18 percent plasticizing substance, by mass*	1.1D	UN0341	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	4E, 27E
-	Nitrocellulose, wetted *with not less than 25 percent alcohol, by mass*	1.3C	UN0342	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Nitrocellulose with alcohol *with not less than 25 percent alcohol by mass, and with not more than 12.6 percent nitrogen, by dry mass*	4.1	UN2556	II	4.1	-	151	212	None	1 kg	15 kg	D	28
-	Nitrocellulose, *with not more than 12.6 percent nitrogen, by dry mass, or* Nitrocellulose mixture with pigment *or* Nitrocellulose mixture with plasticizer *or* Nitrocellulose mixture with pigment and plasticizer	4.1	UN2557	II	4.1	44	151	212	None	1 kg	15 kg	D	28
-	Nitrocellulose with water *with not less than 25 percent water, by mass*	4.1	UN2555	II	4.1	-	151	212	None	15 kg	50 kg	E	28
-	*Nitrochlorobenzene, see* Chloronitrobenzenes *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Nitrocresols	6.1	UN2446	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Nitroethane	3	UN2842	III	3	B1, T8	150	203	242	60 L	220 L	A	-
-	*Nitroethyl nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Nitroethylene polymer*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrogen, compressed	2.2	UN1066	-	2.2	-	306	302	314, 315	75 kg	150 kg	A	-

-	Nitrogen dioxide, *see* Dinitrogen tetroxide	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen fertilizer solution, see* Fertilizer ammoniating solution *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen, mixtures with rare gases, see* Rare gases and nitrogen mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen peroxide, see* Dinitrogen tetroxide, liquefied	-	-	-	-	-	-	-	-	-	-	-	-
-	Nitrogen, refrigerated liquid *cryogenic liquid*	2.2	UN1977	-	2.2	-	320	316	318	50 kg	500 kg	D	-
-	*Nitrogen tetroxide and nitric oxide mixtures, see* Nitric oxide and nitrogen tetroxide mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen tetroxide, see* Dinitrogen tetroxide, liquefied	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen trichloride*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrogen trifluoride, compressed	2.2	UN2451	-	2.2, 5.1	-	None	302	None	Forbidden	25 kg	D	40
-	*Nitrogen triiodide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Nitrogen triiodide monoamine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrogen trioxide	2.3	UN2421	-	2.3, 5.1, 8	1	None	336	245	Forbidden	Forbidden	D	40, 89, 90
-	Nitroglycerin, desensitized *with not less than 40 percent non-volatile water insoluble phlegmatizer, by mass*	1.1D	UN0143	II	1.1D, 6.1	125	None	62	None	Forbidden	Forbidden	B	1E, 4E, 21E
-	*Nitroglycerin, liquid, not desensitized*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitroglycerin mixture, desensitized, liquid, flammable, n.o.s. *with not more than 30 percent nitroglycerin, by mass.*	3	UN3343	-	3	129	None	214	None	Forbidden	Forbidden	D	-
-	Nitroglycerin mixture, desensitized, solid, n.o.s. *with more than 2 percent but not more than 10 percent nitroglycerin, by mass.*	4.1	UN3319	II	4.1	118	None	None	None	Forbidden	0.5 kg	E	-
-	Nitroglycerin, solution in alcohol, *with more than 1 percent but not more than 5 percent nitroglycerin*	3	UN3064	II	3	N8	None	202	None	Forbidden	5 L	E	-
-	Nitroglycerin, solution in alcohol, *with more than 1 percent but not more than 10 percent nitrogylcerin*	1.1D	UN0144	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E, 21E
-	Nitroglycerin solution in alcohol *with not more than 1 percent nitroglycerin*	3	UN1204	II	3	N34, T25	None	202	None	5 L	60 L	B	-
-	*Nitroguanidine nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitroguanidine *or* Picrite, *dry or wetted with less than 20 percent water, by mass*	1.1D	UN0282	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Nitroguanidine, wetted *or* Picrite, wetted *with not less than 20 percent water, by mass*	4.1	UN1336	I	4.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	E	28
-	*1-Nitrohydantoin*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrohydrochloric acid	8	UN1798	I	8	A3, B10, N41, T18, T27	None	201	243	Forbidden	2.5 L	D	40, 66, 74, 89, 90
-	*Nitromannite (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitromannite, wetted, *see* Mannitol hexanitrate, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Nitromethane	3	UN1261	II	3	T25	150	202	None	Forbidden	60 L	A	-
-	*Nitromuriatic acid, see* Nitrohydrochloric acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Nitronaphthalene	4.1	UN2538	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
+	Nitrophenols (*o-; m-; p-;*)	6.1	UN1663	III	6.1	T8, T38	153	213	240	100 kg	200 kg	A	-
-	*m-Nitrophenyldinitro methane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitropropanes	3	UN2608	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	p-Nitrosodimethylaniline	4.2	UN1369	II	4.2	A19, A20, B101, N34	None	212	241	15 kg	50 kg	D	34
-	Nitrostarch, *dry or wetted with less than 20 percent water, by mass*	1.1D	UN0146	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Nitrostarch, wetted *with not less than 20 percent water, by mass*	4.1	UN1337	I	4.1	23, A8, A19, A20, N41	None	211	None	1 kg	15 kg	D	28
-	*Nitrosugars (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Nitrosyl chloride	2.3	UN1069	-	2.3, 8	3, B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	Nitrosylsulfuric acid	8	UN2308	II	8	A3, A6, A7, B2, N34, T9, T27	154	202	242	1 L	30 L	D	40, 66, 74, 89, 90
-	Nitrotoluenes, *liquid o-; m-; p-;*	6.1	UN1664	II	6.1	T14	None	202	243	5 L	60 L	A	-

-	Nitrotoluenes, *solid m-, or p-*	6.1	UN1664	II	6.1	T14	None	212	242	25 kg	100 kg	A	-
-	Nitrotoluidines (mono)	6.1	UN2660	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Nitrotriazolone *or* NTO	1.1D	UN0490	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Nitrous oxide and carbon dioxide mixtures, see* Carbon dioxide and nitrous oxide mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Nitrous oxide	2.2	UN1070	-	2.2, 5.1	-	306	304	314, 315	75 kg	150 kg	A	40
-	Nitrous oxide, refrigerated liquid	2.2	UN2201	-	2.2, 5.1.	B6	None	304	314, 315	75 kg	150 kg	B	40
-	Nitroxylenes, (o-; m-; p-)	6.1	UN1665	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	*Nitroxylol, see* Nitroxylenes	-	-	-	-	-	-	-	-	-	-	-	-
-	Nonanes	3	UN1920	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Nonflammable gas, n.o.s., see* Compressed *or* Liquefied gases, *etc. (UN 1955, UN 1956)*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nonliquefied gases, see* Compressed gases, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Nonliquefied hydrocarbon gas, see* Hydrocarbon gases, compressed, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Nonyltrichlorosilane	8	UN1799	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	*Nordhausen acid, see* Sulfuric acid, fuming *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Octadecyltrichlorosilane	8	UN1800	II	8	A7, B2, B6 N34, T8	None	202	242	Forbidden	30 L	C	40
-	Octadiene	3	UN2309	II	3	B1, T1	150	202	242	5 L	60 L	B	-
-	*1,7-Octadine-3,5-diyne-1,8-dimethoxy-9-octadecynoic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Octafluorobut-2-ene *or* Refrigerant gas R 1318	2.2	UN2422	-	2.2	-	None	304	314, 315	75 kg	150 kg	A	-
-	Octafluorocyclobutane, *or* Refrigerant gas R C318	2.2	UN1976	-	2.2	-	None	304	314, 315	75 kg	150 kg	A	-
-	Octafluoropropane*or* Refrigerant gas R 218	2.2	UN2424	-	2.2	-	None	304	314, 315	75 kg	150 kg	A	-
-	Octanes	3	UN1262	II	3	T1	150	202	242	5 L	60 L	B	-
-	Octogen, *see* Cyclotetramethylene tetranitramine, etc	-	-	-	-	-	-	-	-	-	-	-	-
-	Octolite *or* Octol, *dry or wetted with less than 15 percent water, by mass*	1.1D	UN0266	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Octonal	1.1D	UN0496	-	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Octyl aldehydes	3	UN1191	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Octyltrichlorosilane	8	UN1801	II	8	A7, B2, B6, N34, T8, T26	None	202	242	Forbidden	30 L	C	40
-	Oil gas, compressed	2.3	UN1071	-	2.3, 2.1	6	None	304	314, 315	Forbidden	25 kg	D	40
-	*Oleum, see* Sulfuric acid, fuming	-	-	-	-	-	-	-	-	-	-	-	-
-	Organic peroxide type A, liquid or solid	Forbidden	-	-	-	-	-	-	-	-	-	-	-
G	Organic peroxide type B, liquid	5.2	UN3101	II	5.2, 1	53	152	225	None	Forbidden	Forbidden	D	12, 40
G	Organic peroxide type B, liquid, temperature controlled	5.2	UN3111	II	5.2, 1	53	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type B, solid	5.2	UN3102	II	5.2, 1	53	152	225	None	Forbidden	Forbidden	D	12, 40
G	Organic peroxide type B, solid, temperature controlled	5.2	UN3112	II	5.2, 1	53	None	225	None	Forbidden	Forbidden	D	2, 40
-	Organic peroxide type C, liquid	5.2	UN3103	II	5.2	-	152	225	None	5 L	10 L	D	12, 40
G	Organic peroxide type C, liquid, temperature controlled	5.2	UN3113	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type C, solid	5.2	UN3104	II	5.2	-	152	225	None	5 kg	10 kg	D	12, 40
G	Organic peroxide type C, solid, temperature controlled	5.2	UN3114	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type D, liquid	5.2	UN31	II	5.2	-	152	225	Non	5 L	10 L	D	12, 40

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G	Organic peroxide type D, liquid, temperature controlled	5.2	UN3115	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type D, solid	5.2	UN3106	II	5.2	-	152	225	None	5 kg	10 kg	D	12, 40
G	Organic peroxide type D, solid, temperature controlled	5.2	UN3116	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type E, liquid	5.2	UN3107	II	5.2	-	152	225	None	10 L	25 L	D	12, 40
G	Organic peroxide type E, liquid, temperature controlled	5.2	UN3117	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type E, solid	5.2	UN3108	II	5.2	-	152	225	None	10 kg	25 kg	D	12, 40
G	Organic peroxide type E, solid, temperature controlled	5.2	UN3118	II	5.2	-	None	225	None	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type F, liquid	5.2	UN3109	II	5.2	-	152	225	225	10 L	25 L	D	12, 40
G	Organic peroxide type F, liquid, temperature controlled	5.2	UN3119	II	5.2	-	None	225	225	Forbidden	Forbidden	D	2, 40
G	Organic peroxide type F, solid	5.2	UN3110	II	5.2	T42	152	225	225	10 kg	25 kg	D	12, 40
G	Organic peroxide type F, solid, temperature controlled	5.2	UN3120	II	5.2	-	None	225	225	Forbidden	Forbidden	D	2, 40
-	-	-	-	III	6.1	B1, T14	153	203	242	60 L	220 L	A	40
D	Organic phosphate, mixed with compressed gas *or* Organic phosphate compound, mixed with compressed gas *or* Organic phosphorus compound, mixed with compressed gas	2.3	NA1955	-	2.3	3	None	334	None	Forbidden	Forbidden	D	40
-	Organic pigments, self-heating	4.2	UN3313	III	4.2	-	None	213	241	25 kg	100 kg	C	-
-	-	-	-	III	4.2	B101	None	213	241	25 kg	100 kg	C	-
-	Organoarsenic compound, n.o.s	6.1	UN3280	I	6.1	5	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	T14	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Organochlorine pesticides liquid, flammable, toxic, *flash point less than 23 degrees C*	3	UN2762	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Organochlorine pesticides, liquid, toxic	6.1	UN2996	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Organochlorine pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN2995	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	B1, T14	153	203	242	60 L	220 L	A	40
-	Organochlorine pesticides, solid toxic	6.1	UN2761	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
G	Organometallic compound *or* Compound solution *or* Compound dispersion, water-reactive, flammable, n.o.s	4.3	UN3207	I	4.3, 3	T28	None	201	244	Forbidden	1 L	E	40
G	Organometallic compound *or* Compound solution *or* Compound dispersion, water-reactive, flammable, n.o.s	4.3	UN3207	II	4.3, 3	T28	None	202	243	1 L	5 L	E	40
G	Organometallic compound *or* Compound solution *or* Compound dispersion, water-reactive, flammable, n.o.s	4.3	UN3207	III	4.3, 3	T28	None	203	242	5 L	60L	E	40
G	Organometallic compound, toxic n.o.s	6.1	UN3282	I	6.1	B106	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	T14	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Organophosphorus compound, toxic, flammable, n.o.s	6.1	UN3279	I	6.1, 3	5	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	Organophosphorus compound, toxic n.o.s	6.1	UN3278	I	6.1	5	None	201	243	1 L	30 L	B	-
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	-
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Organophosphorus pesticides, liquid, flammable, toxic, *flash point less than 23 degrees C*	3	UN2784	I	3, 6.1	T42	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	T18	None	202	243	1 L	60 L	B	40
-	Organophosphorus pesticides, liquid, toxic	6.1	UN30	I	6.1	N76, T42	Non	201	243	1 L	30 L	B	40

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-	-	-	-	II	6.1	N76, T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	N76, T14	153	203	241	60 L	220 L	A	40
-	Organophosphorus pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN3017	I	6.1, 3	N76, T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	N76, T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, N76, T14	153	203	242	60 L	220 L	A	40
-	Organophosphorus pesticides, solid, toxic	6.1	UN2783	I	6.1	N77	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	N77	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	N77	153	213	240	100 kg	200 kg	A	40
-	Organotin compounds, liquid, n.o.s	6.1	UN2788	I	6.1	A3, N33, N34, T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	A3, N33, N34, T14	None	202	243	5 L	60 L	A	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Organotin compounds, solid, n.o.s	6.1	UN3146	I	6.1	A5	None	211	242	5 kg	50 kg	B	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Organotin pesticides, liquid, flammable, toxic, *flash point less than 23 degrees C*	3	UN2787	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Organotin pesticides, liquid, toxic	6.1	UN3020	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Organotin pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN3019	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
-	Organotin pesticides, solid, toxic	6.1	UN2786	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Orthonitroaniline, see* Nitroanilines *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Osmium tetroxide	6.1	UN2471	I	6.1	A8, B100, N33, N34	None	211	242	5 kg	50 kg	B	40
D	Other regulated substances, liquid, n.o.s	9	NA3082	III	9	-	155	203	241	No limit	No limit	A	-
D	Other regulated substances, solid, n.o.s	9	NA3077	III	9	B54	155	213	240	No limit	No limit	A	-
G	Oxidizing liquid, corrosive, n.o.s	5.1	UN3098	I	5.1, 8	-	None	201	244	Forbidden	2.5 L	D	34, 56, 58, 69, 106
-	-	-	-	II	5.1, 8	-	None	202	243	1 L	5 L	B	34, 56, 58, 69, 106
-	-	-	-	III	5.1, 8	-	152	203	242	2.5 L	30 L	B	34, 56, 58, 69, 106
G	Oxidizing liquid, n.o.s	5.1	UN3139	I	5.1	127, A2	None	201	243	Forbidden	2.5 L	D	56, 58, 69, 106
-	-	-	-	II	5.1	127, A2	152	202	242	1 L	5 L	B	56, 58, 69, 106
-	-	-	-	III	5.1	127, A2	152	203	241	2.5 L	30 L	B	56, 58, 69, 106
G	Oxidizing liquid, toxic, n.o.s	5.1	UN3099	I	5.1, 6.1	-	None	201	244	Forbidden	2.5 L	D	56, 58, 95, 106

-	-	-	-	II	5.1, 6.1	-	None	202	243	1 L	5 L	B	56, 58, 95, 106
-	-	-	-	III	5.1, 6.1	-	152	203	242	2.5 L	30 L	B	56, 58, 95, 106
G	Oxidizing solid, corrosive, n.o.s	5.1	UN3085	I	5.1, 8	-	None	211	242	1 kg	15 kg	D	13, 34, 56, 58, 69, 106
-	-	-	-	II	5.1, 8	-	None	212	242	5 kg	25 kg	B	13, 34, 56, 58, 69, 106
-	-	-	-	III	5.1, 8	-	152	213	240	25 kg	100 kg	B	13, 34, 56, 58, 69, 106
G	Oxidizing solid, flammable, n.o.s	5.1	UN3137	I	5.1, 4.1	-	None	214	214	Forbidden	Forbidden	-	-
G	Oxidizing solid, n.o.s	5.1	UN1479	I	5.1	-	None	211	242	1 kg	15 kg	D	56, 58, 69, 106
-	-	-	-	II	5.1	-	152	212	240	5 kg	25kg	B	56, 58, 69, 106
-	-	-	-	III	5.1	-	152	213	240	25 kg	100 kg	B	56, 58, 69, 106
G	Oxidizing solid, self-heating, n.o.s	5.1	UN3100	II	5.1, 4.2	-	None	214	214	Forbidden	Forbidden	-	-
G	Oxidizing solid, toxic, n.o.s	5.1	UN3087	I	5.1, 6.1	-	None	211	242	1 kg	15 kg	D	56, 58, 69, 95, 106
-	-	-	-	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	B	56, 58, 69, 95, 106
-	-	-	-	III	5.1, 6.1	-	152	213	240	25 kg	100 kg	B	56, 58, 69, 95, 106
G	Oxidizing solid, water-reactive, n.o.s	5.1	UN3121	-	5.1, 4.3	-	None	214	214	Forbidden	Forbidden	-	-
-	*Oxygen and carbon dioxide mixtures, see* Carbon dioxide and oxygen mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Oxygen, compressed	2.2	UN1072	-	2.2, 5.1	A52	306	302	314, 315	75 kg	150 kg	A	-
-	Oxygen difluoride, compressed	2.3	UN2190	-	2.3, 5.1, 8	1	None	304	None	Forbidden	Forbidden	D	13, 40, 89, 90
-	Oxygen generator, chemical	5.1	UN3356	II	5.1	60, A51	None	212	None	Forbidden	25 kg gross	D	56, 58, 69, 106
+	**Oxygen generator, chemical, spent**	**9**	**NA3356**	**III**	**9**	**61**	**None**	**213**	**None**	**Forbidden**	**Forbidden**	**A**	-
-	*Oxygen, mixtures with rare gases, see* Rare gases and oxygen mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	Oxygen, refrigerated liquid *(cryogenic liquid)*	2.2	UN1073	-	2.2, 5.1	-	320	316	318	Forbidden	Forbidden	D	-
-	Paint *including paint, lacquer, enamel, stain, shellac solutions, varnish, polish, liquid filler, and liquid lacquer base*	3	UN1263	I	3	T8, T31	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	B52, T7, T30	150	173	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	173	242	60 L	220 L	A	-
-	Paint *or* Paint related material	8	UN30	II	8	B2, T14	154	173	242	1 L	30 L	A	-

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-	-	-	-	III	8	B52, T7	154	173	241	5 L	60 L	A	-
-	Paint related material *including paint thinning, drying, removing, or reducing compound*	3	UN1263	I	3	T8, T31	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	B52, T7, T30	150	173	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	173	242	60 L	220 L	A	-
-	Paper, unsaturated oil treated *incompletely dried (including carbon paper)*	4.2	UN1379	III	4.2	B101, B106	None	213	241	Forbidden	Forbidden	A	-
-	Paraformaldehyde	4.1	UN2213	III	4.1	A1	151	213	240	25 kg	100 kg	A	-
-	Paraldehyde	3	UN1264	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Paranitroaniline, solid, see* Nitroanilines *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D	Parathion	6.1	NA2783	I	6.1	T42	None	201	243	Forbidden	1 L	A	40
-	-	-	-	II	6.1	T14	None	202	243	Forbidden	5 L	A	40
D	Parathion and compressed gas mixture	2.3	NA1967	-	2.3	3	None	334	245	Forbidden	Forbidden	E	40
-	*Paris green, solid, see* Copper acetoarsenite	-	-	-	-	-	-	-	-	-	-	-	-
A, W	PCB, *see* Polychlorinated biphenyls	-	-	-	-	-	-	-	-	-	-	-	-
+	Pentaborane	4.2	UN1380	I	4.2, 6.1	1	None	205	245	Forbidden	Forbidden	D	-
-	Pentachloroethane	6.1	UN1669	II	6.1	T14	None	202	243	5 L	60 L	A	40
-	Pentachlorophenol	6.1	UN3155	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Pentaerythrite tetranitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Pentaerythrite tetranitrate mixture, desensitized, solid, n.o.s. *with more than 10 percent but not more than 20 percent PETN, by mass*	4.1	UN3344	II	4.1	118	None	214	None	Forbidden	Forbidden	E	40
-	Pentaerythrite tetranitrate *or* Pentaerythritol tetranitrate *or* PETN, *with not less than 7 percent wax by mass*	1.1D	UN0411	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Pentaerythrite tetranitrate, wetted *or* Pentaerythritol tetranitrate, wetted, *or* PETN, wetted *with not less than 25 percent water, by mass, or* Pentaerythrite tetranitrate, *or* Pentaerythritol tetranitrate *or* PETN, desensitized *with not less than 15 percent phlegmatizer by mass*	1.1D	UN0150	II	1.1D	121	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Pentaerythritol tetranitrate, *see* Pentaerythrite tetranitrate, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Pentafluoroethane *or* Refrigerant gas R 125	2.2	UN3220	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Pentamethylheptane	3	UN2286	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Pentane-2,4-dione	3	UN2310	III	3, 6.1	B1, T1	150	203	242	60 L	220 L	A	-
-	Pentanes	3	UN1265	I	3	T20	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T20	150	202	242	5 L	60 L	E	-
-	*Pentanitroaniline (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Pentanols	3	UN1105	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B3, T1	150	203	242	60 L	220 L	A	-
-	1-Pentene (*n-amylene*)	3	UN1108	I	3	T14	150	201	243	1 L	30 1	E	-
-	1-Pentol	8	UN2705	II	8	B2, T8	154	202	242	1 L	30 L	B	38
-	Pentolite, *dry or wetted with less than 15 percent water, by mass*	1.1D	UN0151	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Pepper spray, see* Aerosols, etc. *or* Self-defense spray, non-pressurized	-	-	-	-	-	-	-	-	-	-	-	-
-	Perchlorates, inorganic, aqueous solution, n.o.s	5.1	UN3211	II	5.1	T8	152	202	242	1 L	5 L	B	46, 56, 58
-	-	-	-	III	5.1	T8	152	203	241	2.5 L	30 L	B	56, 58, 69, 106
-	Perchlorates, inorganic, n.o.s	5.1	UN1481	II	5.1	-	152	212	242	5 kg	25 kg	A	46, 56
-	-	-	-	III	5.1	-	152	213	240	25 kg	100 kg	A	46, 56
-	*Perchloric acid, with more than 72 percent acid by mass*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Perchloric acid *with more than 50 percent but not more than 72 percent acid, by mass*	5.1	UN1873	I	5.1, 8	A2, A3, N41, T9, T27	None	201	243	Forbidden	2.5 L	D	66
-	Perchloric acid *with not more than 50 percent acid by mass*	8	UN1802	II	8, 5.1	N41, T9	None	202	243	Forbidden	30 L	C	66

-	*Perchloroethylene, see* Tetrachloroethylene	-	-	-	-	-	-	-	-	-	-	-	-
-	Perchloromethyl mercaptan	6.1	UN1670	I	6.1	2, A3, A7, B9, B14, B32, B74, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Perchloryl fluoride	2.3	UN3083	-	2.3, 5.1	2, B9, B14	None	302	314, 315	Forbidden	Forbidden	D	40
-	*Percussion caps, see* Primers, cap type	-	-	-	-	-	-	-	-	-	-	-	-
-	*Perfluoro-2-butene, see* Octafluorobut-2-ene	-	-	-	-	-	-	-	-	-	-	-	-
-	Perfluoro(ethyl vinyl ether)	2.1	UN3154	-	2.1	-	306	302, 304, 305	314, 315	Forbidden	150 kg	E	40
-	Perfluoro(methyl vinyl ether)	2.1	UN3153	-	2.1	-	306	302, 304, 305	314, 315	Forbidden	150 kg	E	40
-	Perfumery products *with flammable solvents*	3	UN1266	II	3	T7, T30	150	202	242	15 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Permanganates, inorganic, aqueous solution, n.o.s	5.1	UN3214	II	5.1	26, T8	152	202	242	1 L	5 L	D	56, 58, 69, 106, 107
-	Permanganates, inorganic, n.o.s	5.1	UN1482	II	5.1	26, A30	152	212	242	5 kg	25 kg	D	56, 58, 69, 106, 107
-	-	-	-	III	5.1	26, A30	152	213	240	25 kg	100 kg	D	56, 58, 69, 106, 107
-	Peroxides, inorganic, n.o.s	5.1	UN1483	II	5.1	A7, A20, N34	None	212	242	5 kg	25 kg	A	13, 75, 106
-	-	-	-	III	5.1	A7, A20, N34	152	213	240	25 kg	100 kg	A	13, 75, 106
-	*Peroxyacetic acid, with more than 43 percent and with more than 6 percent hydrogen peroxide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Persulfates, inorganic, aqueous solution, n.o.s	5.1	UN3216	III	5.1	T2	152	203	241	2.5 L	30 L	A	-
-	Persulfates, inorganic, n.o.s	5.1	UN3215	III	5.1	-	152	213	240	25 kg	100 kg	A	-
G	Pesticides, liquid, flammable, toxic, *flashpoint less than 23 degrees C*	3	UN3021	I	3, 6.1	B5	None	201	243	Forbidden	30 L	B	-
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	-
G	Pesticides, liquid, toxic, flammable, n.o.s. *flashpoint not less than 23 degrees C*	6.1	UN2903	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
G	Pesticides, liquid, toxic, n.o.s	6.1	UN2902	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
G	Pesticides, solid, toxic, n.o.s	6.1	UN2588	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	PETN, *see* Pentaerythrite tetranitrate	-	-	-	-	-	-	-	-	-	-	-	-
-	PETN/TNT, *see* Pentolite, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Petrol, *see* Gasoline	-	-	-	-	-	-	-	-	-	-	-	-
-	Petroleum crude oil	3	UN1267	I	3	T8, T31	None	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-

-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Petroleum distillates, n.o.s. *or* Petroleum products, n.o.s	3	UN1268	I	3	T8, T31	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Petroleum gases, liquefied *or* Liquefied petroleum gas	2.1	UN1075	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
D	Petroleum oil	3	NA1270	I	3	T8, T31	None	201	243	1 L	30 L	E	-
-	-	-	-	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Phenacyl bromide	6.1	UN2645	II	6.1	B106	None	212	242	25 kg	100 kg	B	40
+	Phenetidines	6.1	UN2311	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Phenol, molten	6.1	UN2312	II	6.1	B14, B100, T8	None	202	243	Forbidden	Forbidden	B	40
+	Phenol, solid	6.1	UN1671	II	6.1	N78, T14	None	212	242	25 kg	100 kg	A	-
-	Phenol solutions	6.1	UN2821	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Phenolsulfonic acid, liquid	8	UN1803	II	8	B2, N41, T8	154	202	242	1 L	30 L	C	14
-	Phenoxyacetic acid derivative pesticide, liquid, flammable, toxic *flashpoint less than 23°C.*	3	UN3346	I	3, 6.1	T23	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	T14	None	202	243	1 L	60 L	B	40
-	Phenoxyacetic acid derivative pesticide, liquid, toxic	6.1	UN3348	I	6.1	T24, T26	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	153	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Phenoxyacetic acid derivative pesticide, liquid, toxic, flammable, *flashpoint not less than 23°C*	6.1	UN3347	I	6.1, 3	T24, T26	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	153	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	T14	153	203	241	60 L	220 L	A	40
-	Phenoxyacetic acid derivative pesticide, solid, toxic	6.1	UN3345	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	153	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Phenyl chloroformate	6.1	UN2746	II	6.1, 8	T12	None	202	243	1 L	30 L	A	12, 13, 21, 25, 40, 100
-	Phenyl isocyanate	6.1	UN2487	I	6.1, 3	2, B9, B14, B32, B74, B77, N33, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
-	Phenyl mercaptan	6.1	UN2337	I	6.1, 3	2, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	26, 40
-	Phenyl phosphorus dichloride	8	UN2798	II	8	B2, B15, T8, T26	154	202	242	Forbidden	30 L	B	40
-	Phenyl phosphorus thiodichloride	8	UN2799	II	8	B2, B15, T8, T26	154	202	242	Forbidden	30 L	B	40
-	Phenyl urea pesticides, liquid, toxic	6.1	UN3002	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Phenylacetonitrile, liquid	6.1	UN2470	III	6.1	T8	153	203	241	60 L	220 L	A	26
-	Phenylacetyl chloride	8	UN2577	II	8	B2, T8, T26	154	202	242	1 L	30 L	C	40
-	Phenylcarbylamine chloride	6.1	UN1672	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	*m-Phenylene diaminediperchlorate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
+	Phenylenediamines (o-; m-; p-;)	6.1	UN1673	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Phenylhydrazine	6.1	UN2572	II	6.1	T8	None	202	243	5 L	60 L	A	40
-	Phenylmercuric acetate	6.1	UN16	II	6.1	-	Non	212	242	25 kg	100 kg	A	-

			74				e						
-	Phenylmercuric compounds, n.o.s	6.1	UN2026	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Phenylmercuric hydroxide	6.1	UN1894	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Phenylmercuric nitrate	6.1	UN1895	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Phenyltrichlorosilane	8	UN1804	II	8	A7, B6, N34, T8	None	202	242	Forbidden	30 L	C	40
-	Phosgene	2.3	UN1076	-	2.3, 8	1, B7, B46	None	192	314	Forbidden	Forbidden	D	40
-	9-Phosphabicyclononanes *or* Cyclooctadiene phosphines	4.2	UN2940	II	4.2	A19	None	212	241	15 kg	50 kg	A	-
-	Phosphine	2.3	UN2199	-	2.3, 2.1	1	None	192	245	Forbidden	Forbidden	D	40
-	Phosphoric acid	8	UN1805	III	8	A7, N34, T7	154	203	241	5 L	60 L	A	-
-	*Phosphoric acid triethyleneimine, see* Tris-(1-aziridiyl)phosphine oxide, solution	-	-	-	-	-	-	-	-	-	-	-	-
-	*Phosphoric anhydride, see* Phosphorus pentoxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Phosphorous acid	8	UN2834	III	8	T7	154	213	240	25 kg	100 kg	A	48
-	Phosphorus, amorphous	4.1	UN1338	III	4.1	A1, A19, B1, B9, B26	None	213	243	25 kg	100 kg	A	74
-	*Phosphorus bromide, see* Phosphorus tribromide	-	-	-	-	-	-	-	-	-	-	-	-
-	*Phosphorus chloride, see* Phosphorus trichloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Phosphorus heptasulfide, *free from yellow or white phosphorus*	4.1	UN1339	II	4.1	A20, N34	None	212	240	15 kg	50 kg	B	74
-	Phosphorus oxybromide	8	UN1939	II	8	B8, B106, N41, N43	None	212	240	Forbidden	50 kg	C	12, 40
-	Phosphorus oxybromide, molten	8	UN2576	II	8	B2, B8, N41, N43, T8, T27	None	202	242	Forbidden	Forbidden	C	40
+	Phosphorus oxychloride	8	UN1810	II	8, 6.1	2, A7, B9, B14, B32, B74, B77, N34, T38, T43, T45	None	227	244	Forbidden	30 L	C	40
-	Phosphorus pentabromide	8	UN2691	II	8	A7, B106, N34	154	212	240	Forbidden	50 kg	B	12, 40
-	Phosphorus pentachloride	8	UN1806	II	8	A7, B106, N34	None	212	240	Forbidden	50 kg	C	40
-	Phosphorus pentafluoride, compressed	2.3	UN2198	-	2.3, 8	2, B9, B14	None	302, 304	314, 315	Forbidden	Forbidden	D	40
-	Phosphorus pentasulfide, *free from yellow or white phosphorus*	4.3	UN1340	II	4.3, 4.1	A20, B59, B101, B106	151	212	242	15 kg	50 kg	B	74
-	Phosphorus pentoxide	8	UN1807	II	8	A7, N34	154	212	240	15 kg	50 kg	A	-
-	Phosphorus sesquisulfide, *free from yellow or white phosphorus*	4.1	UN1341	II	4.1	A20, N34	None	212	240	15 kg	50 kg	B	74
-	Phosphorus tribromide	8	UN1808	II	8	A3, A6, A7, B2, B25, N34, N43, T8	None	202	242	Forbidden	30 L	C	40
-	Phosphorus trichloride	6.1	UN1809	I	6.1, 8	2, B9, B14, B15, B32, B74, B77, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	C	40
-	Phosphorus trioxide	8	UN2578	III	8	-	154	213	240	25 kg	100 kg	A	12
-	Phosphorus trisulfide, *free from yellow or white phosphorus*	4.1	UN1343	II	4.1	A20, N34	None	212	240	15 kg	50 kg	B	74
-	Phosphorus, white dry *or* Phosphorus, white, under water *or* Phosphorus white, in solution *or* Phosphorus, yellow dry *or* Phosphorus, yellow, under water *or* Phosphorus, yellow, in solution	4.2	UN1381	I	4.2, 6.1	B9, B26, N34, T15, T26, T33	None	188	243	Forbidden	Forbidden	E	-
-	Phosphorus white, molten	4.2	UN2447	I	4.2, 6.1	B9, B26, N34, T15, T26, T29	None	188	243	Forbidden	Forbidden	D	-
-	*Phosphorus (white or red) and a chlorate, mixtures of*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Phosphoryl chloride, see* Phosphorus oxychloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Phthalic anhydride *with more than .05 percent maleic anhydride*	8	UN2214	III	8	T7	154	213	240	25 kg	100 kg	A	-
-	Picolines	3	UN2313	III	3	B1, T8	150	203	242	60 L	220 L	A	40
-	Picric acid, *see* Trinitrophenol, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D	Picric acid, wet, *with not less than 10 percent water*	4.1	NA1344	I	4.1	A19, A20, N41	None	211	None	Forbidden	Forbidden	D	-

-	Picrite, *see* Nitroguanidine, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Picryl chloride, *see* Trinitrochlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-
-	Pine oil	3	UN1272	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	alpha-Pinene	3	UN2368	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Piperazine	8	UN2579	III	8	T7	154	213	240	25 kg	100 kg	A	12
-	Piperidine	8	UN2401	I	8, 3	T17	None	201	243	0.5 L	2.5 L	B	-
-	*Pivaloyl chloride, see* Trimethylacetyl chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Plastic molding compound *in dough, sheet or extruded rope form evolving flammable vapor*	9	UN3314	III	9	32	155	221	221	100 kg	200 kg	A	85, 87
-	*Plastic solvent, n.o.s., see* Flammable liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Plastics, nitrocellulose-based, self-heating, n.o.s	4.2	UN2006	III	4.2	-	None	213	None	Forbidden	Forbidden	C	-
-	*Poisonous gases, n.o.s., see* Compressed *or* liquefied gases, flammable *or* toxic, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	*Polyalkylamines, n.o.s., see* Amines, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
A, W	Polychlorinated biphenyls, liquid	9	UN2315	II	9	9, 81	155	202	241	100 L	220 L	A	34
A, W	Polychlorinated biphenyls, solid	9	UN2315	II	9	9, 81	155	212	240	100 kg	200 kg	A	34
-	Polyester resin kit	3	UN3269	-	3	40	152	225	None	5 kg	5 kg	B	-
-	Polyhalogenated biphenyls, liquid *or* Polyhalogenated terphenyls liquid	9	UN3151	II	9	-	155	204	241	100 L	220 L	A	34
-	Polyhalogenated biphenyls, solid *or* Polyhalogenated terphenyls, solid	9	UN3152	II	9	-	155	204	241	100 kg	200 kg	A	34
-	Polymeric beads, expandable, *evolving flammable vapor*	9	UN2211	III	None	32	155	221	221	100 kg	200 kg	A	85, 87
-	Potassium	4.3	UN2257	I	4.3	A19, A20, B27, B100, N6, N34, T15, T26	None	211	244	Forbidden	15 kg	D	-
-	Potassium arsenate	6.1	UN1677	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Potassium arsenite	6.1	UN1678	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Potassium bisulfite solution, see* Bisulfites, inorganic, aqueous solutions, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium borohydride	4.3	UN1870	I	4.3	A19, B100, N40	None	211	242	Forbidden	15 kg	E	-
-	Potassium bromate	5.1	UN1484	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	*Potassium carbonyl*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Potassium chlorate	5.1	UN1485	II	5.1	A9, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Potassium chlorate, aqueous solution	5.1	UN2427	II	5.1	A2, T8	152	202	241	1 L	5 L	B	56, 58, 106
-	-	-	-	III	5.1	A2, T8	152	203	241	2.5 L	30 L	B	56, 58, 69, 106
-	*Potassium chlorate mixed with mineral oil, see* Explosive, blasting, type C	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium cuprocyanide	6.1	UN1679	II	6.1	-	None	212	242	25 kg	100kg	A	26
-	Potassium cyanide	6.1	UN1680	I	6.1	B69, B77, N74, N75, T18, T26	None	211	242	5 kg	50 kg	B	52
-	*Potassium dichloro isocyanurate or Potassium dichloro-s-triazinetrione, see* Dichloroisocyanuric acid, dry or Dichloroisocyanuric acid salts *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium dithionite *or* Potassium hydrosulfite	4.2	UN1929	II	4.2	A8, A19, A20	None	212	241	15 kg	50 kg	E	13
-	Potassium fluoride	6.1	UN1812	III	6.1	T8	153	213	240	100 kg	200 kg	A	26
-	Potassium fluoroacetate	6.1	UN2628	I	6.1	-	None	211	242	5 kg	50 kg	E	-
-	Potassium fluorosilicate	6.1	UN2655	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	*Potassium hydrate, see* Potassium hydroxide, solid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Potassium hydrogen fluoride, see* Potassium hydrogen difluoride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Potassium hydrogen fluoride solution, see* Corrosive liquid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium hydrogen sulfate	8	UN2509	II	8	A7, N34	154	212	240	15 kg	50 kg	A	-

-	Potassium hydrogendifluoride, *solid*	8	UN1811	II	8, 6.1	B106, N3, N34, T8	154	212	240	15 kg	50 kg	A	25, 26, 40
-	Potassium hydrogendifluoride, *solution*	8	UN1811	II	8, 6.1	N3, N34, T8	154	202	243	1 L	30 L	A	26, 40, 95
-	Potassium hydrosulfite, *see* Potassium dithionite	-	-	-	-	-	-	-	-	-	-	-	-
-	*Potassium hydroxide, liquid, see* Potassium hydroxide solution	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium hydroxide, solid	8	UN1813	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Potassium hydroxide, solution	8	UN1814	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	*Potassium hypochlorite, solution, see* Hypochlorite solutions, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium, metal alloys	4.3	UN1420	I	4.3	A19, A20, B27	None	211	244	Forbidden	15 kg	D	-
-	*Potassium metal, liquid alloy, see* Alkali metal alloys, liquid	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium metavanadate	6.1	UN2864	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Potassium monoxide	8	UN2033	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Potassium nitrate	5.1	UN1486	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Potassium nitrate and sodium nitrite mixtures	5.1	UN1487	II	5.1	B78	152	212	240	5 kg	25 kg	A	56, 58
-	Potassium nitrite	5.1	UN1488	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58
-	Potassium perchlorate, solid	5.1	UN1489	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Potassium perchlorate, solution	5.1	UN1489	II	5.1	-	152	202	242	1 L	5 L	A	56, 58, 106
-	Potassium permanganate	5.1	UN1490	II	5.1	-	152	212	240	5 kg	25 kg	D	56, 58, 69, 106, 107
-	Potassium peroxide	5.1	UN1491	I	5.1	A20, N34	None	211	None	Forbidden	15 kg	B	13, 75, 106
-	Potassium persulfate	5.1	UN1492	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Potassium phosphide	4.3	UN2012	I	4.3, 6.1	A19, N40	None	211	None	Forbidden	15 kg	E	40, 85
-	*Potassium selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	*Potassium selenite, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
-	Potassium sodium alloys	4.3	UN1422	I	4.3	A19, B27, N34, N40, T15, T26	None	211	244	Forbidden	15 kg	D	-
-	Potassium sulfide, anhydrous *or* Potassium sulfide *with less than 30 percent water of crystallization*	4.2	UN1382	II	4.2	A19, A20, B16, B106, N34	None	212	241	15 kg	50 kg	A	-
-	Potassium sulfide, hydrated *with not less than 30 percent water of crystallization*	8	UN1847	II	8	-	154	212	240	15 kg	50 kg	A	26
-	Potassium superoxide	5.1	UN2466	I	5.1	A20	None	211	None	Forbidden	15 kg	B	13, 75, 106
-	Powder cake, wetted *or* Powder paste, wetted *with not less than 17 percent alcohol by mass*	1.1C	UN0433	II	1.1C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Powder cake, wetted *or* Powder paste, wetted *with not less than 25 percent water, by mass*	1.3C	UN0159	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Powder paste, *see* Powder cake, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Powder, smokeless	1.1C	UN0160	II	1.1C	-	None	62	None	Forbidden	Forbidden	B	10E, 26E
-	Powder, smokeless	1.3C	UN0161	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	10E, 26E
-	*Power device, explosive, see* Cartridges, power device	-	-	-	-	-	-	-	-	-	-	-	-
-	Primers, cap type	1.4S	UN0044	II	None	-	None	62	None	25 kg	100 kg	A	-
-	Primers, cap type	1.1B	UN0377	II	1.1B	-	None	62	None	Forbidden	Forbidden	B	2E, 6E
-	Primers, cap type	1.4B	UN0378	II	1.4B	-	None	62	None	Forbidden	75 kg	A	24E
-	*Primers, small arms, see* Primers, cap type	-	-	-	-	-	-	-	-	-	-	-	-
-	Primers, tubular	1.3G	UN0319	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Primers, tubular	1.4G	UN0320	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Primers, tubular	1.4S	UN0376	II	None	-	None	62	None	25 kg	100 kg	A	-

-	Printing ink, *flammable*	3	UN1210	I	3	T8, T31	150	173	243	1 L	30 L	E	-
-	-	-	-	II	3	T7, T30	150	173	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	173	242	60 L	220 L	A	-
-	*Projectiles, illuminating, see* Ammunition, illuminating, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Projectiles, *inert with tracer*	1.4S	UN0345	II	1.4S	-	-	62	None	25 kg	100 kg	A	3E, 7E, 9E
-	Projectiles, *inert, with tracer*	1.3G	UN0424	II	1.3G	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Projectiles, *inert, with tracer*	1.4G	UN0425	II	1.4G	-	-	62	None	Forbidden	75 kg	A	3E, 7E, 24E
-	Projectiles, *with burster or expelling charge*	1.2D	UN0346	II	1.2D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Projectiles, *with burster or expelling charge*	1.4D	UN0347	II	1.4D	-	-	62	None	Forbidden	75 kg	A	3E, 7E, 24E
-	Projectiles, *with burster or expelling charge*	1.2F	UN0426	II	1.2F	-	-	62	None	Forbidden	Forbidden	E	-
-	Projectiles, *with burster or expelling charge*	1.4F	UN0427	II	1.4F	-	-	62	None	Forbidden	Forbidden	E	-
-	Projectiles, *with burster or expelling charge*	1.2G	UN0434	II	1.2G	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Projectiles, *with burster or expelling charge*	1.4G	UN0435	II	1.4G	-	-	62	None	Forbidden	75 kg	A	3E, 7E, 24E
-	Projectiles, *with bursting charge*	1.1F	UN0167	II	1.1F	-	-	62	None	Forbidden	Forbidden	E	-
-	Projectiles, *with bursting charge*	1.1D	UN0168	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Projectiles, *with bursting charge*	1.2D	UN0169	II	1.2D	-	-	62	None	Forbidden	Forbidden	B	3E, 7E
-	Projectiles, *with bursting charge*	1.2F	UN0324	II	1.2F	-	-	62	None	Forbidden	Forbidden	E	-
-	Projectiles, *with bursting charge*	1.4D	UN0344	II	1.4D	-	-	62	None	Forbidden	75 kg	A	3E, 7E, 24E
-	Propadiene, inhibited	2.1	UN2200	-	2.1	-	None	304	314, 315	Forbidden	150 kg	B	40
-	*Propadiene mixed with methyl acetylene, see* Methyl acetylene and propadiene mixtures, stabilized	-	-	-	-	-	-	-	-	-	-	-	-
-	Propane *see also* Petroleum gases, liquefied	2.1	UN1978	-	2.1	19	306	304	314, 315	Forbidden	150 kg	E	40
-	Propanethiols	3	UN2402	II	3	T8	150	202	242	5 L	60 L	E	95, 102
-	n-Propanol *or* Propyl alcohol, normal	3	UN1274	II	3	B1, T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
D	Propargyl alcohol	3	NA1986	II	3, 6.1	-	None	202	243	Forbidden	1 L	B	40
-	Propellant, liquid	1.3C	UN0495	II	1.3C	37	None	62	None	Forbidden	Forbidden	B	-
-	Propellant, liquid	1.1C	UN0497	II	1.1C	37	None	62	None	Forbidden	Forbidden	B	-
-	Propellant, solid	1.1C	UN0498	II	1.1C	-	None	62	None	Forbidden	Forbidden	A	-
-	Propellant, solid	1.3C	UN0499	II	1.3C	-	None	62	None	Forbidden	Forbidden	A	-
-	Propionaldehyde	3	UN1275	II	3	T14	150	202	242	5 L	60 L	E	-
-	Propionic acid	8	UN1848	III	8	T7	154	203	241	5 L	60 L	A	-
-	Propionic anhydride	8	UN2496	III	8	T2	154	203	241	5 L	60 L	A	-
-	Propionitrile	3	UN2404	II	3, 6.1	T14	None	202	243	Forbidden	60 L	E	40
-	Propionyl chloride	3	UN1815	II	3, 8	B100, T8, T26	None	202	243	1 L	5 L	B	40
-	n-Propyl acetate	3	UN1276	II	3	T1	150	202	242	5 L	60 L	B	-
-	Propyl alcohol, *see* Propanol	-	-	-	-	-	-	-	-	-	-	-	-
-	n-Propyl benzene	3	UN2364	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Propyl chloride	3	UN1278	II	3	N34, T14	None	202	242	Forbidden	60 L	E	-
-	n-Propyl chloroformate	6.1	UN27	I	6.1,	2, A3, A6, A7, B9,	Non	227	244	Forbidden	2.5 L	B	21,

			40		3, 8	B14, B32, B74, B77, N34, T38, T43, T45	e						40, 100
-	Propyl formates	3	UN1281	II	3	T8	150	202	242	5 L	60 L	B	-
-	n-Propyl isocyanate	6.1	UN2482	I	6.1, 3	1, A7, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	40
-	*Propyl mercaptan, see* Propanethiols	-	-	-	-	-	-	-	-	-	-	-	-
-	n-Propyl nitrate	3	UN1865	II	3	T25	150	202	None	5 L	60 L	D	-
-	Propylamine	3	UN1277	II	3, 8	N34, T14	None	202	243	1 L	5 L	E	40
-	Propylene *see also* Petroleum gases, liquefied	2.1	UN1077	-	2.1	19	306	304	314, 315	Forbidden	150 kg	E	40
-	Propylene chlorohydrin	6.1	UN2611	II	6.1, 3	T9	None	202	243	5 L	60 L	A	12, 40, 48
-	Propylene oxide	3	UN1280	I	3	A3, N34, T20, T29	None	201	243	1 L	30 L	E	40
-	Propylene tetramer	3	UN2850	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	1,2-Propylenediamine	8	UN2258	II	8, 3	A3, A6, N34, T8	None	202	243	1 L	30 L	A	40
-	Propyleneimine, inhibited	3	UN1921	I	3, 6.1	A3, N34, T24	None	201	243	1 L	30 L	B	40
-	Propyltrichlorosilane	8	UN1816	II	8, 3	A7, B2, B6, N34, T8, T26	None	202	243	Forbidden	30 L	C	40
-	*Prussic acid, see* Hydrogen cyanide	-	-	-	-	-	-	-	-	-	-	-	-
-	Pyrethroid pesticide, liquid, toxic, flammable, *flashpoint less than 23 °C*	3	UN3350	I	3, 6.1	T24, T26	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	T14	None	202	243	1 L	60 L	B	40
-	Pyrethroid pesticide, liquid toxic	6.1	UN3352	I	6.1	-	None	211	242	1 L	30 L	A	40
-	-	-	-	II	6.1	-	153	212	242	5 L	60 L	A	40
-	-	-	-	III	6.1	-	153	213	240	60 L	220 L	A	40
-	Pyrethroid pesticide, liquid, flammable, toxic, *flashpoint not less than 23 degrees C*	6.1	UN3351	I	6.1, 3	T24, T26	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	153	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	T14	153	203	241	60 L	220 L	B	40
-	Pyrethroid pesticide, solid, toxic	6.1	UN3349	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	153	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Pyridine	3	UN1282	II	3	T8	None	202	242	5 L	60 L	B	21, 100
-	*Pyridine perchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
G	Pyrophoric liquid, inorganic, n.o.s	4.2	UN3194	I	4.2	-	None	181	244	Forbidden	Forbidden	D	18
G	Pyrophoric liquids, organic, n.o.s	4.2	UN2845	I	4.2	B11, T42	None	181	244	Forbidden	Forbidden	D	18
G	Pyrophoric metals, n.o.s., *or* Pyrophoric alloys, n.o.s	4.2	UN1383	I	4.2	B11	None	187	242	Forbidden	Forbidden	D	-
G	Pyrophoric organometallic compound, water-reactive, n.o.s	4.2	UN3203	I	4.2, 4.3	T28, T40	None	187	242	Forbidden	Forbidden	D	-
G	Pyrophoric solid, inorganic, n.o.s	4.2	UN3200	I	4.2	-	None	187	242	Forbidden	Forbidden	D	-
G	Pyrophoric solids, organic, n.o.s	4.2	UN2846	I	4.2	-	None	187	242	Forbidden	Forbidden	D	-
-	Pyrosulfuryl chloride	8	UN1817	II	8	B2, T9, T27	154	202	242	1 L	30 L	C	40
-	*Pyroxylin solution or solvent, see* Nitrocellulose	-	-	-	-	-	-	-	-	-	-	-	-
-	Pyrrolidine	3	UN1922	II	3, 8	T1	None	202	243	1 L	5 L	B	40
-	*Quebrachitol pentanitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Quicklime, see* Calcium oxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Quinoline	6.1	UN2656	III	6.1	T8	153	203	241	60 L	220 L	A	12
-	*R 114, see* Dichlorotetrafluoroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 115, see* Chloropentafluoroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 116, see* Hexafluoroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 124, see* Chlorotetrafluoroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 133a, see* Chlorotrifluoroethane	-	-	-	-	-	-	-	-	-	-	-	-

-	*R 152a, see* Difluoroethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 500, see* Dichlorodifluoromethane and difluoroethane, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 502, see* Chlorodifluoromethane and chloropentafluoroethane mixture, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 503, see* Chlorotrifluoromethane and trifluoromethane, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 12, see* Dichlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 12B1, see* Chlorodifluorobromomethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 13, see* Chlorotrifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 13B1, see* Bromotrifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 14, see* Tetrafluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 21, see* Dichlorofluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	*R 22, see* Chlorodifluoromethane	-	-	-	-	-	-	-	-	-	-	-	-
-	Radioactive material, excepted package-articles manufactured from natural *or* depleted uranium or natural thorium	7	UN2910	-	None	-	422, 426	422, 426	422, 426	-	-	A	-
-	Radioactive material, excepted package-empty package *or* empty packaging	7	UN2910	-	empty	-	428	428	428	-	-	A	-
-	Radioactive material, excepted package-instruments *or* articles	7	UN2910	-	None	-	422, 424	422, 424	422, 424	-	-	A	-
-	Radioactive material, excepted package-limited quantity of material	7	UN2910	-	None	-	421, 422	421, 422	421, 422	-	-	A	-
-	Radioactive material, fissile, n.o.s	7	UN2918	-	7	-	453	417	417	-	-	A	40, 95
-	Radioactive material, low specific activity, n.o.s.*or* Radioactive material, LSA, n.o.s	7	UN2912	-	7	-	421, 428	427	427	-	-	A	-
-	Radioactive material, n.o.s	7	UN2982	-	7	-	421, 428	415, 416	415, 416	-	-	A	40, 95
-	Radioactive material, special form, n.o.s	7	UN2974	-	7	-	421, 424	415, 416	415, 416	-	-	A	-
-	Radioactive material, surface contaminated object *or* Radioactive material, SCO	7	UN2913	-	7	-	421, 424, 426	427	427	-	-	A	-
-	*Railway torpedo, see* Signals, railway track, explosive	-	-	-	-	-	-	-	-	-	-	-	-
-	Rare gases and nitrogen mixtures, compressed	2.2	UN1981	-	2.2	-	306	302	None	75 kg	150 kg	A	-
-	Rare gases and oxygen mixtures, compressed	2.2	UN1980	-	2.2	-	306	302	None	75 kg	150 kg	A	-
-	Rare gases mixtures, compressed	2.2	UN1979	-	2.2	-	306	302	None	75 kg	150 kg	A	-
-	*RC 318, see* Octafluorocyclobutane	-	-	-	-	-	-	-	-	-	-	-	-
-	RDX and cyclotetramethylenetetranitramine, wetted *or* desensitized *see* RDX and HMX mixtures, wetted or desensitized	-	-	-	-	-	-	-	-	-	-	-	-
-	RDX and HMX mixtures, wetted *with not less than 15 percent water by mass or* RDX and HMX mixtures, desensitized *with not less than 10 percent phlegmatizer by mass*	1.1D	UN0391	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	RDX and Octogen mixtures, wetted *or* desensitized *see* RDX and HMX mixtures, wetted *or* desensitized *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*RDX, see* Cyclotrimethylene trinitramine, etc	-	-	-	-	-	-	-	-	-	-	-	-
-	Receptacles, small, containing gas (gas cartridges) *flammable, without release device, not refillable and not exceeding 1 L capacity*	2.1	UN2037	-	2.1	-	306	304	None	1 kg	15 kg	B	40
-	Receptacles, small, containing gas (gas cartridges) *non-flammable, without release device, not refillable and not exceeding 1 L capacity*	2.2	UN2037	-	2.2	-	306	304	None	1 kg	15 kg	B	40
-	*Red phosphorus, see* Phosphorus, amorphous	-	-	-	-	-	-	-	-	-	-	-	-
-	Refrigerant gas R 404A	2.2	UN3337	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Refrigerant gas R 407A	2.2	UN3338	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Refrigerant gas R 407B	2.2	UN3339	-	2.2	-	306	304	314,	75 kg	150 kg	A	-

									315				
-	Refrigerant gas R 407C	2.2	UN3340	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
G	Refrigerant gases, n.o.s	2.2	UN1078	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
D	Refrigerant gases, n.o.s. *or* Dispersant gases, n.o.s	2.1	NA1954	-	2.1	-	306	304	314, 315	Forbidden	150 kg	D	40
D	Refrigerating machine	3	NA1993	III	3	-	174	174	None	10 L	10 L	A	-
D	Refrigerating machines, *containing flammable, non-poisonous, liquefied gas*	2.1	NA1954	-	2.1	-	306	306	306	Forbidden	25 kg	C	40
G	Refrigerating machines, *containing non-flammable, nontoxic, liquefied gas or ammonia solution (UN2672)*	2.2	UN2857	-	2.2	-	306, 307	306	306, 307	450 kg	450 kg	A	-
D	Regulated medical waste	6.2	UN3291	II	6.2	A13, A14	134	197	None	Forbidden	Forbidden	E	-
-	Release devices, explosive	1.4S	UN0173	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Resin solution, *flammable*	3	UN1866	I	3	B52, T8, T31	150	201	243	1 L	30 L	E	-
-	-	-	-	II	3	B52, T7, T30	150	173	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B52, T7, T30	150	173	242	60 L	220 L	A	-
-	Resorcinol	6.1	UN2876	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	*Rifle grenade, see* Grenades, *hand or rifle, etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Rifle powder, see* Powder, smokeless *(UN 0160)*	-	-	-	-	-	-	-	-	-	-	-	-
-	Rivets, explosive	1.4S	UN0174	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	*Road asphalt or tar liquid, see* Tars, liquid, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Rocket motors	1.3C	UN0186	II	1.3C	109	None	62	None	Forbidden	220 kg	B	-
-	Rocket motors	1.1C	UN0280	II	1.1C	109	None	62	None	Forbidden	Forbidden	B	-
-	Rocket motors	1.2C	UN0281	II	1.2C	109	None	62	None	Forbidden	Forbidden	B	-
-	Rocket motors, liquid fueled	1.2J	UN0395	II	1.2J	109	None	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Rocket motors, liquid fueled	1.3J	UN0396	II	1.3J	109	None	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Rocket motors with hypergolic liquids *with or without an expelling charge*	1.3L	UN0250	II	1.3L	109	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
-	Rocket motors with hypergolic liquids *with or without an expelling charge*	1.2L	UN0322	II	1.2L	109	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
-	Rockets, line-throwing	1.2G	UN0238	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	Rockets, line-throwing	1.3G	UN0240	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	Rockets, line-throwing	1.4G	UN0453	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Rockets, liquid fueled *with bursting charge*	1.1J	UN0397	II	1.1J	-	None	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Rockets, liquid fueled *with bursting charge*	1.2J	UN0398	II	1.2J	-	None	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Rockets, *with bursting charge*	1.1F	UN0180	II	1.1F	-	None	62	None	Forbidden	Forbidden	E	-
-	Rockets, *with bursting charge*	1.1E	UN0181	II	1.1E	-	None	62	None	Forbidden	Forbidden	B	-
-	Rockets, *with bursting charge*	1.2E	UN0182	II	1.2E	-	None	62	None	Forbidden	Forbidden	B	-
-	Rockets, *with bursting charge*	1.2F	UN0295	II	1.2F	-	None	62	None	Forbidden	Forbidden	E	-
-	Rockets, *with expelling charge*	1.2C	UN0436	II	1.2C	-	None	62	None	Forbidden	Forbidden	B	-
-	Rockets, *with expelling charge*	1.3C	UN0437	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-

-	Rockets, *with expelling charge*	1.4C	UN0438	II	1.4C	-	None	62	None	Forbidden	75 kg	A	24E
-	Rockets, *with inert head*	1.3C	UN0183	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	-
-	Rosin oil	3	UN1286	II	3	T7	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Rubber solution	3	UN1287	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Rubidium	4.3	UN1423	I	4.3	22, A7, A19, B100, N34, N40, N45	None	211	242	Forbidden	15 kg	D	-
-	Rubidium hydroxide	8	UN2678	II	8	T8	154	212	240	15 kg	50 kg	A	-
-	Rubidium hydroxide solution	8	UN2677	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	*Safety fuse, see* Fuse, safety	-	-	-	-	-	-	-	-	-	-	-	-
G	Samples, explosive, *other than initiating explosives*	-	UN0190	II	-	113	None	62	None	Forbidden	Forbidden	E	12E
-	*Sand acid, see* Fluorosilicic acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Seed cake, *containing vegetable oil solvent extractions and expelled seeds, with not more than 10 percent of oil and when the amount of moisture is higher than 11 percent, with not more than 20 percent of oil and moisture combined.*	4.2	UN1386	III	None	N7	None	213	241	Forbidden	Forbidden	A	13
I	Seed cake *with more than 1.5 percent oil and not more than 11 percent moisture*	4.2	UN1386	III	None	N7	None	213	241	Forbidden	Forbidden	E	13
I	Seed cake *with not more than 1.5 percent oil and not more than 11 percent moisture*	4.2	UN2217	III	None	N7	None	213	241	Forbidden	Forbidden	A	13
-	Selenates *or* Selenites	6.1	UN2630	I	6.1	-	None	211	242	5 kg	50 kg	E	-
-	Selenic acid	8	UN1905	I	8	N34	None	211	242	Forbidden	25 kg	A	-
-	Selenium compound, n.o.s	6.1	UN3283	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	T14	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Selenium disulfide	6.1	UN2657	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Selenium hexafluoride	2.3	UN2194	-	2.3, 8	1	None	302	None	Forbidden	Forbidden	D	40
-	*Selenium nitride*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
D	Selenium oxide	6.1	NA2811	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	Selenium oxychloride	8	UN2879	I	8, 6.1	A3, A6, A7, N34, T12, T27	None	201	243	0.5 L	2.5 L	E	40
-	*Self-defense spray, aerosol, see* Aerosols, etc	-	-	-	-	-	-	-	-	-	-	-	-
+AD	Self-defense spray, non-pressurized	9	NA3334	III	9	A37	155	203	None	No limit	No limit	A	-
G	Self-heating liquid, corrosive, inorganic, n.o.s	4.2	UN3188	II	4.2, 8	-	None	202	243	1 L	5 L	C	-
-	-	-	-	III	4.2, 8	-	None	203	241	5 L	60 L	C	-
G	Self-heating liquid, corrosive, organic, n.o.s	4.2	UN3185	II	4.2, 8	-	None	202	243	1 L	5 L	C	-
-	-	-	-	III	4.2, 8	-	None	203	241	5 L	60 L	C	-
G	Self-heating liquid, inorganic, n.o.s	4.2	UN3186	II	4.2	-	None	202	242	1 L	5 L	C	-
-	-	-	-	III	4.2	-	None	203	241	5 L	60 L	C	-
G	Self-heating liquid, organic, n.o.s	4.2	UN3183	II	4.2	-	None	202	242	1 L	5 L	C	-
-	-	-	-	III	4.2	-	None	203	241	5 L	60 L	C	-
G	Self-heating liquid, toxic, inorganic, n.o.s	4.2	UN3187	II	4.2, 6.1	-	None	202	243	1 L	5 L	C	-
-	-	-	-	III	4.2, 6.1	-	None	203	241	5 L	60 L	C	-
G	Self-heating liquid, toxic, organic, n.o.s	4.2	UN3184	II	4.2, 6.1	-	None	202	243	1 L	5 L	C	-
-	-	-	-	III	4.2, 6.1	-	None	203	241	5 L	60 L	C	-
G	Self-heating solid, corrosive, inorganic, n.o.s	4.2	UN3192	II	4.2, 8	-	None	212	242	15 kg	50 kg	C	-

-	-	-	-	III	4.2, 8	-	None	213	242	25 kg	100 kg	C	-
G	Self-heating, solid, corrosive, organic, n.o.s	4.2	UN3126	II	4.2, 8	-	None	212	242	15 kg	50 kg	C	-
-	-	-	-	III	4.2, 8	-	None	213	242	25 kg	100 kg	C	-
G	Self-heating solid, inorganic, n.o.s	4.2	UN3190	II	4.2	-	None	212	241	15 kg	50 kg	C	-
-	-	-	-	III	4.2	-	None	213	241	25 kg	100 kg	C	-
G	Self-heating, solid, organic, n.o.s	4.2	UN3088	II	4.2	B101	None	212	241	15 kg	50 kg	C	-
-	-	-	-	III	4.2	B101	None	213	241	25 kg	100 kg	C	-
G	Self-heating, solid, oxidizing, n.o.s	4.2	UN3127	-	4.2, 5.1	-	None	214	214	Forbidden	Forbidden	-	-
G	Self-heating solid, toxic, inorganic, n.o.s	4.2	UN3191	II	4.2, 6.1	-	None	212	242	15 kg	50 kg	C	-
-	-	-	-	III	4.2, 6.1	-	None	213	242	25 kg	100 kg	C	-
G	Self-heating, solid, toxic, organic, n.o.s	4.2	UN3128	II	4.2, 6.1	-	None	212	242	15 kg	50 kg	C	-
-	-	-	-	III	4.2, 6.1	-	None	213	242	25 kg	100 kg	C	-
-	*Self-propelled vehicle, see* Engines *or* Batteries *etc*	-	-	-	-	-	-	-	-	-	-	-	-
G	Self-reactive liquid type B	4.1	UN3221	II	4.1	53	None	224	None	Forbidden	Forbidden	D	61
G	Self-reactive liquid type B, temperature controlled	4.1	UN3231	II	4.1	53	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive liquid type C	4.1	UN3223	II	4.1	-	None	224	None	5 L	10 L	D	61
G	Self-reactive liquid type C, temperature controlled	4.1	UN3233	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive liquid type D	4.1	UN3225	II	4.1	-	None	224	None	5 L	10 L	D	61
G	Self-reactive liquid type D, temperature controlled	4.1	UN3235	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive liquid type E	4.1	UN3227	II	4.1	-	None	224	None	10 L	25 L	D	61
G	Self-reactive liquid type E, temperature controlled	4.1	UN3237	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive liquid type F	4.1	UN3229	II	4.1	-	None	224	None	10 L	25 L	D	61
G	Self-reactive liquid type F, temperature controlled	4.1	UN3239	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive solid type B	4.1	UN3222	II	4.1	53	None	224	None	Forbidden	Forbidden	D	61
G	Self-reactive solid type B, temperature controlled	4.1	UN3232	II	4.1	53	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive solid type C	4.1	UN3224	II	4.1	-	None	224	None	5 kg	10 kg	D	61
G	Self-reactive solid type C, temperature controlled	4.1	UN3234	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive solid type D	4.1	UN3226	II	4.1	-	None	224	None	5 kg	10 kg	D	61
G	Self-reactive solid type D, temperature controlled	4.1	UN3236	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive solid type E	4.1	UN3228	II	4.1	-	None	224	None	10 kg	25 kg	D	61
G	Self-reactive solid type E, temperature controlled	4.1	UN3238	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
G	Self-reactive solid type F	4.1	UN3230	II	4.1	-	None	224	None	10 kg	25 kg	D	61
G	Self-reactive solid type F, temperature controlled	4.1	UN3240	II	4.1	-	None	224	None	Forbidden	Forbidden	D	2, 61
-	Shale oil	3	UN1288	I	3	T7	None	201	243	1 L	30 L	B	-
-	-	-	-	II	3	T7, T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Shaped charges, commercial, see* Charges, shaped, commercial *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Signal devices, hand	1.4G	UN0191	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Signal devices, hand	1.4S	UN0373	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Signals, distress, *ship*	1.1G	UN0194	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Signals, distress, *ship*	1.3G	UN0195	II	1.3G	-	None	62	None	Forbidden	75 kg	B	-
-	*Signals, highway, see* Signal devices, hand; Fireworks, type D	-	-	-	-	-	-	-	-	-	-	-	-

-	Signals, railway track, explosive	1.1G	UN0192	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Signals, railway track, explosive	1.4S	UN0193	II	1.4S	-	None	62	None	25 kg	100 kg	A	-
-	Signals, railway track, explosive	1.3G	UN0492	-	1.3G	-	None	62	None	Forbidden	Forbidden	E	1E, 8E
-	Signals, railway track, explosive	1.4G	UN0493	-	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	*Signals, ship distress, water-activated, see* Contrivances, water-activated, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Signals, smoke	1.1G	UN0196	II	1.1G	-	None	62	None	Forbidden	Forbidden	B	-
-	Signals, smoke	1.4G	UN0197	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	Signals, smoke	1.2G	UN0313	II	1.2G	-	None	62	None	Forbidden	Forbidden	B	-
-	Signals, smoke	1.3G	UN0487	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Silane, compressed	2.1	UN2203	-	2.1	-	None	302	None	Forbidden	Forbidden	E	40, 57, 104
-	*Silicofluoric acid, see* Fluorosilicic acid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Silicon chloride, see* Silicon tetrachloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Silicon powder, amorphous	4.1	UN1346	III	4.1	A1	None	213	240	25 kg	100 kg	A	-
-	Silicon tetrachloride	8	UN1818	II	8	A3, A6, B2, B6, T18, T26, T29	154	202	242	1 L	30 L	C	40
-	Silicon tetrafluoride, compressed	2.3	UN1859	-	2.3, 8	2	None	302	None	Forbidden	Forbidden	D	40
-	*Silver acetylide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Silver arsenite	6.1	UN1683	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	*Silver azide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Silver chlorite (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Silver cyanide	6.1	UN1684	II	6.1	-	None	212	242	25 kg	100 kg	A	26, 40
-	*Silver fulminate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Silver nitrate	5.1	UN1493	II	5.1	-	152	212	242	5 kg	25 kg	A	-
-	*Silver oxalate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Silver picrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Silver picrate, wetted *with not less than 30 percent water, by mass*	4.1	UN1347	I	4.1	-	None	211	None	Forbidden	Forbidden	D	28, 36
-	Sludge, acid	8	UN1906	II	8	A3, A7, B2, N34, T9, T27	None	202	242	Forbidden	30 L	C	14
D	Smokeless powder for small arms (*100 pounds or less*)	4.1	NA3178	I	4.1	16	None	171	None	Forbidden	7.3 kg	A	-
-	Soda lime *with more than 4 percent sodium hydroxide*	8	UN1907	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Sodium	4.3	UN1428	I	4.3	A7, A8, A19, A20, B9, B48, B68, N34, T15, T29, T46	None	211	244	Forbidden	15 kg	D	-
-	Sodium aluminate, solid	8	UN2812	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Sodium aluminate, solution	8	UN1819	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	T7	154	203	241	5 L	60 L	A	-
-	Sodium aluminum hydride	4.3	UN2835	II	4.3	A8, A19, A20, B100	151	212	242	Forbidden	50 kg	E	-
-	Sodium ammonium vanadate	6.1	UN2863	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Sodium arsanilate	6.1	UN2473	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Sodium arsenate	6.1	UN1685	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Sodium arsenite, aqueous solutions	6.1	UN1686	II	6.1	T15	None	202	243	5 L	60 L	A	-
-	-	-	-	III	6.1	T15	153	203	241	60 L	220 L	A	-
-	Sodium arsenite, solid	6.1	UN2027	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Sodium azide	6.1	UN1687	II	6.1	-	None	212	242	25 kg	100 kg	A	36, 52, 91
-	*Sodium bifluoride, see* Sodium hydrogendifluoride	-	-	-	-	-	-	-	-	-	-	-	-
-	*Sodium bisulfite, solution, see* Bisulfites, aqueous solutions, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium borohydride	4.3	UN14	I	4.3	B100, N40	Non	211	242	Forbidden	15 kg	E	-

			26				e						
-	Sodium borohydride and sodium hydroxide solution, *with not more than 12 percent sodium borohydride and not more than 40 percent sodium hydroxide by mass*	8	UN33 20	II	8	B2, N34, T8	154	202	242	1 L	30 L	A	26
-	-	-	-	III	8	B2, N34, T7	154	203	241	5 L	60 L	A	-
-	Sodium bromate	5.1	UN14 94	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Sodium cacodylate	6.1	UN16 88	II	6.1	-	Non e	212	242	25 kg	100 kg	A	26
-	Sodium chlorate	5.1	UN14 95	II	5.1	A9, N34, T8	152	212	240	5 kg	25 kg	A	56, 58, 106
-	Sodium chlorate, aqueous solution	5.1	UN24 28	II	5.1	A2, B6, T8	152	202	241	1 L	5 L	B	56, 58, 106
-	-	-	-	III	5.1	A2, T8	152	203	241	2.5 L	30 L	B	56, 58, 69, 106
-	*Sodium chlorate mixed with dinitrotoluene, see* Explosive blasting, type C	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium chlorite	5.1	UN14 96	II	5.1	A9, N34, T8	Non e	212	242	5 kg	25 kg	A	56, 58, 106
-	Sodium chloroacetate	6.1	UN26 59	III	6.1	-	153	213	240	100 kg	200 kg	A	-
-	Sodium cuprocyanide, solid	6.1	UN23 16	I	6.1	-	Non e	211	242	5 kg	50 kg	A	26
-	Sodium cuprocyanide, solution	6.1	UN23 17	I	6.1	T8, T26	Non e	201	243	1 L	30 L	B	26, 40
-	Sodium cyanide	6.1	UN16 89	I	6.1	B69, B77, N74, N75, T42	Non e	211	242	5 kg	50 kg	B	52
-	*Sodium dichloroisocyanurate or Sodium dichloro-s-triazinetrione, see* Dichloroisocyanuric acid *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium dinitro-o-cresolate, *dry or wetted with less than 15 percent water, by mass*	1.3C	UN02 34	II	1.3 C	-	Non e	62	Non e	Forbidden	Forbidden	B	1E, 5E
-	Sodium dinitro-o-cresolate, wetted *with not less than 15 percent water, by mass*	4.1	UN13 48	I	4.1, 6.1	23, A8, A19, A20, N41	Non e	211	Non e	1 kg	15 kg	E	28, 36
-	Sodium dithionite *or* Sodium hydrosulfite	4.2	UN13 84	II	4.2	A19, A20, B106	Non e	212	241	15 kg	50 kg	E	13
-	Sodium fluoride	6.1	UN16 90	III	6.1	T8	153	213	240	100 kg	200 kg	A	26
-	Sodium fluoroacetate	6.1	UN26 29	I	6.1	-	Non e	211	242	5 kg	50 kg	E	-
-	Sodium fluorosilicate	6.1	UN26 74	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	*Sodium hydrate, see* Sodium hydroxide, solid	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium hydride	4.3	UN14 27	I	4.3	A19, B100, N40	Non e	211	242	Forbidden	15 kg	E	-
-	Sodium hydrogendifluoride, *solid*	8	UN24 39	II	8	B106, N3, N34	154	212	240	15 kg	50 kg	A	12, 25, 26, 40
-	Sodium hydrogendifluoride *solution*	8	UN24 39	II	8	N3, N34	154	202	242	1 L	30 L	A	12, 25, 26, 40
D	Sodium hydrosulfide, solution	8	NA29 22	II	8, 6.1	B2	154	202	243	1 L	30 L	B	40, 95
-	Sodium hydrosulfide, *with less than 25 percent water of crystallization*	4.2	UN23 18	II	4.2	A7, A19, A20	Non e	212	241	15 kg	50 kg	A	-
-	Sodium hydrosulfide *with not less than 25 percent water of crystallization*	8	UN29 49	II	8	A7	154	212	240	15 kg	50 kg	A	26
-	Sodium hydrosulfite, *see* Sodium dithionite	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium hydroxide, solid	8	UN18 23	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Sodium hydroxide solution	8	UN18 24	II	8	B2, N34, T8	154	202	242	1 L	30 L	A	-
-	-	-	-	III	8	N34, T7	154	203	241	5 L	60 L	A	-
-	*Sodium hypochlorite, solution, see* Hypochlorite solutions *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Sodium metal, liquid alloy, see* Alkali metal alloys, liquid, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Sodium methylate	4.2	UN14 31	II	4.2, 8	A19	Non e	212	242	15 kg	50 kg	B	-
-	Sodium methylate solutions *in alcohol*	3	UN12 89	II	3, 8	T8, T31	Non e	202	243	1 L	5 L	B	-
-	-	-	-	III	3, 8	B1, T7, T30	150	203	242	5 L	60 L	A	-
-	Sodium monoxide	8	UN18 25	II	8	-	154	212	240	15 kg	50 kg	A	-
-	Sodium nitrate	5.1	UN14 98	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-

-	Sodium nitrate and potassium nitrate mixtures	5.1	UN1499	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Sodium nitrite	5.1	UN1500	III	5.1, 6.1	A1, A29	152	213	240	25 kg	100 kg	A	56, 58
-	Sodium pentachlorophenate	6.1	UN2567	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Sodium perchlorate	5.1	UN1502	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Sodium permanganate	5.1	UN1503	II	5.1	-	152	212	242	5 kg	25 kg	D	56, 58, 69, 106, 107
-	Sodium peroxide	5.1	UN1504	I	5.1	A20, N34	None	211	None	Forbidden	15 kg	B	13, 75, 106
-	Sodium peroxoborate, anhydrous	5.1	UN3247	II	5.1	-	152	212	240	5 kg	25 kg	A	13, 25, 106
-	Sodium persulfate	5.1	UN1505	III	5.1	A1	152	213	240	25 kg	100 kg	A	-
-	Sodium phosphide	4.3	UN1432	I	4.3, 6.1	A19, N40	None	211	None	Forbidden	15 kg	E	40, 85
-	Sodium picramate, *dry or wetted with less than 20 percent water, by mass*	1.3C	UN0235	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Sodium picramate, wetted *with not less than 20 percent water, by mass*	4.1	UN1349	I	4.1	23, A8, A19, N41	None	211	None	Forbidden	15 kg	E	28, 36
-	*Sodium picryl peroxide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Sodium potassium alloys, see* Potassium sodium alloys	-	-	-	-	-	-	-	-	-	-	-	-
-	*Sodium selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	-
D	Sodium selenite	6.1	NA2630	II	6.1	-	None	212	242	25 kg	100 kg	E	-
-	Sodium sulfide, anhydrous *or* Sodium sulfide *with less than 30 percent water of crystallization*	4.2	UN1385	II	4.2	A19, A20, B106, N34	None	212	241	15 kg	50 kg	A	-
-	Sodium sulfide, hydrated *with not less than30 percent water*	8	UN1849	II	8	T8	154	212	240	15 kg	50 kg	A	26
-	Sodium superoxide	5.1	UN2547	I	5.1	A20, N34	None	211	None	Forbidden	15 kg	E	13, 75, 106
-	*Sodium tetranitride*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
G	Solids containing corrosive liquid, n.o.s	8	UN3244	II	8	49	154	212	240	15 kg	50 kg	B	40
G	Solids containing flammable liquid, n.o.s	4.1	UN3175	II	4.1	47	151	212	240	15 kg	50 kg	B	-
G	Solids containing toxic liquid, n.o.s	6.1	UN3243	II	6.1	48	None	212	240	25 kg	100 kg	B	40
-	Sounding devices, explosive	1.2F	UN0204	II	1.2F	-	None	62	None	Forbidden	Forbidden	E	-
-	Sounding devices, explosive	1.1F	UN0296	II	1.1F	-	None	62	None	Forbidden	Forbidden	E	-
-	Sounding devices, explosive	1.1D	UN0374	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	-
-	Sounding devices, explosive	1.2D	UN0375	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	-
-	*Spirits of salt, see* Hydrochloric acid	-	-	-	-	-	-	-	-	-	-	-	-
-	*Squibs, see* Igniters *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Stannic chloride, anhydrous	8	UN1827	II	8	B2, T8, T26	154	202	242	1 L	30 L	C	-
-	Stannic chloride, pentahydrate	8	UN2440	III	8	-	154	213	240	25 kg	100 kg	A	-
-	Stannic phosphide	4.3	UN1433	I	4.3, 6.1	A19, B100, N40	None	211	242	Forbidden	15 kg	E	40, 85
-	*Steel swarf, see* Ferrous metal borings, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Stibine	2.3	UN2676	-	2.3, 2.1	1	None	304	None	Forbidden	Forbidden	D	40
-	*Storage batteries, wet, see* Batteries, *wet etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Strontium arsenite	6.1	UN1691	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Strontium chlorate	5.1	UN1506	II	5.1	A1, A9, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Strontium nitrate	5.1	UN1507	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	-
-	Strontium perchlorate	5.1	UN1508	II	5.1	-	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Strontium peroxide	5.1	UN1509	II	5.1	-	152	212	242	5 kg	25 kg	A	13, 75,

													106
-	Strontium phosphide	4.3	UN2013	I	4.3, 6.1	A19, N40	None	211	None	Forbidden	15 kg	E	40, 85
-	Strychnine *or* Strychnine salts	6.1	UN1692	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	Styphnic acid, *see* Trinitroresorcinol, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Styrene monomer, inhibited	3	UN2055	III	3	B1, T1	150	203	242	60 L	220 L	A	-
G	Substances, explosive, n.o.s	1.1L	UN0357	II	1.1L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Substances, explosive, n.o.s	1.2L	UN0358	II	1.2L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Substances, explosive, n.o.s	1.3L	UN0359	II	1.3L	101	None	62	None	Forbidden	Forbidden	E	2E, 8E, 11E, 17E
G	Substances, explosive, n.o.s	1.1A	UN0473	II	1.1A	101, 111	None	62	None	Forbidden	Forbidden	E	2E, 6E
G	Substances, explosive, n.o.s	1.1C	UN0474	II	1.1C	101	None	62	None	Forbidden	Forbidden	B	1E, 5E
G	Substances, explosive, n.o.s	1.1D	UN0475	II	1.1D	101	None	62	None	Forbidden	Forbidden	B	1E, 5E
G	Substances, explosive, n.o.s	1.1G	UN0476	II	1.1G	101	None	62	None	Forbidden	Forbidden	E	1E, 8E
G	Substances, explosive, n.o.s	1.3C	UN0477	II	1.3C	101	None	62	None	Forbidden	Forbidden	B	1E, 5E
G	Substances, explosive, n.o.s	1.3G	UN0478	II	1.3G	101	None	62	None	Forbidden	Forbidden	E	1E, 8E
G	Substances, explosive, n.o.s	1.4C	UN0479	II	1.4C	101	None	62	None	Forbidden	75 kg	A	1E, 5E
G	Substances, explosive, n.o.s	1.4D	UN0480	II	1.4D	101	None	62	None	Forbidden	75 kg	A	1E, 5E, 24E
G	Substances, explosive, n.o.s	1.4S	UN0481	II	1.4S	101	None	62	None	25 kg	75 kg	A	-
G	Substances, explosive, n.o.s	1.4G	UN0485	II	1.4G	101	None	62	None	Forbidden	75kg	E	1E, 8E
G	Substances, explosive, very insensitive, n.o.s., *or* Substances, EVI, n.o.s	1.5D	UN0482	II	1.5D	101	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Substituted nitrophenol pesticides, liquid, flammable, toxic, *flash point less than 23 degrees C*	3	UN2780	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Substituted nitrophenol pesticides, liquid, toxic	6.1	UN3014	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Substituted nitrophenol pesticides, liquid, toxic, flammable *flashpoint not less than 23 degrees C*	6.1	UN3013	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	B1, T14	153	203	242	60 L	220 L	A	40
-	Substituted nitrophenol pesticides, solid, toxic	6.1	UN2779	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Sucrose octanitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Sulfamic acid	8	UN2967	III	8	-	154	213	240	25 kg	100 kg	A	-
D	Sulfur	9	NA1350	III	9	30	None	None	240	No limit	No limit	A	19, 74
I	Sulfur	4.1	UN1350	III	9	30, T1	None	None	240	No limit	No limit	A	19, 74
-	*Sulfur and chlorate, loose mixtures of*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Sulfur chlorides	8	UN1828	I	8	5, A3, B10, B77, N34, T18, T27	None	201	243	Forbidden	2.5 L	C	40
-	*Sulfur dichloride, see* Sulfur chlorides	-	-	-	-	-	-	-	-	-	-	-	-
-	Sulfur dioxide	2.3	UN1079	-	2.3, 8	3, B14	None	304	314, 315	Forbidden	25 kg	D	40
-	*Sulfur dioxide solution, see* Sulfurous acid	-	-	-	-	-	-	-	-	-	-	-	-
-	Sulfur hexafluoride	2.2	UN1080	-	2.2	-	306	304	314,	75 kg	150 kg	A	-

									315				
D	Sulfur, molten	9	NA2448	III	9	T9, T38	None	213	247	Forbidden	Forbidden	C	61
I	Sulfur, molten	4.1	UN2448	III	4.1	T9, T38	None	213	247	Forbidden	Forbidden	C	61
-	Sulfur tetrafluoride	2.3	UN2418	-	2.3, 8	1	None	302	245	Forbidden	Forbidden	D	40
+	Sulfur trioxide, inhibited *or* Sulfur trioxide, stabilized	8	UN1829	I	8, 6.1	2, A7, B9, B14, B32, B49, B74, B77, N34, T38, T43, T45	None	227	244	Forbidden	25 kg	A	40
+, D	Sulfur trioxide, uninhibited	8	NA1829	I	8, 6.1	2, A7, B9, B14, B32, B49, B74, B77, N34, T38, T43, T45	None	227	244	Forbidden	25 kg	C	10, 40
-	*Sulfuretted hydrogen, see* Hydrogen sulfide, liquefied	-	-	-	-	-	-	-	-	-	-	-	-
-	Sulfuric acid, fuming *with less than 30 percent free sulfur trioxide*	8	UN1831	I	8	A3, A7, B84, N34, T18, T27	None	201	243	Forbidden	2.5 L	C	14, 40
+	Sulfuric acid, fuming *with 30 percent or more free sulfur trioxide*	8	UN1831	I	8, 6.1	2, A3, A6, A7, B9, B14, B32, B74, B77, B84, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	C	14, 40
-	Sulfuric acid, spent	8	UN1832	II	8	A3, A7, B2, B83, B84, N34, T9, T27	None	202	242	Forbidden	30 L	C	14
-	Sulfuric acid *with more than 51 percent acid*	8	UN1830	II	8	A3, A7, B3, B83, B84, N34, T9, T27	154	202	242	1 L	30 L	C	14
-	Sulfuric acid *with not more than 51% acid*	8	UN2796	II	8	A3, A7, B2, B15, N6, N34, T9, T27	154	202	242	1 L	30 L	B	-
-	Sulfuric and hydrofluoric acid mixtures, *see* Hydrofluoric and sulfuric acid mixtures	-	-	-	-	-	-	-	-	-	-	-	-
-	*Sulfuric anhydride, see* Sulfur trioxide, inhibited	-	-	-	-	-	-	-	-	-	-	-	-
-	Sulfurous acid	8	UN1833	II	8	B3, T8	154	202	242	1 L	30 L	B	40
+	Sulfuryl chloride	8	UN1834	I	8, 6.1	1, A3, B6, B9, B10, B14, B30, B74, B77, N34, T38, T43, T44	None	226	244	Forbidden	Forbidden	C	40
-	Sulfuryl fluoride	2.3	UN2191	-	2.3	4	None	304	314, 315	Forbidden	25 kg	D	40
-	Tars, liquid *including road asphalt and oils, bitumen and cut backs*	3	UN1999	II	3	B13, T7, T30	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, B13, T7, T30	150	203	242	60 L	220 L	A	-
-	Tear gas candles	6.1	UN1700	II	6.1, 4.1	-	None	340	None	Forbidden	50 kg	D	40
-	*Tear gas cartridges, see* Ammunition, tear-producing, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
D	Tear gas devices *with more than 2 percent tear gas substances, by mass*	6.1	NA1693	I	6.1	-	None	340	None	Forbidden	Forbidden	D	40
-	-	-	-	II	6.1	-	None	340	None	Forbidden	Forbidden	D	40
-	*Tear gas devices, with not more than 2 percent tear gas substances, by mass, see* Aerosols, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	*Tear gas grenades, see* Tear gas candles	-	-	-	-	-	-	-	-	-	-	-	-
G	Tear gas substances, liquid, n.o.s	6.1	UN1693	I	6.1	-	None	201	None	Forbidden	Forbidden	D	40
-	-	-	-	II	6.1	-	None	202	None	Forbidden	5 L	D	40
G	Tear gas substances, solid, n.o.s	6.1	UN1693	I	6.1	-	None	211	None	Forbidden	Forbidden	D	40
-	-	-	-	II	6.1	-	None	212	None	Forbidden	25 kg	D	40
-	Tellurium compound, n.o.s	6.1	UN3284	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	T14	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Tellurium hexafluoride	2.3	UN2195	-	2.3, 8	1	None	302	None	Forbidden	Forbidden	D	40
-	Terpene hydrocarbons, n.o.s	3	UN2319	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Terpinolene	3	UN2541	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Tetraazido benzene quinone*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetrabromoethane	6.1	UN2504	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Tetrachloroethane	6.1	UN17	II	6.1	N36, T14	Non	202	243	5 L	60 L	A	40

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-	Tetrachloroethylene	6.1	UN1897	III	6.1	N36, T1	153	203	241	60 L	220 L	A	40
-	Tetraethyl dithiopyrophosphate	6.1	UN1704	II	6.1	-	None	212	242	25 kg	100 kg	D	40
D	Tetraethyl lead, liquid	6.1	NA1649	I	6.1, 3	-	None	201	None	Forbidden	Forbidden	E	40
D	Tetraethyl pyrophosphate, *liquid*	6.1	NA3018	I	6.1	-	None	201	243	Forbidden	1 L	A	40
D	Tetraethyl pyrophosphate *solid*	6.1	NA2783	I	6.1	N77	None	211	242	Forbidden	50 kg	A	40
-	Tetraethyl silicate	3	UN1292	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	*Tetraethylammonium perchlorate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetraethylenepentamine	8	UN2320	III	8	T2	154	203	241	5 L	60 L	A	-
-	1,1,1,2-Tetrafluoroethane *or* Refrigerant gas R 134a	2.2	UN3159	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Tetrafluoroethylene, inhibited	2.1	UN1081	-	2.1	-	306	304	None	Forbidden	150 kg	E	40
-	Tetrafluoromethane, compressed *or* Refrigerant gas R 14	2.2	UN1982	-	2.2	-	None	302	None	75 kg	150 kg	A	-
-	1,2,3,6-Tetrahydrobenzaldehyde	3	UN2498	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Tetrahydrofuran	3	UN2056	II	3	T8	None	202	242	5 L	60 L	B	-
-	Tetrahydrofurfurylamine	3	UN2943	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Tetrahydrophthalic anhydrides *with more than 0.05 percent of maleic anhydride*	8	UN2698	III	8	-	154	213	240	25 kg	100 kg	A	-
-	1,2,3,6-Tetrahydropyridine	3	UN2410	II	3	T8	150	202	242	5 L	60 L	B	-
-	Tetrahydrothiophene	3	UN2412	II	3	T7	150	202	242	5 L	60 L	B	-
-	Tetramethylammonium hydroxide	8	UN1835	II	8	B2, T8	154	202	242	1 L	30 L	A	-
-	*Tetramethylene diperoxide dicarbamide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetramethylsilane	3	UN2749	I	3	T21, T26	None	201	243	Forbidden	30 L	D	-
-	*Tetranitro diglycerin*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetranitroaniline	1.1D	UN0207	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
+	Tetranitromethane	5.1	UN1510	I	5.1, 6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	None	Forbidden	Forbidden	D	40, 66, 106
-	*2,3,4,6-Tetranitrophenol*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,3,4,6-Tetranitrophenyl methyl nitramine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,3,4,6-Tetranitrophenylnitramine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Tetranitroresorcinol (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,3,5,6-Tetranitroso-1,4-dinitrobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,3,5,6-Tetranitroso nitrobenzene (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetrapropylorthotitanate	3	UN2413	III	3	B1, T8	150	203	242	60 L	220 L	A	-
-	Tetrazene, *see* Guanyl nitrosaminoguanyltetrazene	-	-	-	-	-	-	-	-	-	-	-	-
-	*Tetrazine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetrazol-1-acetic acid	1.4C	UN0407	II	1.4C	-	None	62	None	Forbidden	75 kg	A	1E, 5E, 24E
-	*Tetrazolyl azide (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tetryl, *see* Trinitrophenylmethylnitramine	-	-	-	-	-	-	-	-	-	-	-	-
-	Thallium chlorate	5.1	UN2573	II	5.1, 6.1	-	None	212	242	5 kg	25 kg	A	56, 58, 106
-	Thallium compounds, n.o.s	6.1	UN1707	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Thallium nitrate	6.1	UN2727	II	6.1, 5.1	-	None	212	242	5 kg	25 kg	A	-
D	Thallium sulfate, solid	6.1	NA1707	II	6.1	-	None	212	242	5 kg	50 kg	A	-
-	4-Thiapentanal	6.1	UN2785	III	6.1	T8	153	203	241	60 L	220 L	D	25, 49
-	Thioacetic acid	3	UN2436	II	3	T8	150	202	242	5 L	60 L	B	-
-	Thiocarbamate pesticide, liquid, flammable, toxic, *flash*	3	UN27	I	3,	-	Non	201	243	Forbidden	30 L	B	40

	point less than 23 degrees C		72		6.1		e						
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Thiocarbamate pesticides, liquid, flammable, toxic, *flash point not less than 23 degrees C*	6.1	UN3005	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	T13	153	203	242	60 L	220 L	A	40
-	Thiocarbamate pesticide, liquid, toxic	6.1	UN3006	I	6,1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Thiocarbamate pesticides, solid, toxic	6.1	UN2771	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	*Thiocarbonylchloride, see* Thiophosgene	-	-	-	-	-	-	-	-	-	-	-	-
-	Thioglycol	6.1	UN2966	II	6.1	T8	None	202	243	5 L	60 L	A	-
-	Thioglycolic acid	8	UN1940	II	8	A7, B2, N34, T8	154	202	242	1 L	30 L	A	-
-	Thiolactic acid	6.1	UN2936	II	6.1	T8	None	212	242	25 kg	100 kg	A	-
-	Thionyl chloride	8	UN1836	I	8	A7, B6, B10, N34, T18, T27	None	201	243	Forbidden	Forbidden	C	40
-	Thiophene	3	UN2414	II	3	B101, T2	150	202	242	5 L	60 L	B	40
+	Thiophosgene	6.1	UN2474	II	6.1	2, A7, B9, B14, B32, B74, N33, N34, T38, T43, T45	None	227	244	Forbidden	60 L	B	26, 40
-	Thiophosphoryl chloride	8	UN1837	II	8	A3, A7, B2, B8, B25, B101, N34, T12	None	202	242	Forbidden	30 L	C	40
-	Thiourea dioxide	4.2	UN3341	II	4.2	-	None	212	241	15 kg	50 kg	D	-
-	-	-	-	III	4.2	-	None	213	241	25 kg	100 kg	D	-
-	Thorium metal, pyrophoric	7	UN2975	-	7, 4.2	-	None	418	None	Forbidden	Forbidden	D	-
-	Thorium nitrate, solid	7	UN2976	-	7, 5.1	-	None	419	None	Forbidden	15 kg	A	-
-	*Tin chloride, fuming, see* Stannic chloride, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	*Tin perchloride or Tin tetrachloride, see* Stannic chloride, anhydrous	-	-	-	-	-	-	-	-	-	-	-	-
-	Tinctures, medicinal	3	UN1293	II	3	T8, T31	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	*Tinning flux, see* Zinc chloride	-	-	-	-	-	-	-	-	-	-	-	-
-	Titanium disulphide	4.2	UN3174	III	4.2	-	None	213	241	25 kg	100 kg	A	-
-	Titanium hydride	4.1	UN1871	II	4.1	A19, A20, N34	None	212	241	15 kg	50 kg	E	-
-	Titanium powder, dry	4.2	UN2546	I	4.2	-	None	211	242	Forbidden	Forbidden	D	-
-	-	-	-	II	4.2	A19, A20, N5, N34	None	212	241	15 kg	50 kg	D	-
-	-	-	-	III	4.2	-	None	213	241	25 kg	100 kg	D	-
-	Titanium powder, wetted *with not less than 25 percent water (a visible excess of water must be present) (a) mechanically produced, particle size less than 53 microns; (b) chemically produced, particle size less than 840 microns*	4.1	UN1352	II	4.1	A19, A20, N34	None	212	240	15 kg	50 kg	E	-
-	Titanium sponge granules *or* Titanium sponge powders	4.1	UN2878	III	4.1	A1	None	213	240	25 kg	100 kg	D	-
D	Titanium sulfate solution	8	NA1760	II	8	B2, B15	None	202	242	1 L	30 L	B	40
+	Titanium tetrachloride	8	UN1838	II	8, 6.1	2, A3, A6, B7, B9, B14, B32, B74, B77, T38, T43, T45	None	227	244	Forbidden	30 L	C	40
-	Titanium trichloride mixtures	8	UN2869	II	8	A7, B106, N34	154	212	240	15 kg	50 kg	A	40
-	-	-	-	III	8	A7, N34	154	213	240	25 kg	100 kg	A	40
-	Titanium trichloride, pyrophoric *or* Titanium trichloride mixtures, pyrophoric	4.2	UN2441	I	4.2, 8	A7, A8, A19, A20, N34	None	181	244	Forbidden	Forbidden	D	40

-	*TNT mixed with aluminum,* see *Tritonal*	-	-	-	-	-	-	-	-	-	-	-	-
-	TNT, *see* Trinitrotoluene, *etc*	-	-	-	-	-	-	-	-	-	-	-	-
-	Toluene	3	UN1294	II	3	T1	150	202	242	5 L	60 L	B	-
+	Toluene diisocyanate	6.1	UN2078	II	6.1	B110, T14	None	202	243	5 L	60 L	D	25, 40
-	*Toluene sulfonic acid, see* Alkyl, *or* Aryl sulfonic acid *etc*	-	-	-	-	-	-	-	-	-	-	-	-
+	Toluidines *liquid*	6.1	UN1708	II	6.1	T14	None	202	243	5 L	60 L	A	-
+	Toluidines *solid*	6.1	UN1708	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	2,4-Toluylenediamine *or* 2,4-Toluenediamine	6.1	UN1709	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Torpedoes, liquid fueled, *with inert head*	1.3J	UN0450	II	1.3J	-	-	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Torpedoes, liquid fueled, *with or without bursting charge*	1.1J	UN0449	II	1.1J	-	-	62	None	Forbidden	Forbidden	E	7E, 16E, 23E
-	Torpedoes *with bursting charge*	1.1E	UN0329	II	1.1E	-	-	62	None	Forbidden	Forbidden	B	-
-	Torpedoes *with bursting charge*	1.1F	UN0330	II	1.1F	-	-	62	None	Forbidden	Forbidden	B	-
-	Torpedoes *with bursting charge*	1.1D	UN0451	II	1.1D	-	-	62	None	Forbidden	Forbidden	B	-
G	Toxic liquid, corrosive, inorganic, n.o.s	6.1	UN3289	I and II	6.1, 8	T42	None	201	243	0.5 L	2.5 L	A	-
G	-	-	-	II	6.1, 8	T14	None	202	243	1 L	30 L	A	-
G	Toxic liquid, corrosive, inorganic, n.o.s. *Inhalation Hazard, Packing Group I, Zone A*	6.1	UN3289	I	6.1, 8	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	B	40
G	Toxic liquid, corrosive, inorganic, n.o.s. *Inhalation Hazard, Packing Group I, Zone B*	6.1	UN3289	I	6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	40
G	Toxic liquid, inorganic, n.o.s	6.1	UN3287	I	6.1	T42	None	201	243	1 L	30 L	A	-
G	-	-	-	II	6.1	B110, T14	None	202	243	5 L	60 L	A	-
G	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
G	Toxic liquid, inorganic, n.o.s. *Inhalation Hazard, Packing Group I, Zone A*	6.1	UN3287	I	6.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	B	40
G	Toxic liquid, inorganic, n.o.s. *Inhalation Hazard, Packing Group I, Zone B*	6.1	UN3287	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	B	40
G	Toxic liquids, corrosive, organic, n.o.s	6.1	UN2927	I	6.1, 8	T42	None	201	243	0.5 L	2.5 L	B	40
G	-	-	-	II	6.1, 8	T42	None	202	243	1 L	30 L	B	40
G	Toxic liquids, corrosive, organic, n.o.s., *inhalation hazard, Packing Group I, Zone A*	6.1	UN2927	I	6.1, 8	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic liquids, corrosive, organic, n.o.s., *inhalation hazard, Packing Group I, Zone B*	6.1	UN2927	I	6.1, 8	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic liquids, flammable, organic, n.o.s	6.1	UN2929	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
G	-	-	-	II	6.1, 3	T15	None	202	243	5 L	60 L	B	40
G	Toxic liquids, flammable, organic, n.o.s., *inhalation hazard, Packing Group I, Zone A*	6.1	UN2929	I	6.1, 3	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic liquids, flammable, organic, n.o.s., *inhalation hazard, Packing Group I, Zone B*	6.1	UN2929	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic, liquids, organic, n.o.s	6.1	UN2810	I	6.1	T42	None	201	243	1 L	30 L	B	40
G	-	-	-	II	6.1	B110, T14	None	202	243	5 L	60 L	B	40
G	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	40
G	Toxic, liquids, organic, n.o.s. *Inhalation hazard, Packing Group I, Zone A*	6.1	UN2810	I	6.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic, liquids, organic, n.o.s. *Inhalation hazard, Packing Group I, Zone B*	6.1	UN2810	I	6.1	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	20, 40, 95
G	Toxic liquids, oxidizing, n.o.s	6.1	UN3122	I	6.1, 5.1	A4	None	201	243	Forbidden	2.5 L	C	-
G	-	-	-	II	6.1, 5.1	-	None	202	243	1 L	5 L	C	-

G	Toxic liquids, oxidizing, n.o.s. *Inhalation hazard, Packing Group I, Zone A*	6.1	UN3122	I	6.1, 5.1	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	C	-
G	Toxic liquids, oxidizing, n.o.s. *Inhalation Hazard, Packing Group I, Zone B*	6.1	UN3122	I	6.1, 5.1	2, B9, B14, B32, T38, T43, T45	None	227	244	Forbidden	Forbidden	C	-
G	Toxic liquids, water-reactive, n.o.s	6.1	UN3123	I	6.1, 4.3	A4	None	201	243	Forbidden	1 L	E	40
G	-	-	-	II	6.1, 4.3	-	None	202	243	1 L	5 L	E	40
G	Toxic liquids, water-reactive, n.o.s. *Inhalation hazard, packing group I, Zone A*	6.1	UN3123	I	6.1, 4.3	1, B9, B14, B30, B72, T38, T43, T44	None	226	244	Forbidden	Forbidden	E	40
G	Toxic liquids, water-reactive, n.o.s. *Inhalation hazard, packing group I, Zone B*	6.1	UN3123	I	6.1, 4.3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	E	40
G	Toxic solid, corrosive, inorganic, n.o.s	6.1	UN3290	I	6.1, 8	-	None	211	242	1 kg	25 kg	A	-
-	-	-	-	II	6.1, 8	-	None	212	242	15 kg	50 kg	A	-
G	Toxic solid, inorganic, n.o.s	6.1	UN3288	I	6.1	-	None	211	242	5 kg	50 kg	A	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
G	Toxic solids, corrosive, organic, n.o.s	6.1	UN2928	I	6.1, 8	-	None	211	242	1 kg	25 kg	B	40
-	-	-	-	II	6.1, 8	-	None	212	242	15 kg	50 kg	B	40
G	Toxic solids, flammable, organic, n.o.s	6.1	UN2930	I	6.1, 4.1	B106	None	211	242	1 kg	15 kg	B	-
-	-	-	-	II	6.1, 4.1	B106	None	212	242	15 kg	50 kg	B	-
G	Toxic solids, organic, n.o.s	6.1	UN2811	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	-
G	Toxic solids, oxidizing, n.o.s	6.1	UN3086	I	6.1, 5.1	-	None	211	242	1 kg	15 kg	C	-
-	-	-	-	II	6.1, 5.1	-	None	212	242	15 kg	50 kg	C	-
G	Toxic solids, self-heating, n.o.s	6.1	UN3124	I	6.1, 4.2	A5, B100	None	211	242	5 kg	15 kg	D	40
-	-	-	-	II	6.1, 4.2	-	None	212	242	15 kg	50 kg	D	40
G	Toxic solids, water-reactive, n.o.s	6.1	UN3125	I	6.1, 4.3	A5, B100	None	211	242	5 kg	15 kg	D	40
-	-	-	-	II	6.1, 4.3	B101	None	212	242	15 kg	50 kg	D	40
D	Toy Caps	1.4S	NA0337	II	1.4S	-	None	62	None	25 kg	100 kg	A	9E
-	Tracers for ammunition	1.3G	UN0212	II	1.3G	-	None	62	None	Forbidden	Forbidden	B	-
-	Tracers for ammunition	1.4G	UN0306	II	1.4G	-	None	62	None	Forbidden	75 kg	A	24E
-	*Tractors, see* Vehicles, self propelled	-	-	-	-	-	-	-	-	-	-	-	-
-	*Tri-(b-nitroxyethyl) ammonium nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Triallyl borate	6.1	UN2609	III	6.1	-	153	203	241	60 L	220 L	A	13
-	Triallylamine	3	UN2610	III	3, 8	B1, T1	None	203	242	5 L	60 L	A	40
-	Triazine pesticides, flammable, toxic, *flash point less than 23 degrees C*	3	UN2764	I	3, 6.1	-	None	201	243	Forbidden	30 L	B	40
-	-	-	-	II	3, 6.1	-	None	202	243	1 L	60 L	B	40
-	Triazine pesticides, liquid, toxic	6.1	UN2998	I	6.1	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1	T14	153	203	241	60 L	220 L	A	40
-	Triazine pesticides, liquid, toxic, flammable, *flashpoint not less than 23 degrees C*	6.1	UN2997	I	6.1, 3	T42	None	201	243	1 L	30 L	B	40
-	-	-	-	II	6.1, 3	T14	None	202	243	5 L	60 L	B	40
-	-	-	-	III	6.1, 3	T14	153	203	242	60 L	220 L	A	40
-	Triazine pesticides, solid, toxic	6.1	UN2763	I	6.1	-	None	211	242	5 kg	50 kg	A	40
-	-	-	-	II	6.1	-	None	212	242	25 kg	100 kg	A	40
-	-	-	-	III	6.1	-	153	213	240	100 kg	200 kg	A	40

-	Tributylamine	6.1	UN2542	II	6.1	B110, T14	None	202	243	5 L	60 L	A	-
-	Tributylphosphane	4.2	UN3254	I	4.2	-	None	211	242	Forbidden	Forbidden	D	-
D	mono-(Trichloro) tetra-(monopotassium dichloro)-penta-s-triazinetrione, dry (*with more than 39 percent available chlorine*)	5.1	NA2468	II	5.1	-	152	212	240	5 kg	25 kg	A	13
-	*Trichloro-s-triazinetrione dry, with more than 39 percent available chlorine, see* Trichloroisocyanuric acid, dry	-	-	-	-	-	-	-	-	-	-	-	-
-	Trichloroacetic acid	8	UN1839	II	8	A7, N34	154	212	240	15 kg	50 kg	A	-
-	Trichloroacetic acid, solution	8	UN2564	II	8	A3, A6, A7, B2, N34, T8	154	202	242	1 L	30 L	B	-
-	-	-	-	III	8	A3, A6, A7, N34, T7	154	203	241	5 L	60 L	B	8
+	Trichloroacetyl chloride	8	UN2442	II	8, 6.1	2, A3, A7, B9, B14, B32, B74, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	40
-	Trichlorobenzenes, liquid	6.1	UN2321	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	Trichlorobutene	6.1	UN2322	II	6.1	T8	None	202	243	5 L	60 L	A	25, 40
-	1,1,1-Trichloroethane	6.1	UN2831	III	6.1	N36, T7	153	203	241	60 L	220 L	A	40
-	Trichloroethylene	6.1	UN1710	III	6.1	N36, T1	153	203	241	60 L	220 L	A	40
-	Trichloroisocyanuric acid, dry	5.1	UN2468	II	5.1	-	152	212	240	5 kg	25 kg	A	13
-	*Trichloromethyl perchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trichlorosilane	4.3	UN1295	I	4.3, 3, 8	A7, N34, T24, T26	None	201	244	Forbidden	Forbidden	D	21, 28, 40, 49, 100
-	Tricresyl phosphate *with more than 3 percent ortho isomer*	6.1	UN2574	II	6.1	A3, N33, N34, T8	None	202	243	5 L	60 L	A	-
-	Triethyl phosphite	3	UN2323	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Triethylamine	3	UN1296	II	3, 8	B101, T8	None	202	243	1 L	5 L	B	40
-	Triethylenetetramine	8	UN2259	II	8	B2, T8	154	202	242	1 L	30 L	B	40
-	Trifluoroacetic acid	8	UN2699	I	8	A3, A6, A7, B4, N3, N34, T18, T27	None	201	243	0.5 L	2.5 L	B	12, 40
-	Trifluoroacetyl chloride	2.3	UN3057	-	2.3, 8	2, B7, B9, B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	Trifluorochloroethylene, inhibited	2.3	UN1082	-	2.3, 2.1	3,B14	None	304	314, 315	Forbidden	Forbidden	D	40
-	1,1,1-Trifluoroethane, compressed *or* Refrigerant gas R 143a	2.1	UN2035	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Trifluoromethane *or* Refrigerant gas R 23	2.2	UN1984	-	2.2	-	306	304	314, 315	75 kg	150 kg	A	-
-	Trifluoromethane, refrigerated liquid	2.2	UN3136	-	2.2	-	306	None	314, 315	50 kg	500 kg	D	-
-	2-Trifluoromethylaniline	6.1	UN2942	III	6.1	-	153	203	241	60 L	220 L	A	-
-	3-Trifluoromethylaniline	6.1	UN2948	II	6.1	T14	None	202	243	5 L	60 L	A	40
-	*Triformoxime trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Triisobutylene	3	UN2324	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	-
-	Triisopropyl borate	3	UN2616	II	3	T8, T31	150	202	242	5 L	60 L	A	-
-	-	-	-	III	3	B1, T8, T31	150	203	242	60 L	220 L	A	-
D	Trimethoxysilane	6.1	NA9269	I	6.1, 3	2, B9, B14, B32, B74, T38, T43, T45	None	227	244	Forbidden	Forbidden	E	40
-	Trimethyl borate	3	UN2416	II	3	T14	150	202	242	5 L	60 L	B	-
-	Trimethyl phosphite	3	UN23	III	3	B1, T1	150	203	242	60 L	220 L	A	-

			29										
-	*1,3,5-Trimethyl-2,4,6-trinitrobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trimethylacetyl chloride	6.1	UN2438	I	6.1, 8, 3	2, A3, A6, A7, B3, B9, B14, B32, B74, N34, T38, T43, T45	None	227	244	Forbidden	Forbidden	D	25, 40
-	Trimethylamine, anhydrous	2.1	UN1083	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Trimethylamine, aqueous solutions *with not more than 50 percent trimethylamine by mass*	3	UN1297	I	3, 8	T42	None	201	243	0.5 L	2.5 L	D	40, 41
-	-	-	-	II	3, 8	B1, T14	None	202	243	1 L	5 L	B	40, 41
-	-	-	-	III	3, 8	B1	150	203	242	5 L	60 L	A	40, 41
-	1,3,5-Trimethylbenzene	3	UN2325	III	3	B1, T1	None	203	242	60 L	220 L	A	-
-	Trimethylchlorosilane	3	UN1298	II	3, 8	A3, A7, B77, N34, T14, T26	None	202	243	1 L	5 L	E	40
-	Trimethylcyclohexylamine	8	UN2326	III	8	T2	154	203	241	5 L	60 L	A	-
-	*Trimethylene glycol diperchlorate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trimethylhexamethylene diisocyanate	6.1	UN2328	III	6.1	T8	153	203	241	60 L	220 L	B	-
-	Trimethylhexamethylenediamines	8	UN2327	III	8	T7	154	203	241	5 L	60 L	A	-
-	*Trimethylol nitromethane trinitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitro-meta-cresol	1.1D	UN0216	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*2,4,6-Trinitro-1,3-diazobenzene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,4,6-Trinitro-1,3,5-triazido benzene (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Trinitroacetic acid*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Trinitroacetonitrile*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Trinitroamine cobalt*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitroaniline *or* Picramide	1.1D	UN0153	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitroanisole	1.1D	UN0213	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrobenzene, *dry or wetted with less than 30 percent water, by mass*	1.1D	UN0214	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrobenzene, wetted *with not less than 30 percent water, by mass*	4.1	UN1354	I	4.1	23, A2, A8, A19, N41	None	211	None	0.5 kg	0.5 kg	E	28
-	Trinitrobenzenesulfonic acid	1.1D	UN0386	II	1.1D	-	None	62	None	Forbidden	Forbidden	E	1E, 5E
-	Trinitrobenzoic acid, *dry or wetted with less than 30 percent water, by mass*	1.1D	UN0215	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrobenzoic acid, wetted *with not less than 30 percent water, by mass*	4.1	UN1355	I	4.1	23, A2, A8, A19, N41	None	211	None	0.5 kg	0.5 kg	E	28
-	Trinitrochlorobenzene *or* Picryl chloride	1.1D	UN0155	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Trinitroethanol*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Trinitroethylnitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitrofluorenone	1.1D	UN0387	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	*Trinitromethane*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*1,3,5-Trinitronaphthalene*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitronaphthalene	1.1D	UN0217	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrophenetole	1.1D	UN0218	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrophenol *or* Picric acid, *dry or wetted with less than 30 percent water, by mass*	1.1D	UN0154	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrophenol, wetted *with not less than 30 percent water, by mass*	4.1	UN1344	I	4.1	23, A8, A19, N41	None	211	None	1 kg	15 kg	E	28, 36
-	*2,4,6-Trinitrophenyl guanidine (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,4,6-Trinitrophenyl nitramine*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*2,4,6-Trinitrophenyl trimethylol methyl nitramine trinitrate (dry)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitrophenylmethylnitramine *or* Tetryl	1.1D	UN0208	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitroresorcinol *or* Styphnic acid, *dry or wetted with less than 20 percent water, or mixture of alcohol and water, by mass*	1.1D	UN0219	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitroresorcinol, wetted *or* Styphnic acid, wetted *with not less than 20 percent water, or mixture of alcohol and water by mass*	1.1D	UN0394	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E

-	*2,4,6-Trinitroso-3-methyl nitraminoanisole*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	*Trinitrotetramine cobalt nitrate*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Trinitrotoluene and Trinitrobenzene mixtures *or* TNT and trinitrobenzene mixtures *or* TNT and hexanitrostilbene mixtures *or* Trinitrotoluene and hexanitrostilnene mixtures	1.1D	UN0388	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrotoluene mixtures containing Trinitrobenzene and Hexanitrostilbene *or* TNT mixtures containing trinitrobenzene and hexanitrostilbene	1.1D	UN0389	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrotoluene *or* TNT, *dry or wetted with less than 30 percent water, by mass*	1.1D	UN0209	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Trinitrotoluene, wetted *with not less than 30 percent water, by mass*	4.1	UN1356	I	4.1	23, A2, A8, A19, N41	None	211	None	0.5 kg	0.5 kg	E	28
-	Tripropylamine	3	UN2260	III	3, 8	B1, T8	150	203	242	5 L	60 L	A	40
-	Tripropylene	3	UN2057	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Tris-(1-aziridinyl)phosphine oxide, solution	6.1	UN2501	II	6.1	T8	None	202	243	5 L	60L	A	-
-	-	-	-	III	6.1	T7	153	203	241	60 L	220 L	A	-
-	*Tris, bis-bifluoroamino diethoxy propane (TVOPA)*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Tritonal	1.1D	UN0390	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Tungsten hexafluoride	2.3	UN2196	-	2.3, 8	2	None	338	None	Forbidden	Forbidden	D	40
-	Turpentine	3	UN1299	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Turpentine substitute	3	UN1300	I	3	T1	None	201	243	1 L	30 L	B	-
-	-	-	-	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Undecane	3	UN2330	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Uranium hexafluoride, *fissile excepted or non-fissile*	7	UN2978	-	7, 8	-	423	420, 427	420, 427	-	-	-	-
-	Uranium hexafluoride, fissile (*with more than 1 percent U-235*)	7	UN2977	-	7, 8	-	453	417, 420	417, 420	-	-	A	-
-	Uranium metal, pyrophoric	7	UN2979	-	7, 4.2	-	None	418	None	-	-	D	-
-	Uranyl nitrate hexahydrate solution	7	UN2980		7, 8		421, 427	415, 416, 417	415, 416, 417	-	-	D	-
-	Uranyl nitrate, solid	7	UN2981	-	7, 5.1	-	None	419	None	Forbidden	15 kg	A	-
-	Urea hydrogen peroxide	5.1	UN1511	III	5.1, 8	A1, A7, A29	152	213	240	25 kg	100kg	A	13
-	Urea nitrate, *dry or wetted with less than 20 percent water, by mass*	1.1D	UN0220	II	1.1D	119	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Urea nitrate, wetted *with not less than 20 percent water, by mass*	4.1	UN1357	I	4.1	39, A8, A19, N41	None	211	None	1 kg	15 kg	A	28
-	*Urea peroxide, see* Urea hydrogen peroxide	-	-	-	-	-	-	-	-	-	-	-	-
-	Valeraldehyde	3	UN2058	II	3	T1	150	202	242	5 L	60 L	B	-
-	*Valeric acid, see* Corrosive liquids, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Valeryl chloride	8	UN2502	II	8, 3	A3, A6, A7, B2, N34, T8	154	202	243	1 L	30 L	C	40
-	Vanadium compound, n.o.s	6.1	UN3285	I	6.1	-	None	211	242	5 kg	50 kg	B	-
-	-	-	-	II	6.1	T14	None	212	242	25 kg	100 kg	B	-
-	-	-	-	III	6.1	T7	153	213	240	100 kg	200 kg	A	-
-	Vanadium oxytrichloride	8	UN2443	II	8	A3, A6, A7, B2, B16, N34, T8, T26	154	202	242	Forbidden	30 L	C	40
-	Vanadium pentoxide, *non-fused form*	6.1	UN2862	III	6.1	-	153	213	240	100 kg	200 kg	A	40
-	Vanadium tetrachloride	8	UN2444	I	8	A3, A6, A7, B4, N34, T8, T26	None	201	243	Forbidden	2.5 L	C	40
-	Vanadium trichloride	8	UN2475	III	8	-	154	213	240	25 kg	100 kg	A	40
-	Vanadyl sulfate	6.1	UN29	II	6.1	-	Non	212	242	25 kg	100 kg	A	-

			31				e						
-	Vehicle, flammable gas powered	9	UN3166	-	9	135	220	220	220	Forbidden	No limit	A	-
-	Vehicle, flammable liquid powered	9	UN3166	-	9	135	220	220	220	No limit	No limit	A	-
-	*Very signal cartridge, see* Cartridges, signal	-	-	-	-	-	-	-	-	-	-	-	-
-	Vinyl acetate, inhibited	3	UN1301	II	3	T8	150	202	242	5 L	60 L	B	-
-	Vinyl bromide, inhibited	2.1	UN1085	-	2.1	-	306	304	314, 315	Forbidden	150 kg	B	40
-	Vinyl butyrate, inhibited	3	UN2838	II	3	T7	150	202	242	5 L	60 L	B	-
-	Vinyl chloride, inhibited *or* Vinyl chloride, stabilized	2.1	UN1086	-	2.1	21, B44	306	304	314, 315	Forbidden	150 kg	B	40
-	Vinyl chloroacetate	6.1	UN2589	II	6.1, 3	T14	None	202	243	5 L	60 L	A	-
-	Vinyl ethyl ether, inhibited	3	UN1302	I	3	A3, B100, T14	None	201	243	1 L	30 L	D	-
-	Vinyl fluoride, inhibited	2.1	UN1860	-	2.1	-	306	304	314, 315	Forbidden	150 kg	E	40
-	Vinyl isobutyl ether, inhibited	3	UN1304	II	3	T8	150	202	242	5 L	60 L	B	-
-	Vinyl methyl ether, inhibited	2.1	UN1087	-	2.1	B44	306	304	314, 315	Forbidden	150 kg	B	40
-	*Vinyl nitrate polymer*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Vinyltoluenes, inhibited	3	UN2618	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Vinylidene chloride, inhibited	3	UN1303	I	3	T23, T29	150	201	243	1 L	30 L	E	40
-	Vinylpyridines, inhibited	6.1	UN3073	II	6.1, 3, 8	B100, T8	None	202	243	1 L	30 L	B	40
-	Vinyltrichlorosilane, inhibited	3	UN1305	I	3, 8	A3, A7, B6, N34, T14, T26	None	201	243	Forbidden	2.5 L	B	40
-	Warheads, rocket *with burster or expelling charge*	1.4D	UN0370	II	1.4D	-	None	62	None	Forbidden	75 kg	A	3E, 7E, 24E
-	Warheads, rocket *with burster or expelling charge*	1.4F	UN0371	II	1.4F	-	None	62	None	Forbidden	Forbidden	E	-
-	Warheads, rocket *with bursting charge*	1.1D	UN0286	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	3E, 7E
-	Warheads, rocket *with bursting charge*	1.2D	UN0287	II	1.2D	-	None	62	None	Forbidden	Forbidden	B	3E, 7E
-	Warheads, rocket *with bursting charge*	1.1F	UN0369	II	1.1F	-	None	62	None	Forbidden	Forbidden	E	-
-	Warheads, torpedo *with bursting charge*	1.1D	UN0221	II	1.1D	-	None	62	None	Forbidden	Forbidden	B	3E, 7E
G	Water-reactive liquid, corrosive, n.o.s	4.3	UN3129	I	4.3, 8	-	None	201	243	Forbidden	1 L	D	-
-	-	-	-	II	4.3, 8	B106	None	202	243	1 L	5 L	E	85
-	-	-	-	III	4.3, 8	B106	None	203	242	5 L	60 L	E	-
G	Water-reactive liquid, n.o.s	4.3	UN3148	I	4.3	-	None	201	244	Forbidden	1 L	E	40
-	-	-	-	II	4.3	B106	None	202	243	1 L	5 L	E	40
-	-	-	-	III	4.3	B106	None	203	242	5 L	60 L	E	40
G	Water-reactive liquid, toxic, n.o.s	4.3	UN3130	I	4.3, 6.1	A4	None	201	243	Forbidden	1 L	D	-
-	-	-	-	II	4.3, 6.1	B106	None	202	243	1 L	5 L	E	85
-	-	-	-	III	4.3, 6.1	B106	None	203	242	5 L	60 L	E	85
G	Water-reactive solid, corrosive, n.o.s	4.3	UN3131	I	4.3, 8	B101, B106, N40	None	211	242	Forbidden	15 kg	D	-
-	-	-	-	II	4.3, 8	B101, B106	151	212	242	15 kg	50 kg	E	85
-	-	-	-	III	4.3, 8	B105, B106	151	213	241	25 kg	100 kg	E	85
G	Water-reactive solid, flammable, n.o.s	4.3	UN3132	I	4.3, 4.1	B101, B106, N40	None	211	242	Forbidden	15 kg	D	-
-	-	-	-	II	4.3,	B101, B106	151	212	242	15 kg	50 kg	E	-

					4.1								
-	-	-	-	III	4.3, 4.1	B105, B106	151	213	241	25 kg	100 kg	E	-
G	Water-reactive solid, n.o.s	4.3	UN2813	I	4.3	B101, B106, N40	None	211	242	Forbidden	15 kg	E	40
-	-	-	-	II	4.3	B101, B106	151	212	242	15 kg	50 kg	E	40
-	-	-	-	III	4.3	B105, B106	151	213	241	25 kg	100 kg	E	40
G	Water-reactive, solid, oxidizing, n.o.s.	4.3	UN3133	II	4.3, 5.1	-	None	214	214	Forbidden	Forbidden	E	40
-	-	-	-	III	4.3, 5.1	-	None	214	214	Forbidden	Forbidden	E	40
G	Water-reactive solid, self-heating, n.o.s	4.3	UN3135	I	4.3, 4.2	B100, N40	None	211	242	Forbidden	15 kg	E	-
-	-	-	-	II	4.3, 4.2	B101, B106	None	212	242	15 kg	50 kg	E	-
-	-	-	-	III	4.3, 4.2	B101, B106	None	213	241	25 kg	100 kg	E	-
G	Water-reactive solid, toxic, n.o.s	4.3	UN3134	I	4.3, 6.1	A8, B101, B106, N40	None	211	242	Forbidden	15 kg	D	-
-	-	-	-	II	4.3, 6.1	B105, B106	151	212	242	15 kg	50 kg	E	85
-	-	-	-	III	4.3, 6.1	B105, B106	151	213	241	25 kg	100 kg	E	85
-	*Wheel chair, electric, see* Battery powered vehicle *or* Battery powered equipment	-	-	-	-	-	-	-	-	-	-	-	-
-	*White acid, see* Hydrofluoric acid mixtures	-	-	-	-	-	-	-	-	-	-	-	-
I	White asbestos *(chrysotile, actinolite, anthophyllite, tremolite)*	9	UN2590	III	9	-	155	216	240	200 kg	200 kg	A	34, 40
-	Wood preservatives, liquid	3	UN1306	II	3	T7, T30	150	202	242	5 L	60 L	B	40
-	-	-	-	III	3	B1, T7, T30	150	203	242	60 L	220 L	A	40
-	Xanthates	4.2	UN3342	II	4.2	-	None	212	241	15kg	50kg	D	40
-	-	-	-	III	4.2	-	None	213	241	25kg	100kg	D	40
-	Xenon, compressed	2.2	UN2036	-	2.2	-	306	302	None	75 kg	150 kg	A	-
-	Xenon, refrigerated liquid *(cryogenic liquids)*	2.2	UN2591	-	2.2	-	320	None	None	50 kg	500 kg	B	-
-	Xylenes	3	UN1307	II	3	T1	150	202	242	5 L	60 L	B	-
-	-	-	-	III	3	B1, T1	150	203	242	60 L	220 L	A	-
-	Xylenols	6.1	UN2261	II	6.1	T8	None	212	242	25 kg	100 kg	A	-
-	Xylidines, solid	6.1	UN1711	II	6.1	T14	None	212	242	25 kg	100 kg	A	-
-	Xylidines, solution	6.1	UN1711	II	6.1	T14	None	202	243	5 L	60 L	A	-
-	Xylyl bromide	6.1	UN1701	II	6.1	A3, A6, A7, N33	None	340	None	Forbidden	60 L	D	40
-	*p-Xylyl diazide*	Forbidden	-	-	-	-	-	-	-	-	-	-	-
-	Zinc ammonium nitrite	5.1	UN1512	II	5.1	-	None	212	242	5 kg	25 kg	E	-
-	Zinc arsenate *or* Zinc arsenite *or* Zinc arsenate and zinc arsenite mixtures.	6.1	UN1712	II	6.1	-	None	212	242	25 kg	100 kg	A	-
-	Zinc ashes	4.3	UN1435	III	4.3	A1, A19, B108	151	213	241	25 kg	100 kg	A	-
-	*Zinc bisulfite solution, see* Bisulfites, inorganic aqueous solutions, n.o.s	-	-	-	-	-	-	-	-	-	-	-	-
-	Zinc bromate	5.1	UN2469	III	5.1	A1, A29	152	213	240	25 kg	100kg	A	56, 58, 106
-	Zinc chlorate	5.1	UN1513	II	5.1	A9, N34	152	212	242	5 kg	25 kg	A	56, 58, 106
-	Zinc chloride, anhydrous	8	UN2331	III	8	-	None	213	240	25 kg	100 kg	A	-
-	Zinc chloride, solution	8	UN1840	III	8	T7	154	203	241	5 L	60 L	A	-
-	Zinc cyanide	6.1	UN1713	I	6.1	-	None	211	242	5 kg	50 kg	A	26
-	Zinc dithionite *or* Zinc hydrosulfite	9	UN1931	III	None	-	155	204	240	100 kg	200 kg	A	49
-	*Zinc ethyl, see* Diethylzinc	-	-	-	-	-	-	-	-	-	-	-	-
-	Zinc fluorosilicate	6.1	UN2855	III	6.1	-	153	213	240	100 kg	200 kg	A	26
-	Zinc hydrosulfite, *see* Zinc dithionite	-	-	-	-	-	-	-	-	-	-	-	-
-	*Zinc muriate solution, see* Zinc chloride, solution	-	-	-	-	-	-	-	-	-	-	-	-
-	Zinc nitrate	5.1	UN1514	II	5.1	-	152	212	240	5 kg	25 kg	A	-

-	Zinc permanganate	5.1	UN1515	II	5.1	-	152	212	242	5 kg	25 kg	D	56, 58, 69, 106, 107
-	Zinc peroxide	5.1	UN1516	II	5.1	-	152	212	242	5 kg	25 kg	A	13, 75, 106
-	Zinc phosphide	4.3	UN1714	I	4.3, 6.1	A19, N40	None	211	None	Forbidden	15 kg	E	40, 85
-	Zinc powder *or* Zinc dust	4.3	UN1436	I	4.3, 4.2	A19, B109, N40	None	211	242	Forbidden	15 kg	A	–
-	-	-	-	II	4.3, 4.2	A19, B109	None	212	242	15 kg	50 kg	A	–
-	-	-	-	III	4.3, 4.2	B108	None	213	242	25 kg	100 kg	A	–
-	Zinc resinate	4.1	UN2714	III	4.1	A1	151	213	240	25 kg	100 kg	A	–
-	*Zinc selenate, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	–
-	*Zinc selenite, see* Selenates *or* Selenites	-	-	-	-	-	-	-	-	-	-	-	–
-	*Zinc silicofluoride, see* Zinc fluorosilicate	-	-	-	-	-	-	-	-	-	-	-	–
-	Zirconium, dry, *coiled wire, finished metal sheets, strip (thinner than 254 microns but not thinner than 18 microns)*	4.1	UN2858	III	4.1	A1	151	213	240	25 kg	100 kg	A	–
-	Zirconium, dry, *finished sheets, strip or coiled wire*	4.2	UN2009	III	4.2	A1, A19	None	213	240	25 kg	100 kg	D	–
-	Zirconium hydride	4.1	UN1437	II	4.1	A19, A20, N34	None	212	240	15 kg	50 kg	E	–
-	Zirconium nitrate	5.1	UN2728	III	5.1	A1, A29	152	213	240	25 kg	100 kg	A	–
-	Zirconium picramate, *dry or wetted with less than 20 percent water, by mass*	1.3C	UN0236	II	1.3C	-	None	62	None	Forbidden	Forbidden	B	1E, 5E
-	Zirconium picramate, wetted *with not less than 20 percent water, by mass*	4.1	UN1517	I	4.1	23, N41	None	211	None	1 kg	15 kg	D	28, 36
-	Zirconium powder, dry	4.2	UN2008	I	4.2	-	None	211	242	Forbidden	Forbidden	D	–
-	-	-	-	II	4.2	A19, A20, N5, N34	None	212	241	15 kg	50 kg	D	–
-	-	-	-	III	4.2	-	None	213	241	25 kg	100 kg	D	–
-	Zirconium powder, wetted *with not less than 25 percent water (a visible excess of water must be present) (a) mechanically produced, particle size less than 53 microns; (b) chemically produced, particle size less than 840 microns*	4.1	UN1358	II	4.1	A19, A20, N34	None	212	241	15 kg	50 kg	E	–
-	Zirconium scrap	4.2	UN1932	III	4.2	N34	None	213	240	Forbidden	Forbidden	D	–
D	Zirconium sulfate	8	NA9163	III	8	N34	None	213	240	50 kg	No limit	A	–
-	Zirconium suspended in a liquid	3	UN1308	I	3	-	None	201	243	Forbidden	Forbidden	B	–
-	-	-	-	II	3	-	None	202	242	5 L	60 L	B	–
-	-	-	-	III	3	B1	150	203	242	60 L	220 L	B	–
-	Zirconium tetrachloride	8	UN2503	III	8	-	154	213	240	25 kg	100 kg	A	-

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §171.101, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45396, Aug. 19, 1999, §172.101 was amended by adding the entry for Qxygen, generator, chemical, spent and revising the entry for Oxygen, compressed, effective Mar. 1, 2000. For the convenience of the user, the superseded text is set forth as follows:

§172.101 Purpose and use of hazardous materials table.

* * * * *

§172.101.-HAZARDOUS MATERIALS TABLE

SYMBOLS	HAZARDOUS MATERIALS DESCRIPTIONS AND PROPER SHIPPING NAMES	HAZARD CLASS OR DIVISION	IDENTIFICATION NUMBERS	PG	LABEL CODES	SPECIAL PROVISIONS	(8) PACKAGING AUTHORIZATIONS (173.***)			(9) QUANTITY LIMITATIONS		(10) VESSEL STOWAGE REQUIREMENTS	
-	-	-	-	-	-	-	EXCEPTIONS	NON-BULK	BULK	PASSENGER AIRCRAFT/RAIL	CARGO AIRCRAFT ONLY	LOCATION	OTHER
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8A)	(8B)	(8C)	(9A)	(9B)	(10A)	(10B)
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	Oxygen, compressed	2.2	UN1072	-	2.2, 5.1	-	306	302	314, 315	75 kg	150 kg	A	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

to §172.101-List of Hazardous Substances and Reportable Quantities

1. This appendix lists materials and their corresponding reportable quantities (RQ's) that are listed or designated as "hazardous substances" under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9601(14) (CERCLA; 42 U.S.C. 9601 *et seq). This listing fulfills the requirement of CERCLA, 42 U.S.C. 9656(a), that all "hazardous substances," as defined in 42 U.S.C. 9601(14), be listed and regulated as hazardous materials under 49 U.S.C. 5101-5127. That definition includes substances listed under sections 311(b)(2)(A) and 307(a) of the Federal Water Pollution Control Act, 33 U.S.C. 1321(b)(2)(A) and 1317(a), section 3001 of the Solid Waste Disposal Act, 42 U.S.C. 6921, and section 112 of the Clean Air Act, 42 U.S.C. 7412. In addition, this list contains materials that the Administrator of the Environmental Protection Agency has determined to be hazardous substances in accordance with section 102 of CERCLA, 42 U.S.C. 9602. It should be noted that 42 U.S.C. 9656(b) provides that common and contract carriers may be held liable under laws other than CERCLA for the release of a hazardous substance as defined in that Act, during transportation that commenced before the effective date of the listing and regulating of that substance as a hazardous material under 49 U.S.C. 5101-5127.*

2. This appendix is divided into two TABLES which are entitled "TABLE 1-HAZARDOUS SUBSTANCES OTHER THAN RADIONUCLIDES" and "TABLE 2-RADIONUCLIDES." A material listed in this appendix is regulated as a hazardous material and a hazardous substance under this subchapter if it meets the definition of a hazardous substance in §171.8 of this subchapter.

3. The procedure for selecting a proper shipping name for a hazardous substance is

set forth in §172.101(c)(8).

4. Column 1 of TABLE 1, entitled *"Hazardous substance", contains the names of those elements and compounds that are hazardous substances. Following the listing of elements and compounds is a listing of waste streams. These waste streams appear on the list in numerical sequence and are referenced by the appropriate "D", "F", or "K" numbers. Column 2 of TABLE 1, entitled "Reportable quantity (RQ)", contains the reportable quantity (RQ), in pounds and kilograms, for each hazardous substance listed in Column 1 of TABLE 1.*

5. A series of notes is used throughout TABLE 1 and TABLE 2 to provide additional information concerning certain hazardous substances. These notes are explained at the end of each TABLE.

6. TABLE 2 lists radionuclides that are hazardous substances and their corresponding RQ's. The RQ's in table 2 for radionuclides are expressed in units of curies and terabecquerels, whereas those in table 1 are expressed in units of pounds and kilograms. If a material is listed in both table 1 and table 2, the lower RQ shall apply. Radionuclides are listed in alphabetical order. The RQ's for radionuclides are given in the radiological unit of measure of curie, abbreviated "Ci", followed, in parentheses, by an equivalent unit measured in terabecquerels, abbreviated "TBq".

7. For mixtures of radionuclides, the following requirements shall be used in determining if a package contains an RQ of a hazardous substance: (i) if the identity and quantity (in curies or terabecquerels) of each radionuclide in a mixture or solution is known, the ratio between the quantity per package (in curies or terabecquerels) and the RQ for the radionuclide must be determined for each radionuclide. A package contains an RQ of a hazardous substance when the sum of the ratios for the radionuclides in the mixture or solution is equal to or greater than one; (ii) if the identity of each radionuclide in a mixture or solution is known but the quantity per package (in curies or terabecquerels) of one or more of the radionuclides is unknown, an RQ of a hazardous substance is present in a package when the total quantity (in curies or terabecquerels) of the mixture or solution is equal to or greater than the lowest RQ of any individual radionuclide in the mixture or solution; and(iii) if the identity of one or more radionuclides in a mixture or solution is unknown (or if the identity of a radionuclide by itself is unknown), an RQ of a hazardous substance is present when the total quantity (in curies or terabecquerels) in a package is equal to or greater than either one curie or the lowest RQ of any known individual radionuclide in the mixture or solution, whichever is lower.

Table 1 to Appendix A-Hazardous Substances Other Than Radionuclides

Hazardous substance	Reportable quantity (RQ) pounds (kilograms)
Acenaphthene	100 (45.4)
Acenaphthylene	5000 (2270)
Acetaldehyde	1000 (454)
Acetaldehyde, chloro-	1000 (454)

Acetaldehyde, trichloro-	5000 (2270)
Acetamide	100 (45.4)
Acetamide, N-(aminothioxomethyl)-	1000 (454)
Acetamide, N-(4-ethoxyphenyl)-	100 (45.4)
Acetamide, N-fluoren-2-yl-	1 (0.454)
Acetamide, 2-fluoro-	100 (45.4)
Acetic acid	5000 (2270)
Acetic acid (2,4-dichlorophenoxy)-	100 (45.4)
Acetic acid, ethyl ester	5000 (2270)
Acetic acid, fluoro-, sodium salt	10 (4.54)
Acetic acid, lead (2+) salt	10 (4.54)
Acetic acid, thallium(I+) salt	1000 (454)
Acetic anhydride	5000 (2270)
Acetone	5000 (2270)
Acetone cyanohydrin	10 (4.54)
Acetonitrile	5000 (2270)
Acetophenone	5000 (2270)
2-Acetylaminofluorene	1 (0.454)
Acetyl bromide	5000 (2270)
Acetyl chloride	5000 (2270)
1-Acetyl-2-thiourea	1 (0.454)
Acrylamide	5000 (2270)
Acrylic acid	5000 (2270)
Acrylonitrile	100 (45.4)
Adipic acid	5000 (2270)
AldicarbD1 (0.454)	-
Aldrin	1 (0.454)
Allyl alcohol	100 (45.4)
Allyl chloride	1000 (454)
Aluminum phosphide	100 (45.4)
Aluminum sulfate	5000 (2270)
4-Aminobiphenyl	1 (0.454)
5-(Aminomethyl)-3-isoxazolol	1000 (454)
4-Aminopyridine	1000 (454)
Amitrole	10 (4.54)
Ammonia	100 (45.4)
Ammonium acetate	5000 (2270)
Ammonium benzoate	5000 (2270)
Ammonium bicarbonate	5000 (2270)
Ammonium bichromate	10 (4.54)
Ammonium bifluoride	100 (45.4)
Ammonium bisulfite	5000 (2270)
Ammonium carbamate	5000 (2270)
Ammonium carbonate	5000 (2270)
Ammonium chloride	5000 (2270)
Ammonium chromate	10 (4.54)
Ammonium citrate, dibasic	5000 (2270)
Ammonium dichromate @	10 (4.54)
Ammonium fluoborate	5000 (2270)
Ammonium fluoride	100 (45.4)
Ammonium hydroxide	1000 (454)
Ammonium oxalate	5000 (2270)
Ammonium picrate	10 (4.54)
Ammonium silicofluoride	1000 (454)

Ammonium sulfamate	5000 (2270)
Ammonium sulfide	100 (45.4)
Ammonium sulfite	5000 (2270)
Ammonium tartrate	5000 (2270)
Ammonium thiocyanate	5000 (2270)
Ammonium vanadate	1000 (454)
Amyl acetate	5000 (2270)
iso-Amyl acetate	-
sec-Amyl acetate	-
tert-Amyl acetate	-
Aniline	5000 (2270)
o-Anisidine	100 (45.4)
Anthracene	5000 (2270)
Antimony ¢*	5000 (2270)
Antimony pentachloride	1000 (454)
Antimony potassium tartrate	100 (45.4)
Antimony tribromide	1000 (454)
Antimony trichloride	1000 (454)
Antimony trifluoride	1000 (454)
Antimony trioxide	1000 (454)
Argentate(1-), bis(cyano-C)-, potassium	1 (0.454)
Aroclor 1016	1 (0.454)
Aroclor 1221	1 (0.454)
Aroclor 1232	1 (0.454)
Aroclor 1242	1 (0.454)
Aroclor 1248	1 (0.454)
Aroclor 1254	1 (0.454)
Aroclor 1260	1 (0.454)
Arsenic ¢*	1 (0.454)
Arsenic acid	1 (0.454)
Arsenic acid H3AsO4	1 (0.454)
Arsenic disulfide	1 (0.454)
Arsenic oxide As203	1 (0.454)
Arsenic oxide As205	1 (0.454)
Arsenic pentoxide	1 (0.454)
Arsenic trichloride	1 (0.454)
Arsenic trioxide	1 (0.454)
Arsenic trisulfide	1 (0.454)
Arsine, diethyl-	1 (0.454)
Arsinic acid, dimethyl-	1 (0.454)
Arsonous dichloride, phenyl-	1 (0.454)
Asbestos ¢*¢*	1 (0.454)
Auramine100 (45.4)	-
Azaserine	1 (0.454)
Aziridine	1 (0.454)
Aziridine, 2-methyl-	1 (0.454)
Azirino[2',3':3,4]pyrrolo(1,2-a)indole-4,7-dione,6- amino-8-[[(aminocarbonyl)oxy] methyl]-1,1a,2,8,8a, 8b-hexahydro-8a-methoxy-5-methyl-, [1aS-[aalpha,8beta,8aalpha,8balpha)]-	10 (4.54)
Barium cyanide	10 (4.54)
Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	10 (4.54)
Benz[c]acridine	100 (45.4)
3,4-Benzacridine	100 (45.4)
Benzal chloride	5000 (2270)

Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)	5000 (2270)
Benz[a]anthracene	10 (4.54)
1,2-Benzanthracene	10 (4.54)
Benz[a]anthracene, 7,12-dimethyl-	1 (0.454)
Benzenamine	5000 (2270)
Benzenamine, 4,4'-carbonimidoylbis (N,N-dimethyl-	100 (45.4)
Benzenamine, 4-chloro-	1000 (454)
Benzenamine, 4-chloro-2-methyl-, hydrochloride	100 (45.4)
Benzenamine, N,N-dimethyl-4-(phenylazo)-	10 (4.54)
Benzenamine, 2-methyl-	100 (45.4)
Benzenamine, 4-methyl-	100 (45.4)
Benzenamine, 4,4'-methylenebis(2-chloro-	10 (4.54)
Benzenamine, 2-methyl-, hydrochloride	100 (45.4)
Benzenamine, 2-methyl-5-nitro-	100 (45.4)
Benzenamine, 4-nitro-	5000 (2270)
Benzene	10 (4.54)
Benzene, 1-bromo-4-phenoxy-	100 (45.4)
Benzene, chloro-	100 (45.4)
Benzene, chloromethyl-	100 (45.4)
Benzene, 1,2-dichloro-	100 (45.4)
Benzene, 1,3-dichloro-	100 (45.4)
Benzene, 1,4-dichloro-	100 (45.4)
Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro	1 (0.454)
Benzene, dichloromethyl-	5000 (2270)
Benzene, 1,3-diisocyanatomethyl	100 (45.4)
Benzene, dimethyl-	100 (45.4)
Benzene, m-dimethyl-	1000 (454)
Benzene, o-dimethyl-	1000 (454)
Benzene, p-dimethyl-	100 (45.4)
Benzene, hexachloro-	10 (4.54)
Benzene, hexahydro-	1000 (454)
Benzene, hydroxy-	1000 (454)
Benzene, methyl-	1000 (454)
Benzene, 1-methyl-2,4-dinitro-	10 (4.54)
Benzene, 2-methyl-1,3-dinitro-	100 (45.4)
Benzene, 1-methylethyl-	5000 (2270)
Benzene, nitro-	1000 (454)
Benzene, pentachloro-	10 (4.54)
Benzene, pentachloronitro-	100 (45.4)
Benzene, 1,2,4,5-tetrachloro-	5000 (2270)
Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-	1 (0.454)
Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy)-	1 (0.454)
Benzene, (trichloromethyl)	10 (4.54)
Benzene, 1,3,5-trinitro-	10 (4.54)
Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester	10 (4.54)
Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-	10 (4.54)
Benzenediamine, ar-methyl-	10 (4.54)
1,2-Benzenedicarboxylic acid, [bis(2-ethylhexyl)] ester	100 (45.4)
1,2-Benzenedicarboxylic acid, dibutyl ester	10 (4.54)
1,2-Benzenedicarboxylic acid, diethyl ester	1000 (454)
1,2-Benzenedicarboxylic acid, dimethyl ester	5000 (2270)
1,2-Benzenedicarboxylic acid, dioctyl ester	5000 (2270)
1,3-Benzenediol	5000 (2270)
1,2-Benzenediol,4-[1-hydroxy-2-(methylamino)ethyl]-	1000 (454)

Benzeneethanamine, alpha,alpha-dimethyl-	5000 (2270)
Benzeneethanamine, alpha,alpha-dimethyl-	5000 (2270)
Benzenesulfonic acid chloride	100 (45.4)
Benzenesulfonyl chloride	100 (45.4)
Benzenethiol	100 (45.4)
Benzidine	1 (0.454)
1,2-Benzisothiazol-3(2H)-one,1,1-dioxide	100 (45.4)
Benzo[a]anthracene	10 (4.54)
1,3-Benzodioxole, 5-(2-propenyl)-	100 (45.4)
1,3-Benzodioxole, 5-(1-propenyl)-	100 (45.4)
1,3-Benzodioxole, 5-propyl-	10 (4.54)
Benzo[b]fluoranthene	1 (0.454)
Benzo[k]fluoranthene	5000 (2270)
Benzo[j,k]fluorene	100 (45.4)
Benzoic acid	5000 (2270)
Benzonitrile	5000 (2270)
Benzo[g,h,i]perylene	5000 (2270)
2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts, when present at concentrations greater than 0.3%	100 (45.4)
Benzo[a]pyrene	1 (0.454)
3,4-Benzopyrene	1 (0.454)
p-Benzoquinone	10 (4.54)
Benzo [rst]pentaphene	10 (4.54)
Benzotrichloride	10 (4.54)
Benzoyl chloride	1000 (454)
1,2-Benzphenanthrene	100 (45.4)
Benzyl chloride	100 (45.4)
Beryllium ¢*	10 (4.54)
Beryllium chloride	1 (0.454)
Beryllium dust ¢*	10 (4.54)
Beryllium fluoride	1 (0.454)
Beryllium nitrate	1 (0.454)
alpha - BHC	10 (4.54)
beta - BHC	1 (0.454)
delta - BHC	1 (0.454)
gamma - BHC	1 (0.454)
2,2'Bioxirane	10 (4.54)
Biphenyl	100 (45.4)
(1,1'-Biphenyl)-4,4'-diamine	1 (0.454)
(1,1'-Biphenyl)-4,4'-diamine,3,3'-dichloro-	1 (0.454)
(1,1'-Biphenyl)-4,4'-diamine,3,3'-dimethoxy-	10 (4.54)
(1,1'-Biphenyl)-4,4'-diamine,3,3'-dimethyl-	10 (4.54)
Bis(2-chloroethoxy) methane	1000 (454)
Bis(2-chloroethyl) ether	10 (4.54)
Bis(2-ethylhexyl)phthalate	100 (45.4)
Bromoacetone	1000 (454)
Bromoform	100 (45.4)
4-Bromophenyl phenyl ether	100 (45.4)
Brucine	100 (45.4)
1,3-Butadiene	10 (4.54)
1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	1 (0.454)
1-Butanamine, N-butyl-N-nitroso-	10 (4.54)
1-Butanol	5000 (2270)
2-Butanone	5000 (2270)

2-Butanone, 3,3-dimethyl-1-(methylthio)-,O-[(methylamino)carbonyl] oxime	100 (45.4)
2-Butanone peroxide	10 (4.54)
2-Butenal	100 (45.4)
2-Butene, 1,4-dichloro-	1 (0.454)
2-Butenoic acid, 2-methyl-,7[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*, 3R*), 7alpha]]-	10 (4.54)
Butyl acetate	5000 (2270)
iso-Butyl acetate	-
sec-Butyl acetate	-
tert-Butyl acetate	-
n-Butyl alcohol	5000 (2270)
Butylamine	1000 (454)
iso-Butylamine	-
sec-Butylamine	-
tert-Butylamine	-
Butyl benzyl phthalate	100 (45.4)
n-Butyl phthalate	10 (4.54)
Butyric acid	5000 (2270)
iso-Butyric acid	-
Cacodylic acid	1 (0.454)
Cadmium ¢*	10 (4.54)
Cadmium acetate	10 (4.54)
Cadmium bromide	10 (4.54)
Cadmium chloride	10 (4.54)
Calcium arsenate	1 (0.454)
Calcium arsenite	1 (0.454)
Calcium carbide	10 (4.54)
Calcium chromate	10 (4.54)
Calcium cyanamide	1000 (454)
Calcium cyanide	10 (4.54)
Calcium cyanide Ca(CN)2	10 (4.54)
Calcium dodecylbenzene sulfonate	1000 (454)
Calcium hypochlorite	10 (4.54)
Camphene, octachloro-	1 (0.454)
Caprolactam	5000 (2270)
Captan	10 (4.54)
Carbamic acid, ethyl ester	100 (45.4)
Carbamic acid, methylnitroso-, ethyl ester	1 (0.454)
Carbamic chloride, dimethyl-	1 (0.454)
Carbamide, thio-	10 (4.54)
Carbamimidoselenoic acid	1000 (454)
Carbamothioic acid, bis (1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester	100 (45.4)
Carbaryl	100 (45.4)
Carbofuran	10 (4.54)
Carbon bisulfide	100 (45.4)
Carbon disulfide	100 (45.4)
Carbonic acid, dithallium (I+)	100 (45.4)
Carbonic dichloride	10 (4.54)
Carbonic difluoride	1000 (454)
Carbonochloridic acid, methyl ester	1000 (454)
Carbon oxyfluoride	1000 (454)
Carbon tetrachloride	10 (4.54)
Carbonyl sulfide	100 (45.4)

Catechol	100 (45.4)
Chloral	5000(2270)
Chloramben	100 (45.4)
Chlorambucil	10 (4.54)
Chlordane	1 (0.454)
Chlordane, alpha & gamma isomers	1 (0.454)
Chlordane, technical	1 (0.454)
Chlorine	10 (4.54)
Chlornaphazine	100 (45.4)
Chloroacetaldehyde	1000 (454)
Chloroacetic acid	100 (45.4)
2-Chloroacetophenone	100 (45.4)
p-Chloroaniline	1000 (454)
Chlorobenzene	100 (45.4)
Chlorobenzilate	10 (4.54)
4-Chloro-m-cresol	5000 (2270)
p-Chloro-m-cresol	5000 (2270)
Chlorodibromomethane	100 (45.4)
Chloroethane	100 (45.4)
2-Chloroethyl vinyl ether	1000 (454)
Chloroform	10 (4.54)
Chloromethane	100 (45.4)
Chloromethyl methyl ether	1 (0.454)
beta-Chloronaphthalene	5000 (2270)
2-Chloronaphthalene	5000 (2270)
2-Chlorophenol	100 (45.4)
o-Chlorophenol	100 (45.4)
4-Chlorophenyl phenyl ether	5000 (2270)
1-(o-Chlorophenyl)thiourea	100 (45.4)
Chloroprene	100 (45.4)
3-Chloropropionitrile	1000 (454)
Chlorosulfonic acid	1000 (454)
4-Chloro-o-toluidine, hydrochloride	100 (45.4)
Chlorpyrifos	1 (0.454)
Chromic acetate	1000 (454)
Chromic acid	10 (4.54)
Chromic acid H2CrO4, calcium salt	10 (4.54)
Chromic sulfate	1000 (454)
Chromium ¢*	5000 (2270)
Chromous chloride	1000 (454)
Chrysene	100 (45.4)
Cobaltous bromide	1000 (454)
Cobaltous formate	1000 (454)
Cobaltous sulfamate	1000 (454)
Coke Oven Emissions	1 (0.454)
Copper ¢*	5000 (2270)
Copper chloride @	10 (4.54)
Copper cyanide	10 (4.54)
Copper cyanide CuCN	10 (4.54)
Coumaphos	10 (4.54)
Creosote	1 (0.454)
Cresols (isomers and mixture)	100 (45.4)
m-Cresol	100 (45.4)
o-Cresolo	100 (45.4)

p-Cresol	100 (45.4)
Cresylic acid (isomers and mixture)	100 (45.4)
m-Cresylic acid	100 (45.4)
o-Cresylic acid	100 (45.4)
p-Cresylic acid	100 (45.4)
Crotonaldehyde	100 (45.4)
Cumene	5000 (2270)
Cupric acetate	100 (45.4)
Cupric acetoarsenite	1 (0.454)
Cupric chloride	10 (4.54)
Cupric nitrate	100 (45.4)
Cupric oxalate	100 (45.4)
Cupric sulfate	10 (4.54)
Cupric sulfate ammoniated	100 (45.4)
Cupric tartrate	100 (45.4)
Cyanides (soluble salts and complexes) not otherwise specified	10 (4.54)
Cyanogen	100 (45.4)
Cyanogen bromide	1000 (454)
Cyanogen bromide (CN)Br	1000 (454)
Cyanogen chloride	10 (4.54)
Cyanogen chloride (CN)Cl	10 (4.54)
2,5-Cyclohexadiene-1,4-dione	10 (4.54)
Cyclohexane	1000 (454)
Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-	1 (0.454)
Cyclohexanone	5000 (2270)
2-Cyclohexyl-4,6-dinitrophenol	100 (45.4)
1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-	10 (4.54)
Cyclophosphamide	10 (4.54)
2,4-D Acid	100 (45.4)
2,4-D Ester	100 (45.4)
Daunomycin	10 (4.54)
DDD	1 (0.454)
4,4'-DDD	1 (0.454)
DDE	5000 (2270)
4,4'-DDE	5000 (2270)
DDE	1 (0.454)
4,4'-DDE	1 (0.454)
DDT	1 (0.454)
4,4'-DDT	1 (0.454)
Diallate	100 (45.4)
Diamine	1 (0.454)
Diazinon	1 (0.454)
Diazomethane	100 (45.4)
Dibenz[a,h]anthracene	1 (0.454)
1,2:5,6-Dibenzanthracene	1 (0.454)
Dibenzo[a,h]anthracene	1 (0.454)
Dibenzofuran	100 (45.4)
Dibenz[a,i]pyrene	10 (4.54)
1,2-Dibromo-3-chloropropane	1 (0.454)
Dibutyl phthalate	10 (4.54)
Di-n-butyl phthalate	10 (4.54)
Dicamba	1000 (454)
Dichlobenil	100 (45.4)
Dichlone	1 (0.454)

Dichlorobenzene	100 (45.4)
1,2-Dichlorobenzene	100 (45.4)
1,3-Dichlorobenzene	100 (45.4)
1,4-Dichlorobenzene	100 (45.4)
m-Dichlorobenzene	100 (45.4)
o-Dichlorobenzene	100 (45.4)
p-Dichlorobenzene	100 (45.4)
3,3'-Dichlorobenzidine	1 (0.454)
Dichlorobromomethane	5000 (2270)
1,4-Dichloro-2-butene	1 (0.454)
Dichlorodifluoromethane	5000 (2270)
1,1-Dichloroethane	1000 (454)
1,2-Dichloroethane	100 (45.4)
1,1-Dichloroethylene	100 (45.4)
1,2-Dichloroethylene	1000 (454)
Dichloroethyl ether	10 (4.54)
Dichloroisopropyl-ether	1000 (454)
Dichloromethane @	1000 (454)
Dichloromethoxy ethane	1000 (454)
Dichloromethyl ether	1 (0.454)
2,4-Dichlorophenol	100 (45.4)
2,6-Dichlorophenol	100 (45.4)
Dichlorophenylarsine	1 (0.454)
Dichloropropane	1000 (454)
1,1-Dichloropropane	-
1,3-Dichloropropane	-
1,2-Dichloropropane	1000 (454)
Dichloropropane - Dichloropropene (mixture)	100 (45.4)
Dichloropropene	100 (45.4)
2,3-Dichloropropene	-
1,3-Dichloropropene	100 (45.4)
2,2-Dichloropropionic acid	5000 (2270)
Dichlorvos	10 (4.54)
Dicofol	10 (4.54)
Dieldrin	1 (0.454)
1,2:3,4-Diepoxybutane	10 (4.54)
Diethanolamine	100 (45.4)
Diethylamine	1000 (454)
N,N-diethylaniline	1000 (454)
Diethylarsine	1 (0.454)
1,4-Diethylenedioxide	100 (45.4)
Diethylhexyl phthalate	100 (45.4)
N,N'-Diethylhydrazine	10 (4.54)
O,O-Diethyl S-methyl dithiophosphate	5000 (2270)
Diethyl-p-nitrophenyl phosphate	100 (45.4)
Diethyl phthalate	1000(454)
O,O-Diethyl O-pyrazinyl phosphorothioate	100 (45.4)
Diethylstilbestrol	1 (0.454)
Diethyl sulfate	10 (4.54)
Dihydrosafrole	10 (4.54)
Diisopropyl fluorophosphate	100 (45.4)
1,4,5,8-Dimethanonaphthalene 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro, (1alpha,4alpha,4abeta,5abeta,8beta,8abeta)-	1 (0.454)
1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-10-hexachloro-1,4,4a,5,8,8a-	1 (0.454)

hexahydro-,(1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-	
2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-,(1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta,7aalpha)-	1 (0.454)
2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-,(1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta,7aalpha)-	1 (0.454)
Dimethoate	10 (4.54)
3,3'-Dimethoxybenzidine	10 (4.54)
Dimethylamine	1000 (454)
p-Dimethylaminoazobenzene	10 (4.54)
N,N-dimethylaniline	100 (45.4)
7,12-Dimethylbenz[a]anthracene	1 (0.454)
3,3'-Dimethylbenzidine	10 (4.54)
alpha,alpha-Dimethylbenzylhydroperoxide	10 (4.54)
Dimethylcarbamoyl chloride	1 (0.454)
Dimethylformamide	100 (45.4)
1,1-Dimethylhydrazine	10 (4.54)
1,2-Dimethylhydrazine	1 (0.454)
Dimethylhydrazine, unsymmetrical @	10 (4.54)
alpha,alpha-Dimethylphenethylamine	5000 (2270)
12,4-Dimethylphenol	100 (45.4)
Dimethyl phthalate	5000 (2270)
Dimethyl sulfate	100 (45.4)
Dinitrobenzene (mixed)	100 (45.4)
m-Dinitrobenzene	-
o-Dinitrobenzene	-
p-Dinitrobenzene	-
4,6-Dinitro-o-cresol and salts	10 (4.54)
Dinitrogen tetroxide @	10 (4.54)
Dinitrophenol	10 (4.54)
2,5-Dinitrophenol	-
2,4-Dinitrophenol	10 (4.54)
Dinitrotoluene	10 (4.54)
3,4-Dinitrotoluene	-
2,4-Dinitrotoluene	10 (4.54)
2,6-Dinitrotoluene	100 (45.4)
Dinoseb	1000 (454)
Di-n-octyl phthalate	5000 (2270)
1,4-Dioxane	100 (45.4)
1,2-Diphenylhydrazine	10 (4.54)
Diphosphoramide, octamethyl-	100 (45.4)
Diphosphoric acid, tetraethyl ester	10 (4.54)
Dipropylamine	5000 (2270)
Di-n-propylnitrosamine	10 (4.54)
Diquat	1000 (454)
Disulfoton	1 (0.454)
Dithiobiuret	100 (45.4)
Diuron	100 (45.4)
Dodecylbenzenesulfonic acid	1000 (454)
2,4-D, salts and esters	100 (45.4)
Endosulfan	1 (0.454)
alpha-Endosulfan	1 (0.454)
beta-Endosulfan	1 (0.454)

Endosulfan sulfate	1 (0.454)
Endothall	1000 (454)
Endrin	1 (0.454)
Endrin, & metabolites	1 (0.454)
Endrin aldehyde	1 (0.454)
Epichlorohydrin	100 (45.4)
Epinephrine	1000 (454)
1,2-Epoxybutane	100 (45.4)
Ethanal	1000 (454)
Ethanamine, N-ethyl-N-nitroso-	1 (0.454)
Ethane, 1,2-dibromo-	1 (0.454)
Ethane, 1,1-dichloro-	1000 (454)
Ethane, 1,2-dichloro-	100 (45.4)
Ethane, hexachloro-	100 (45.4)
Ethane, 1,1'-[methylenebis(oxy)]bis(2-chloro-	1000 (454)
Ethane, 1,1'-oxybis-	100 (45.4)
Ethane, 1,1'-oxybis(2-chloro-	10 (4.54)
Ethane, pentachloro-	10 (4.54)
Ethane, 1,1,1,2-tetrachloro-	100 (45.4)
Ethane, 1,1,2,2-tetrachloro-	100 (45.4)
Ethane, 1,1,2-trichloro-	100 (45.4)
Ethane, 1,1,1-trichloro-	1000 (454)
1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienyl-methyl)-	5000 (2270)
Ethanedinitrile	100 (45.4)
Ethanenitrile	5000 (2270)
Ethanethioamide	10 (4.54)
Ethanimidothioic acid, N-[[(methylamino)carbonyl] oxy]-, methyl ester	100 (45.4)
Ethanol, 2-ethoxy-	1000 (454)
Ethanol, 2,2'-(nitrosoimino)bis-	1 (0.454)
Ethanone, 1-phenyl-	5000 (2270)
Ethanoyl chloride	5000 (2270)
Ethene, chloro-	1 (0.454)
Ethene, 2-chloroethoxy-	1000 (454)
Ethene, 1,1-dichloro-	100 (45.4)
Ethene, 1,2-dichloro- (E)	1000 (454)
Ethene, tetrachloro-	100 (45.4)
Ethene, trichloro-	100 (45.4)
Ethion	10 (4.54)
Ethyl acetate	5000 (2270)
Ethyl acrylate	1000 (454)
Ethylbenzene	1000 (454)
Ethyl carbamate (Urethan)	100 (45.4)
Ethyl chloride @	100 (45.4)
Ethyl cyanide	10 (4.54)
Ethylene dibromide	1 (0.454)
Ethylene dichloride	100 (45.4)
Ethylene glycol	5000 (2270)
Ethylene glycol monoethyl ether	1000 (454)
Ethylene oxide	10 (4.54)
Ethylenebisdithiocarbamic acid	5000 (2270)
Ethylenebisdithiocarbamic acid, salts and esters	5000 (2270)
Ethylenediamine	5000 (2270)
Ethylenediamine tetraacetic acid (EDTA)	5000 (2270)
Ethylenethiourea	10 (4.54)

Ethylenimine	1 (0.454)
Ethyl ether	100 (45.4)
Ethylidene dichloride	1000 (454)
Ethyl methacrylate	1000 (454)
Ethyl methanesulfonate	1 (0.454)
Ethyl methyl ketone @	5000 (2270)
Famphurdimethylester	1000 (454)
Ferric ammonium citrate	1000 (454)
Ferric ammonium oxalate	1000 (454)
Ferric chloride	1000 (454)
Ferric fluoride	100 (45.4)
Ferric nitrate	1000 (454)
Ferric sulfate	1000 (454)
Ferrous ammonium sulfate	1000 (454)
Ferrous chloride	100 (45.4)
Ferrous sulfate	1000 (454)
Fluoranthene	100 (45.4)
Fluorene	5000 (2270)
Fluorine	10 (4.54)
Fluoroacetamide	100 (45.4)
Fluoroacetic acid, sodium salt	10 (4.54)
Formaldehyde	100 (45.4)
Formic acid	5000 (2270)
Fulminic acid, mercury(2+)salt	10 (4.54)
Fumaric acid	5000 (2270)
Furan	100 (45.4)
Furan, tetrahydro-	1000 (454)
2-Furancarboxaldehyde	5000 (2270)
2,5-Furandione	5000 (2270)
Furfural	5000 (2270)
Furfuran	100 (45.4)
Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-	1 (0.454)
D-Glucose, 2-deoxy-2-[[methylnitrosoamino)-carbonyl]amino]-	1 (0.454)
Glycidylaldehyde	10 (4.54)
Guanidine, N-methyl-N'-nitro-N-nitroso-	10 (4.54)
Guthion	1 (0.454)
Heptachlor	1 (0.454)
Heptachlor epoxide	1 (0.454)
Hexachlorobenzene	10 (4.54)
Hexachlorobutadiene	1 (0.454)
Hexachlorocyclohexane (gamma isomer)	1 (0.454)
Hexachlorocyclopentadiene	10 (4.54)
Hexachloroethane	100 (45.4)
1,2,3,4,10-10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo,exo-dimethanonaphthalene	1 (0.454)
Hexachlorophene	100 (45.4)
Hexachloropropene	1000 (454)
Hexaethyl tetraphosphate	100 (45.4)
Hexamethylene-1,6-diisocyanate	100 (45.4)
Hexamethylphosphoramide	1 (0.454)
Hexane	5000 (2270)
Hydrazine	1 (0.454)
Hydrazine, 1,2-diethyl-	10 (4.54)
Hydrazine, 1,1-dimethyl-	10 (4.54)

Hydrazine, 1,2-dimethyl-	1 (0.454)
Hydrazine, 1,2-diphenyl-	10 (4.54)
Hydrazine, methyl-	10 (4.54)
Hydrazinecarbothioamide	100 (45.4)
Hydrochloric acid	5000 (2270)
Hydrocyanic acid	10 (4.54)
Hydrofluoric acid	100 (45.4)
Hydrogen chloride	5000 (2270)
Hydrogen cyanide	10 (4.54)
Hydrogen fluoride	100 (45.4)
Hydrogen phosphide	100 (45.4)
Hydrogen sulfide	100 (45.4)
Hydrogen sulfide H2S	100 (45.4)
Hydroperoxide, 1-methyl-1-phenylethyl-	10 (4.54)
Hydroquinone	100 (45.4)
2-Imidazolidinethione	10 (4.54)
Indeno(1,2,3-cd)pyrene	100 (45.4)
1,3-Isobenzofurandione	5000 (2270)
Isobutyl alcohol	5000 (2270)
Isodrin	1 (0.454)
Isophorone	5000 (2270)
Isoprene	100 (45.4)
Isopropanolamine dodecylbenzene sulfonate	1000 (454)
Isosafrole	100 (45.4)
3(2H)-Isoxazolone, 5-(aminomethyl)-	1000 (454)
Keponedecachloroc-tahydro-	1 (0.454)
Lasiocarpine	10 (4.54)
Lead ¢*	10 (4.54)
Lead acetate	10 (4.54)
Lead arsenate	1 (0.454)
Lead, bis(acetato-O)tetrahydroxytri	10 (4.54)
Lead chloride	10 (4.54)
Lead fluoborate	10 (4.54)
Lead fluoride	10 (4.54)
Lead iodide	10 (4.54)
Lead nitrate	10 (4.54)
Lead phosphate	10 (4.54)
Lead stearate	10 (4.54)
Lead subacetate	10 (4.54)
Lead sulfate	10 (4.54)
Lead sulfide	10 (4.54)
Lead thiocyanate	10 (4.54)
Lindane	1 (0.454)
Lithium chromate	10 (4.54)
Malathion	100 (45.4)
Maleic acid	5000 (2270)
Maleic anhydride	5000 (2270)
Maleic hydrazide	5000 (2270)
Malononitrile	1000 (454)
MDI	5000 (2270)
Melphalan	1 (0.454)
Mercaptodimethur	10 (4.54)
Mercuric cyanide	1 (0.454)
Mercuric nitrate	10 (4.54)

Mercuric sulfate	10 (4.54)
Mercuric thiocyanate	10 (4.54)
Mercurous nitrate	10 (4.54)
Mercury	1 (0.454)
Mercury, (acetato-O)phenyl-	100 (45.4)
Mercury fulminate	10 (4.54)
Methacrylonitrile	1000 (454)
Methanamine, N-methyl-	1000 (454)
Methanamine, N-methyl-N-nitroso	10 (4.54)
Methane, bromo-	1000 (454)
Methane, chloro-	100 (45.4)
Methane, chloromethoxy-	1 (0.454)
Methane, dibromo-	1000 (454)
Methane, dichloro-	1000 (454)
Methane, dichlorodifluoro-	5000 (2270)
Methane, iodo-	100 (45.4)
Methane, isocyanato-	10 (4.54)
Methane, oxybis(chloro-	1 (0.454)
Methane, tetrachloro-	10 (4.54)
Methane, tetranitro-	10 (4.54)
Methane, tribromo-	100 (45.4)
Methane, trichloro-	10 (4.54)
Methane, trichlorofluoro-	5000 (2270)
Methanesulfenyl chloride, trichloro-	100 (45.4)
Methanesulfonic acid, ethyl ester	1 (0.454)
Methanethiol	100 (45.4)
6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	1 (0.454)
Methanoic acid	5000 (2270)
4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-a,4,7,7a-tetrahydro-	1 (0.454)
4,7-Methano-1H-indene, 1,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-	1 (0.454)
Methanol	5000 (2270)
Methapyrilene	5000 (2270)
1,3,4-Metheno-2H-cyclobutal[cd]-pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachloroctahydro-	1 (0.454)
Methomyl	100 (45.4)
Methoxychlor	1 (0.454)
Methyl alcohol	5000 (2270)
Methylamine @	100 (45.4)
Methyl bromide	1000 (454)
1-Methylbutadiene	100 (45.4)
Methyl chloride	100 (45.4)
Methyl chlorocarbonate	1000 (454)
Methyl chloroform	1000 (454)
Methyl chloroformate	1000 (454)
Methylchloromethyl ether @	1 (0.454)
3-Methylcholanthrene	10 (4.54)
4,4'-Methylenebis(2-chloroaniline)	10 (4.54)
Methylene bromide	1000 (454)
Methylene chloride	1000 (454)
4,4'-Methylenedianiline	10 (4.54)
Methylene diphenyl diisocyanate	5000 (2270)
Methylene oxide	100 (45.4)
Methyl ethyl ketone (MEK)	5000 (2270)

Methyl ethyl ketone peroxide	10 (4.54)
Methyl hydrazine	10 (4.54)
Methyl iodide	100 (45.4)
Methyl isobutyl ketone	5000 (2270)
Methyl isocyanate	10 (4.54)
2-Methyllactonitrile	10 (4.54)
Methyl mercaptan	100 (45.4)
Methyl methacrylate	1000 (454)
Methyl parathion	100 (45.4)
4-Methyl-2-pentanone	5000 (2270)
Methyl tert-butyl ether	1000 (454)
Methylthiouracil	10 (4.54)
Mevinphos	10 (4.54)
Mexacarbate	1000 (454)
Mitomycin C	10 (4.54)
MNNG	10 (4.54)
Monoethylamine	100 (45.4)
Monomethylamine	100 (45.4)
Muscimol	1000 (454)
Naled	10 (4.54)
5,12-Naphthacenedione, 8-acetyl-10-[3-amino-2,3,6-trideoxy-alpha-L-lyxo-hexopyranosyl) oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-	10 (4.54)
Naphthalenamine, N,N-bis(2-chloroethyl)-	100 (45.4)
Naphthalene	100 (45.4)
Naphthalene, 2-chloro-	5000 (2270)
1,4-Naphthalenedione	5000 (2270)
2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'- dimethyl-(l,1'-biphenyl)-4,4'-diyl)-bis(azo)]bis(5-amino-4-hydroxy)-tetrasodium salt	10 (4.54)
Naphthenic acid	100 (45.4)
1,4-Naphthoquinone	5000 (2270)
alpha-Naphthylamine	100 (45.4)
beta-Naphthylamine	1 (0.454)
1-Naphthylamine	100 (45.4)
2-Naphthylamine	1 (0.454)
alpha-Naphthylthiourea	100 (45.4)
Nickel ¢*	100 (45.4)
Nickel ammonium sulfate	100 (45.4)
Nickel carbonyl	10 (4.54)
Nickel carbonyl Ni(CO)4,(T-4)-	10 (4.54)
Nickel chloride	100 (45.4)
Nickel cyanide	10 (4.54)
Nickel cyanide Ni(CN)2	10 (4.54)
Nickel hydroxide	10 (4.54)
Nickel nitrate	100 (45.4)
Nickel sulfate	100 (45.4)
Nicotine and salts	100 (45.4)
Nitric acid	1000 (454)
Nitric acid, thallium(1+) salt	100 (45.4)
Nitric oxide	10 (4.54)
p-Nitroaniline	5000 (2270)
Nitrobenzene	1000 (454)
4-nitrobiphenyl	10 (4.54)
Nitrogen dioxide	10 (4.54)
Nitrogen oxide NO	10 (4.54)

Nitrogen oxide NO2	10 (4.54)
Nitroglycerine	10 (4.54)
Nitrophenol (mixed)	100 (45.4)
m-	-
o-	-
p-	-
o-Nitrophenol	100 (45.4)
p-Nitrophenol	100 (45.4)
2-Nitrophenol	100 (45.4)
4-Nitrophenol	100 (45.4)
2-Nitropropane	10 (4.54)
N-Nitrosodi-n-butylamine	10 (4.54)
N-Nitrosodiethanolamine	1 (0.454)
N-Nitrosodiethylamine	1 (0.454)
N-Nitrosodimethylamine	10 (4.54)
N-Nitrosodiphenylamine	100 (45.4)
N-Nitroso-N-ethylurea	1 (0.454)
N-Nitroso-N-methylurea	1 (0.454)
N-Nitroso-N-methylurethane	1 (0.454)
N-Nitrosomethylvinylamine	10 (4.54)
n-Nitrosomorpholine	1 (0.454)
N-Nitrosopiperidine	10 (4.54)
N-Nitrosopyrrolidine	1 (0.454)
Nitrotoluene	1000 (454)
m-Nitrotoluene	-
o-Nitrotoluene	-
p-Nitrotoluene	-
5-Nitro-o-toluidine	100 (45.4)
Octamethylpyrophosphoramide	100 (45.4)
Osmium oxide OsO4 (T-4)-	1000 (454)
Osmium tetroxide	1000 (454)
7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	1000 (454)
1,2-Oxathiolane, 2,2-dioxide	10 (4.54)
2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide	10 (4.54)
Oxirane	10 (4.54)
Oxiranecarboxyaldehyde	10 (4.54)
Oxirane, (chloromethyl)-	100 (45.4)
Paraformaldehyde	1000 (454)
Paraldehyde	1000 (454)
Parathion	10 (4.54)
Pentachlorobenzene	10 (4.54)
Pentachloroethane	10 (4.54)
Pentachloronitrobenzene (PCNB)	100 (45.4)
Pentachlorophenol	10 (4.54)
1,3-Pentadiene	100 (45.4)
Perchloroethylene	100 (45.4)
Perchloromethyl mercaptan @	100 (45.4)
Phenacetin	100 (45.4)
Phenanthrene	5000 (2270)
Phenol	1000 (454)
Phenol, 2-chloro-	100 (45.4)
Phenol, 4-chloro-3-methyl-	5000 (2270)
Phenol, 2-cyclohexyl-4,6-dinitro-	100 (45.4)
Phenol, 2,4-dichloro-	100 (45.4)

Phenol, 2,6-dichloro-	100 (45.4)
Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)	1 (0.454)
Phenol, 2,4-dimethyl-	100 (45.4)
Phenol, 2,4-dinitro-	10 (4.54)
Phenol, methyl-	100 (45.4)
Phenol, 2-methyl-4,6-dinitro-	10 (4.54)
Phenol, 2,2'-methylenebis[3,4,6-trichloro-	100 (45.4)
Phenol, 2-(1-methylpropyl)-4,6-dinitro	1000 (454)
Phenol, 4-nitro-	100 (45.4)
Phenol, pentachloro-	10 (4.54)
Phenol, 2,3,4,6-tetrachloro-	10 (4.54)
Phenol, 2,4,5-trichloro-	10 (4.54)
Phenol, 2,4,6-trichloro-	10 (4.54)
Phenol, 2,4,6-trinitro-, ammonium salt	10 (4.54)
L-Phenylalanine, 4-[bis(2-chloroethyl)aminol]	1 (0.454)
p-Phenylenedimine	5000 (2270)
1,10-(1,2-Phenylene)pyrene	100 (45.4)
Phenyl mercaptan @	100 (45.4)
Phenylmercuric acetate	100 (45.4)
Phenylthiourea	100 (45.4)
Phorate	10 (4.54)
Phosgene	10 (4.54)
Phosphine	100 (45.4)
Phosphoric acid	5000 (2270)
Phosphoric acid, diethyl 4-nitrophenyl ester	100 (45.4)
Phosphoric acid, lead(2+) salt (2:3)	10 (4.54)
Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl]ester	1 (0.454)
Phosphorodithioic acid, O,O-diethyl S-(ethylthio), methyl ester	10 (4.54)
Phosphorodithioic acid, O,O-diethyl S-methyl ester	5000 (2270)
Phosphorodithioic acid, O,O-dimethyl S-[2 (methylamino)-2-oxoethyl] ester	10 (4.54)
Phosphorofluoridic acid, bis(1-methylethyl) ester	100 (45.4)
Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	10 (4.54)
Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	100 (45.4)
Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester	100 (45.4)
Phosphorothioic acid, O,[4-[(dimethylamino)sulfonyl] phenyl] O,O-dimethyl ester	1000 (454)
Phosphorus	1 (0.454)
Phosphorus oxychloride	1000 (454)
Phosphorus pentasulfide	100 (45.4)
Phosphorus sulfide	100 (45.4)
Phosphorus trichloride	1000 (454)
Phthalic anhydride	5000 (2270)
2-Picoline	5000 (2270)
Piperidine, 1-nitroso-	10 (4.54)
Plumbane, tetraethyl-	10 (4.54)
POLYCHLORINATED BIPHENYLS (PCBs)	1 (0.454)
Potassium arsenate	1 (0.454)
Potassium arsenite	1 (0.454)
Potassium bichromate	10 (4.54)
Potassium chromate	10 (4.54)
Potassium cyanide	10 (4.54)
Potassium cyanide K(CN)	10 (4.54)
Potassium hydroxide	1000 (454)
Potassium permanganate	100 (45.4)
Potassium silver cyanide	1 (0.454)

Pronamide	5000 (2270)
Propanal, 2-methyl-2-(methylthio)-,O-[(methylamino)carbonyl]oxime	1 (0.454)
1-Propanamine	5000 (2270)
1-Propanamine, N-nitroso-N-propyl-	10 (4.54)
1-Propanamine, N-propyl-	5000 (2270)
Propane, 1,2-dibromo-3-chloro-	1 (0.454)
Propane, 1,2-dichloro-	1000 (454)
Propane, 2-nitro-	10 (4.54)
Propane, 2,2'-oxybis [2-chloro-	1000 (454)
1,3-Propane sultone	10 (4.54)
Propanedinitrile	1000 (454)
Propanenitrile	10 (4.54)
Propanenitrile, 3-chloro-	1000 (454)
Propanenitrile, 2-hydroxy-2-methyl-	10 (4.54)
1,2,3-Propanetriol, trinitrate-	10 (4.54)
1-Propanol, 2,3-dibromo-, phosphate (3:1)	10 (4.54)
1-Propanol, 2-methyl-	5000 (2270)
2-Propanone	5000 (2270)
2-Propanone, 1-bromo-	1000 (454)
Propargite	10 (4.54)
Propargyl alcohol	1000 (454)
2-Propenal	1 (0.454)
2-Propenamide	5000 (2270)
1-Propene, 1,3-dichloro-	100 (45.4)
1-Propene, 1,1,2,3,3,3-hexachloro-	1000 (454)
2-Propenenitrile	100 (45.4)
2-Propenenitrile, 2-methyl-	1000 (454)
2-Propenoic acid	5000 (2270)
2-Propenoic acid, ethyl ester	1000 (454)
2-Propenoic acid, 2-methyl-, ethyl ester	1000 (454)
2-Propenoic acid, 2-methyl-, methyl ester	1000 (454)
2-Propen-1-ol	100 (45.4)
beta-Propioaldehyde	1000 (454)
Propionic acid	5000 (2270)
Propionic acid, 2-(2,4,5-trichlorophenoxy)-	100 (45.4)
Propionic anhydride	5000 (2270)
Propoxur (baygon)	100 (45.4)
n-Propylamine	5000 (2270)
Propylene dichloride	1000 (454)
Propylene oxide	100 (45.4)
1,2-Propylenimine	1 (0.454)
2-Propyn-1-ol	1000 (454)
Pyrene	5000 (2270)
Pyrethrins	1 (0.454)
3,6-Pyridazinedione, 1,2-dihydro-	5000 (2270)
4-Pyridinamine	1000 (454)
Pyridine	1000 (454)
Pyridine, 2-methyl-	5000 (2270)
Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)	100 (45.4)
2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-	10 (4.54)
4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-	10 (4.54)
Pyrrolidine, 1-nitroso-	1 (0.454)
Quinoline	5000 (2270)
RADIONUCLIDES	See table 2

Reserpine	5000 (2270)
Resorcinol	5000 (2270)
Saccharin and salts	100 (45.4)
Safrole	100 (45.4)
Selenious acid	10 (4.54)
Selenious acid, dithallium(1+) salt	1000 (454)
Selenium ¢*	100 (45.4)
Selenium dioxide	10 (4.54)
Selenium oxide	10 (4.54)
Selenium sulfide	10 (4.54)
Selenium sulfide SeS2	10 (4.54)
Selenourea	1000 (454)
L-Serine, diazoacetate (ester)	1 (0.454)
Silver ¢*	1000 (454)
Silver cyanide	1 (0.454)
Silver cyanide Ag(CN)	1 (0.454)
Silver nitrate	1 (0.454)
Silvex(2,4,5-TP)	100 (45.4)
Sodium	10 (4.54)
Sodium arsenate	1 (0.454)
Sodium arsenite	1 (0.454)
Sodium azide	1000 (454)
Sodium bichromate	10 (4.54)
Sodium bifluoride	100 (45.4)
Sodium bisulfite	5000 (2270)
Sodium chromate	10 (4.54)
Sodium cyanide	10 (4.54)
Sodium cyanide Na(CN)	10 (4.54)
Sodium dodecylbenzene sulfonate	1000 (454)
Sodium fluoride	1000 (454)
Sodium hydrosulfide	5000 (2270)
Sodium hydroxide	1000 (454)
Sodium hypochlorite	100 (45.4)
Sodium methylate	1000 (454)
Sodium nitrite	100 (45.4)
Sodium phosphate, dibasic	5000 (2270)
Sodium phosphate, tribasic	5000 (2270)
Sodium selenite	100 (45.4)
Streptozotocin	1 (0.454)
Strontium chromate	10 (4.54)
Strychnidin-10-one	10 (4.54)
Strychnidin-10-one, 2,3-dimethoxy-	100 (45.4)
Strychnine and salts	10 (4.54)
Styrene	1000 (454)
Styrene oxide	100 (45.4)
Sulfur chloride @	1000 (454)
Sulfur monochloride	1000 (454)
Sulfur phosphide	100 (45.4)
Sulfuric acid	1000 (454)
Sulfuric acid, dimethyl ester	100 (45.4)
Sulfuric acid, dithallium(I+) salt	100 (45.4)
2,4,5-T	1000 (454)
2,4,5-T acid	1000 (454)
2,4,5-T amines	5000 (2270)

2,4,5-T esters	1000 (454)
2,4,5-T salts	1000 (454)
TDE	1 (0.454)
1,2,4,5-Tetrachlorobenzene	5000 (2270)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1 (0.454)
1,1,1,2-Tetrachloroethane	100 (45.4)
1,1,2,2-Tetrachloroethane	100 (45.4)
Tetrachloroethane @	100 (45.4)
Tetrachloroethene	100 (45.4)
Tetrachloroethylene	100 (45.4)
2,3,4,6-Tetrachlorophenol	10 (4.54)
Tetraethyl lead	10 (4.54)
Tetraethyl pyrophosphate	10 (4.54)
Tetraethyldithiopyrophosphate	100 (45.4)
Tetrahydrofuran	1000 (454)
Tetranitromethane	10 (4.54)
Tetraphosphoric acid, hexaethyl ester	100 (45.4)
Thallic oxide	100 (45.4)
Thallium ¢*	1000 (454)
Thallium(I) acetate	100 (45.4)
Thallium(I) carbonate	100 (45.4)
Thallium(I) chloride	100 (45.4)
Thallium chloride TlCl	100 (45.4)
Thallium(I) nitrate	100 (45.4)
Thallium oxide T1203	100 (45.4)
Thallium selenite	1000 (454)
Thallium(I) sulfate	100 (45.4)
Thioacetamide	10 (4.54)
Thiodiphosphoric acid, tetraethyl ester	100 (45.4)
Thiofanox	100 (45.4)
Thioimidodicarbonic diamide [(H2N)C(S)]2NH	100 (45.4)
Thiomethanol	100 (45.4)
Thioperoxydicarbonic diamide [(H2N)C(S)]2S2, tetramethyl-	10 (4.54)
Thiophenol	100 (45.4)
Thiosemicarbazide	100 (45.4)
Thiourea	10 (4.54)
Thiourea, (2-chlorophenyl)-	100 (45.4)
Thiourea, 1-naphthalenyl-	100 (45.4)
Thiourea, phenyl-	100 (45.4)
Thiram	10 (4.54)
Titanium tetrachloride	1000 (454)
Toluene	1000 (454)
Toluenediamine	10 (4.54)
Toluene diisocyanate	100 (45.4)
o-Toluidine	100 (45.4)
p-Toluidine	100 (45.4)
o-Toluidine hydrochloride	100 (45.4)
Toxaphene	1 (0.454)
2,4,5-TP acid	100 (45.4)
2,4,5-TP acid esters	100 (45.4)
1H-1,2,4-Triazol-3-amine	10 (4.54)
Trichlorfon	100 (45.4)
1,2,4-Trichlorobenzene	100 (45.4)
1,1,1-Trichloroethane	1000 (454)

1,1,2-Trichloroethane	100 (45.4)
Trichloroethene	100 (45.4)
Trichloroethylene	100 (45.4)
Trichloromethanesulfenyl chloride	100 (45.4)
Trichloromonofluoromethane	5000 (2270)
Trichlorophenol	10 (4.54)
2,3,4-Trichlorophenol	-
2,3,5-Trichlorophenol	-
2,3,6-Trichlorophenol	-
2,4,5-Trichlorophenol	-
2,4,6-Trichlorophenol	-
3,4,5-Trichlorophenol	-
2,4,5-Trichlorophenol	10 (4.54)
2,4,6-Trichlorophenol	10 (4.54)
Triethanolamine dodecylbenzene sulfonate	1000 (454)
Triethylamine	5000 (2270)
Trifluralin	10 (4.54)
Trimethylamine	100 (45.4)
2,2,4-Trimethylpentane	1000 (454)
1,3,5-Trinitrobenzene	10 (4.54)
1,3,5-Trioxane, 2,4,6-trimethyl-	1000 (454)
Tris(2,3-dibromopropyl) phosphate	10 (4.54)
Trypan blue	10 (4.54)
Uracil mustard	10 (4.54)
Uranyl acetate	100 (45.4)
Uranyl nitrate	100 (45.4)
Urea, N-ethyl-N-nitroso-	1 (0.454)
Urea, N-methyl-N-nitroso-	1 (0.454)
Vanadic acid, ammonium salt	1000 (454)
Vanadium oxide V205	1000 (454)
Vanadium pentoxide	1000 (454)
Vanadyl sulfate	1000 (454)
Vinyl acetate	5000 (2270)
Vinyl acetate monomer	5000 (2270)
Vinylamine, N-methyl-N-nitroso-	10 (4.54)
Vinyl bromide	100 (45.4)
Vinyl chloride	1 (0.454)
Vinylidene chloride	100 (45.4)
Warfarin, & salts, when present at concentrations greater than 0.3%	100 (45.4)
Xylene	100 (45.4)
m-Xylene	1000 (454)
o-Xylene	1000 (454)
p-Xylene	100 (45.4)
Xylene (mixed)	100 (45.4)
Xylenes (isomers and mixture)	100 (45.4)
Xylenol	1000 (454)
Yohimban-16-carboxylic acid,11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester (3beta,16beta,17alpha,18beta,20alpha)-	5000 (2270)
Zinc ¢*	1000 (454)
Zinc acetate	1000 (454)
Zinc ammonium chloride	1000 (454)
Zinc borate	1000 (454)
Zinc bromide	1000 (454)
Zinc carbonate	1000 (454)

Zinc chloride	1000 (454)
Zinc cyanide	10 (4.54)
Zinc cyanide Zn(CN)2	10 (4.54)
Zinc fluoride	1000 (454)
Zinc formate	1000 (454)
Zinc hydrosulfite	1000 (454)
Zinc nitrate	1000 (454)
Zinc phenolsulfonate	5000 (2270)
Zinc phosphide	100 (45.4)
Zinc phosphide Zn3P2, when present at concentrations greater than 10%	100 (45.4)
Zinc silicofluoride	5000 (2270)
Zinc sulfate	1000 (454)
Zirconium nitrate	5000 (2270)
Zirconium potassium fluoride	1000 (454)
Zirconium sulfate	5000 (2270)
Zirconium tetrachloride	5000 (2270)
D001 Unlisted Hazardous Wastes Characteristic of Ignitability	100 (45.4)
D002 Unlisted Hazardous Wastes Characteristic of Corrosivity	100 (45.4)
D003 Unlisted Hazardous Wastes Characteristic of Reactivity	100 (45.4)
D004-D043 Unlisted Hazardous Wastes Characteristic of Toxicity	-
D004 Arsenic	1 (0.454)
D005 Barium	1000 (454)
D006 Cadmium	10 (4.54)
D007 Chromium	10 (4.54)
D008 Lead	10 (4.54)
D009 Mercury	1 (0.454)
D010 Selenium	10 (4.54)
D011 Silver	1 (0.454)
D012 Endrin	1 (0.454)
D013 Lindane	1 (0.454)
D014 Methoxychlor	1 (0.454)
D015 Toxaphene	1 (0.454)
D016 2,4-D	100 (45.4)
D017 2,4,5-TP	100 (45.4)
D018 Benzene	10 (4.54)
D019 Carbon tetrachloride	10 (4.54)
D020 Chlordane	1 (0.454)
D021 Chlorobenzene	100 (45.4)
D022 Chloroform	10 (4.54)
D023 o-Cresol	100 (45.4)
D024 m-Cresol	100 (45.4)
D025 p-Cresol	100 (45.4)
D026 Cresol	100 (45.4)
D027 1,4-Dichlorobenzene	100 (45.4)
D028 1,2-Dichloroethane	100 (45.4)
D029 1,1-Dichloroethylene	100 (45.4)
D030 2,4-Dinitrotoluene	10 (4.54)
D031 Heptachlor (and hydroxide)	1 (0.454)
D032 Hexachlorobenzene	10 (4.54)
D033 Hexachlorobutadiene	1 (0.454)
D034 Hexachloroethane	100 (45.4)
D035 Methyl ethyl ketone	5000 (2270)
D036 Nitrobenzene	1000 (454)
D037 Pentachlorophenol	10 (4.54)

D038 Pyridine	1000 (454)
D039 Tetrachloroethylene	100 (45.4)
D040 Tricholorethylene	100 (45.4)
D041 2,4,5-Trichlorophenol	10 (4.54)
D042 2,4,6-Trichlorophenol	10 (4.54)
D043 Vinyl chloride	1 (0.454)
F001 The following spent halogenated solvents used in degreasing; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the below listed halogenated solvents or those solvents listed in F002, F004 and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	10 (4.54)
(a) Tetrachloroethylene	100 (45.4)
(b) Trichloroethylene	100 (45.4)
(c) Methylene chloride	1000 (454)
(d) 1,1,1-Trichloroethane	1000 (454)
(e) Carbon tetrachloride	10 (4.54)
(f) Chlorinated fluorocarbons	5000 (2270)
F002 The following spent halogenated solvents; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the below listed halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	10 (4.54)
(a) Tetrachloroethylene	100 (45.4)
(b) Methylene chloride	1000 (454)
(c) Trichloroethylene	100 (45.4)
(d) 1,1,1-Trichloroethane	1000 (454)
(e) Chlorobenzene	100 (45.4)
(f) 1,1,2-Trichloro-1,2,2-trifluoroethane	5000 (2270)
(g) o-Dichlorobenzene	100 (45.4)
(h) Trichlorofluoromethane	5000 (2270)
(i) 1,1,2 Trichloroethane	100 (45.4)
F003 The following spent non-halogenated solvents and solvents:	100 (45.4)
(a) Xylene	1000 (454)
(b) Acetone	5000 (2270)
(c) Ethyl acetate	5000 (2270)
(d) Ethylbenzene	1000 (454)
(e) Ethyl ether	100 (45.4)
(f) Methyl isobutyl ketone	5000 (2270)
(g) n-Butyl alcohol	5000 (2270)
(h) Cyclohexanone	5000 (2270)
(i) Methanol	5000 (2270)
F004	100 (45.4)
The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:	-
(a) Cresols/Cresylic acid	1000 (454)
(b) Nitrobenzene	100 (45.4)
F005 The following spent non-halogenated solvents and the still bottoms from the recovery of these solvents:	100 (45.4)
(a) Toluene	1000 (454)
(b) Methyl ethyl ketone	5000 (2270)
(c) Carbon disulfide	100 (45.4)
(d) Isobutanol	5000 (2270)
(e) Pyridine	1000 (454)
F006 Wastewater treatment sludges from electroplating operations except from the following processes: (1) sulfuric acid anodizing of aluminum, (2) tin plating on carbon steel, (3) zinc plating (segregated basis) on carbonsteel, (4) aluminum or	10 (4.54)

zinc-aluminum plating on carbon steel, (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel, and (6) chemical etching and milling of aluminum	
F007 Spent cyanide plating bath solutions from electroplating operations	10 (4.54)
F008 Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process	10 (4.54)
F009 Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process	10 (4.54)
F010 Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process	10 (4.54)
F011 Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations (except for precious metals heat treating spent cyanide solutions from salt bath pot cleaning)	10 (4.54)
F012 Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process	10 (4.54)
F019 Wastewater treatment sludges from the chemical conversion coating of aluminum-except from zirconium phosphating in aluminum can washing when such phosphating is an exclusive conversion coating process	10 (4.54)
F020 Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of hexachlorophene from highly purified 2,4,5-trichlorophenol.)	1 (0.454)
F021 Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.	1 (0.454)
F022 Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions.	1 (0.454)
F023 Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of hexachlorophene from highly purified 2,4,5-trichlorophenol.)	1 (0.454)
F024 Wastes, including but not limited to distillation residues, heavy ends, tars, and reactor cleanout wastes, from the production of chlorinated aliphatichydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. (This listing does not include light ends, spent filters and filter aids, spent dessicants(sic), wastewater, wastewater treatment sludges,spent catalysts, and wastes listed in 40 CFR 261.32.)	1 (0.454)
F025 Condensed light ends, spent filters and filter aids, and spent desiccant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. These chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution	1 (0.454)
F026 Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.	1 (0.454)
F027 Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing	1 (0.454)

hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component.)	
F028 Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027.	1 (0.454)
F032	1 (0.454)
F034	1 (0.454)
F035	1 (0.454)
F037	1 (0.454)
F038	1 (0.454)
F039 Multi source leachate	1 (0.454)
K001 Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	-
K002 Wastewater treatment sludge from the production of chrome yellow and orange pigments	10 (4.54)
K003 Wastewater treatment sludge from the production of molybdate orange pigments	-
K004 Wastewater treatment sludge from the production of zinc yellow pigments	10 (4.54)
K005 Wastewater treatment sludge from the production of chrome green pigments	-
K006 Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)	10 (4.54)
K007 Wastewater treatment sludge from the production of iron blue pigments	-
K008 Oven residue from the production of chrome oxide green pigments	10 (4.54)
K009 Distillation bottoms from the production of acetaldehyde from ethylene	10 (4.54)
K010 Distillation side cuts from the production of acetaldehyde from ethylene	10 (4.54)
K011 Bottom stream from the wastewater stripper in the production of acrylonitrile	10 (4.54)
K013 Bottom stream from the acetonitrile column in the production of acrylonitrile	10 (4.54)
K014 Bottoms from the acetonitrile purification column in the production of acrylonitrile	5000 (2270)
K015 Still bottoms from the distillation of benzyl chloride	10 (4.54)
K016 Heavy ends or distillation residues from the production of carbon tetrachloride	1 (0.454)
K017 Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin	10 (4.54)
K018 Heavy ends from the fractionation column in ethyl chloride production	1 (0.454)
K019 Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production.	1 (0.454)
K020 Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production	1 (0.454)
K021 Aqueous spent antimony catalyst waste from fluoromethanes production	10 (4.54)
K022 Distillation bottom tars from the production of phenol/acetone from cumene	1 (0.454)
K023 Distillation light ends from the production of phthalic anhydride from naphthalene	5000 (2270)
K024 Distillation bottoms from the production of phthalic anhydride from naphthalene	5000 (2270)
K025 Distillation bottoms from the production of nitrobenzene by the nitration of benzene	10 (4.54)
K026 Stripping still tails from the production of methyl ethyl pyridines	1000 (454)
K027 Centrifuge and distillation residues from toluene diisocyanate production	10 (4.54)
K028 Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane	1 (0.454)
K029 Waste from the product steam stripper in the production of 1,1,1-trichloroethane	1 (0.454)
K030 Column bottoms or heavy ends from the combined production of	1 (0.454)

trichloroethylene and perchloroethylene	
K031 By-product salts generated in the production of MSMA and cacodylic acid	1 (0.454)
K032 Wastewater treatment sludge from the production of chlordane	10 (4.54)
K033 Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane	10 (4.54)
K034 Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane	10 (4.54)
K035 Wastewater treatment sludges generated in the production of creosote	1 (0.454)
K036 Still bottoms from toluene reclamation distillation in the production ofdisulfoton	1 (0.454)
K037 Wastewater treatment sludges from the production of disulfoton	1 (0.454)
K038 Wastewater from the washing and stripping of phorate production	10 (4.54)
K039 Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate	10 (4.54)
K040 Wastewater treatment sludge from the production of phorate	10 (4.54)
K041 Wastewater treatment sludge from the production of toxaphene	1 (0.454)
K042 Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	10 (4.54)
K043 2,6-dichlorophenol waste from the production of 2,4-D	10 (4.54)
K044 Wastewater treatment sludges from the manufacturing and processing of explosives	10 (4.54)
K045 Spent carbon from the treatment of wastewater containing explosives	10 (4.54)
K046 Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds	10 (4.54)
K047 Pink/red water from TNT operations	10 (4.54)
K048 Dissolved air flotation (DAF) float from the petroleum refining industry	10 (4.54)
K049 Slop oil emulsion solids from the petroleum refining industry	10 (4.54)
K050 Heat exchanger bundle cleaning sludge from the petroleum refining industry	10 (4.54)
K051 API separator sludge from the petroleum refining industry	10 (4.54)
K052 Tank bottoms (leaded) from the petroleum refining industry	10 (4.54)
K060 Ammonia still lime sludge from coking operations	1 (0.454)
K061 Emission control dust/sludge from the primary production of steel in electric furnaces	10 (4.54)
K062 Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry	10 (4.54)
K064 Acid plant blowdown slurry/sludge resulting from thickening of blowdown slurry from primary copper production.	10 (4.54)
K065 Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.	10 (4.54)
K066 Sludge from treatment of process wastewater and /or acid plant blowdown from primary zinc production.	10 (4.54)
K069 Emission control dust/sludge from secondary lead smelting	10 (4.54)
K071 Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used	1 (0.454)
K073 Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production.	10 (4.54)
K083 Distillation bottoms from aniline extraction	100 (45.4)
K084 Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	1 (0.454)
K085 Distillation or fractionation column bottoms from the production of chlorobenzenes	10 (4.54)
K086 Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	10 (4.54)
K087 Decanter tank tar sludge from coking operations	100 (45.4)

K088	10 (4.54)
Spent potliners from primary aluminum reduction.	-
K090	10 (4.54)
Emission control dust or sludge from ferrochromiumsilicon production	-
K091	10 (4.54)
Emission control dust or sludge from ferrochromium production	-
K093 Distillation light ends from the production of phthalic anhydride from ortho-xylene	5000 (2270)
K094 Distillation bottoms from the production of phthalic anhydride from ortho-xylene	5000 (2270)
K095 Distillation bottoms from the production of 1,1,1-trichloroethane.	100 (45.4)
K096 Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane.	100 (45.4)
K097 Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane	1 (0.454)
K098 Untreated process wastewater from the production of toxaphene	1 (0.454)
K099 Untreated wastewater from the production of 2,4-D	10 (4.54)
K100 Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting	10 (4.54)
K101 Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	1 (0.454)
K102 Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	1 (0.454)
K103 Process residues from aniline extraction from the production of aniline	100 (45.4)
K104 Combined wastewater streams generated from nitrobenzene/aniline chlorobenzenes	10 (4.54)
K105 Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes	10 (4.54)
K106 Wastewater treatment sludge from the mercury cell process in chlorine production	1 (0.454)
K107 Column bottoms from product seperation from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazines	10 (4.54)
K108 Condensed column overheads from product seperation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydrazides	10 (4.54)
K109 Spent filter cartidges from product purification from the production of 1,1-dimethylhydrazine (UDMH) from carboxylic acid hydazides	10 (4.54)
K110 Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazines (UDMH) from carboxylic acid hydrazides	10 (4.54)
K111 Product washwaters from the production of dinitrotoluene via nitration of toluene.	10 (4.54)
K112 Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.	10 (4.54)
K113 Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	10 (4.54)
K114 Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	10 (4.54)
K115 Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.	10 (4.54)
K116 Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine.	10 (4.54)
K117 Wastewater from the reaction vent gas scrubber in the production of ethylene bromide via bromination of ethene.	1 (0.454)
K118 Spent absorbent solids from purification of ethylene dibromide in the	1 (0.454)

production of ethylene dibromide.	
K123 Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salts.	10 (4.54)
K124 Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts.	10 (4.54)
K125 Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts.	10 (4.54)
K126 Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salts.	10 (4.54)
K131 Waste water from the reactor and spent sulfuric acid from the acid dryer in the production of methyl bromide	100 (45.4)
K132 Spent absorbent and wastewater solids from the production of methyl bromide	1000 (454)
K136 Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.	1 (0.454)
K141	1 (0.454)
K142	1 (0.454)
K143	1 (0.454)
K144	1 (0.454)
K145	1 (0.454)
K147	1 (0.454)
K148	1 (0.454)
K149	10 (4.54)
K150	10 (4.54)
K151	10 (4.54)

Footnotes:

¢* The RQ for these hazardous substances is limited to those pieces of the metal having a diameter smaller than 100 micrometers (0.004 inches)

¢*¢* The RQ for asbestos is limited to friable forms only

@ Indicates that the name was added by RSPA because (1) the name is a synonym for a specific hazardous substance and (2) the name appears in the Hazardous Materials Table as a proper shipping name.

List of Hazardous Substances and Reportable Quantities

Table 2 to Appendix A-Radionuclides

(1)-Radionuclide	(2)-Atomic Number	(3)-Reportable Quantity (RQ) Ci (TBq)
Actinium-224	89	100 (3.7)
Actinium-225	89	1 (.037)
Actinium-226	89	10 (.37)
Actinium-227	89	0.001 (.000037)
Actinium-228	89	10 (.37)
Aluminum-26	13	10 (.37)
Americium-237	95	1000 (37)
Americium-238	95	100 (3.7)
Americium-239	95	100 (3.7)
Americium-240	95	10 (.37)

Americium-241	95	0.01 (.00037)
Americium-242	95	100 (3.7)
Americium-242m	95	0.01 (.00037)
Americium-243	95	0.01 (.00037)
Americium-244	95	10 (.37)
Americium-244m	95	1000 (37)
Americium-245	95	1000 (37)
Americium-246	95	1000 (37)
Americium-246m	95	1000 (37)
Antimony-115	51	1000 (37)
Antimony-116	51	1000 (37)
Antimony-116m	51	100 (3.7)
Antimony-117	51	1000 (37)
Antimony-118m	51	10 (.37)
Antimony-119	51	1000 (37)
Antimony-120 (16 min)	51	1000 (37)
Antimony-120 (5.76 day)	51	10 (.37)
Antimony-122	51	10 (.37)
Antimony-124	51	10 (.37)
Antimony-124m	51	1000 (37)
Antimony-125	51	10 (.37)
Antimony-126	51	10 (.37)
Antimony-126m	51	1000 (37)
Antimony-127	51	10 (.37)
Antimony-128 (10.4 min)	51	1000 (37)
Antimony-128 (9.01 hr)	51	10 (.37)
Antimony-129	51	100 (3.7)
Antimony-130	51	100 (3.7)
Antimony-131	51	1000 (37)
Argon-39	18	1000 (37)
Argon-41	18	10 (.37)
Arsenic-69	33	1000 (37)
Arsenic-70	33	100 (3.7)
Arsenic-71	33	100 (3.7)
Arsenic-72	33	10 (.37)
Arsenic-73	33	100 (3.7)
Arsenic-74	33	10 (.37)
Arsenic-76	33	100 (3.7)
Arsenic-77	33	1000 (37)
Arsenic-78	33	100 (3.7)
Astatine-207	85	100 (3.7)
Astatine-211	85	100 (3.7)
Barium-126	56	1000 (37)
Barium-128	56	10 (.37)
Barium-131	56	10 (.37)
Barium-131m	56	1000 (37)
Barium-133	56	10 (.37)
Barium-133m	56	100 (3.7)
Barium-135m	56	1000 (37)
Barium-139	56	1000 (37)
Barium-140	56	10 (.37)
Barium-141	56	1000 (37)
Barium-142	56	1000 (37)
Berkelium-245	97	100 (3.7)

Berkelium-246	97	10 (.37)
Berkelium-247	97	0.01 (.00037)
Berkelium-249	97	1 (.037)
Berkelium-250	97	100 (3.7)
Beryllium-10	4	1 (.037)
Beryllium-7	4	100 (3.7)
Bismuth-200	83	100 (3.7)
Bismuth-201	83	100 (3.7)
Bismuth-202	83	1000 (37)
Bismuth-203	83	10 (.37)
Bismuth-205	83	10 (.37)
Bismuth-206	83	10 (.37)
Bismuth-207	83	10 (.37)
Bismuth-210	83	10 (.37)
Bismuth-210m	83	0.1 (.0037)
Bismuth-212	83	100 (3.7)
Bismuth-213	83	100 (3.7)
Bismuth-214	83	100 (3.7)
Bromine-74	35	100 (3.7)
Bromine-74m	35	100 (3.7)
Bromine-75	35	100 (3.7)
Bromine-76	35	10 (.37)
Bromine-77	35	100 (3.7)
Bromine-80	35	1000 (37)
Bromine-80m	35	1000 (37)
Bromine-82	35	10 (.37)
Bromine-83	35	1000 (37)
Bromine-84	35	100 (3.7)
Cadmium-104	48	1000 (37)
Cadmium-107	48	1000 (37)
Cadmium-109	48	1 (.037)
Cadmium-113	48	0.1 (.0037)
Cadmium-113m	48	0.1 (.0037)
Cadmium-115	48	100 (3.7)
Cadmium-115m	48	10 (.37)
Cadmium-117	48	100 (3.7)
Cadmium-117m	48	10 (.37)
Calcium-41	20	10 (.37)
Calcium-45	20	10 (.37)
Calcium-47	20	10 (.37)
Californium-244	98	1000 (37)
Californium-246	98	10 (.37)
Californium-248	98	0.1 (.0037)
Californium-249	98	0.01 (.00037)
Californium-250	98	0.01 (.00037)
Californium-251	98	0.01 (.00037)
Californium-252	98	0.1 (.0037)
Californium-253	98	10 (.37)
Californium-254	98	0.1 (.0037)
Carbon-11	6	1000 (37)
Carbon-14	6	10 (.37)
Cerium-134	58	10 (.37)
Cerium-135	58	10 (.37)
Cerium-137	58	1000 (37)

Cerium-137m	58	100 (3.7)
Cerium-139	58	100 (3.7)
Cerium-141	58	10 (.37)
Cerium-143	58	100 (3.7)
Cerium-144	58	1 (.037)
Cesium-125	55	1000 (37)
Cesium-127	55	100 (3.7)
Cesium-129	55	100 (3.7)
Cesium-130	55	1000 (37)
Cesium-131	55	1000 (37)
Cesium-132	55	10 (.37)
Cesium-134	55	1 (.037)
Cesium-134m	55	1000 (37)
Cesium-135	55	10 (.37)
Cesium-135m	55	100 (3.7)
Cesium-136	55	10 (.37)
Cesium-137	55	1 (.037)
Cesium-138	55	100 (3.7)
Chlorine-36	17	10 (.37)
Chlorine-38	17	100 (3.7)
Chlorine-39	17	100 (3.7)
Chromium-48	24	100 (3.7)
Chromium-49	24	1000 (37)
Chromium-51	24	1000 (37)
Cobalt-55	27	10 (.37)
Cobalt-56	27	10 (.37)
Cobalt-57	27	100 (3.7)
Cobalt-58	27	10 (.37)
Cobalt-58m	27	1000 (37)
Cobalt-60	27	10 (.37)
Cobalt-60m	27	1000 (37)
Cobalt-61	27	1000 (37)
Cobalt-62m	27	1000 (37)
Copper-60	29	100 (3.7)
Copper-61	29	100 (3.7)
Copper-64	29	1000 (37)
Copper-67	29	100 (3.7)
Curium-238	96	1000 (37)
Curium-240	96	1 (.037)
Curium-241	96	10 (.37)
Curium-242	96	1 (.037)
Curium-243	96	0.01 (.00037)
Curium-244	96	0.01 (.00037)
Curium-245	96	0.01 (.00037)
Curium-246	96	0.01 (.00037)
Curium-247	96	0.01 (.00037)
Curium-248	96	0.001 (.000037)
Curium-249	96	1000 (37)
Dysprosium-155	66	100 (3.7)
Dysprosium-157	66	100 (3.7)
Dysprosium-159	66	100 (3.7)
Dysprosium-165	66	1000 (37)
Dysprosium-166	66	10 (.37)
Einsteinium-250	99	10 (.37)

Einsteinium-251	99	1000 (37)
Einsteinium-253	99	10 (.37)
Einsteinium-254	99	0.1 (.0037)
Einsteinium-254m	99	1 (.037)
Erbium-161	68	100 (3.7)
Erbium-165	68	1000 (37)
Erbium-169	68	100 (3.7)
Erbium-171	68	100 (3.7)
Erbium-172	68	10 (.37)
Europium-145	63	10 (.37)
Europium-146	63	10 (.37)
Europium-147	63	10 (.37)
Europium-148	63	10 (.37)
Europium-149	63	100 (3.7)
Europium-150 (12.6 hr)	63	1000 (37)
Europium-150 (34.2 yr)	63	10 (.37)
Europium-152	63	10 (.37)
Europium-152m	63	100 (3.7)
Europium-154	63	10 (.37)
Europium-155	63	10 (.37)
Europium-156	63	10 (.37)
Europium-157	63	10 (.37)
Europium-158	63	1000 (37)
Fermium-252	100	10 (.37)
Fermium-253	100	10 (.37)
Fermium-254	100	100 (3.7)
Fermium-255	100	100 (3.7)
Fermium-257	100	1 (.037)
Fluorine-18	9	1000 (37)
Francium-222	87	100 (3.7)
Francium-223	87	100 (3.7)
Gadolinium-145	64	100 (3.7)
Gadolinium-146	64	10 (.37)
Gadolinium-147	64	10 (.37)
Gadolinium-148	64	0.001 (.000037)
Gadolinium-149	64	100 (3.7)
Gadolinium-151	64	100 (3.7)
Gadolinium-152	64	0.001 (.000037)
Gadolinium-153	64	10 (.37)
Gadolinium-159	64	1000 (37)
Gallium-65	31	1000 (37)
Gallium-66	31	10 (.37)
Gallium-67	31	100 (3.7)
Gallium-68	31	1000 (37)
Gallium-70	31	1000 (37)
Gallium-72	31	10 (.37)
Gallium-73	31	100 (3.7)
Germanium-66	32	100 (3.7)
Germanium-67	32	1000 (37)
Germanium-68	32	10 (.37)
Germanium-69	32	10 (.37)
Germanium-71	32	1000 (37)
Germanium-75	32	1000 (37)
Germanium-77	32	10 (.37)

Germanium-78	32	1000 (37)
Gold-193	79	100 (3.7)
Gold-194	79	10 (.37)
Gold-195	79	100 (3.7)
Gold-198	79	100 (3.7)
Gold-198m	79	10 (.37)
Gold-199	79	100 (3.7)
Gold-200	79	1000 (37)
Gold-200m	79	10 (.37)
Gold-201	79	1000 (37)
Hafnium-170	72	100 (3.7)
Hafnium-172	72	1 (.037)
Hafnium-173	72	100 (3.7)
Hafnium-175	72	100 (3.7)
Hafnium-177m	72	1000 (37)
Hafnium-178m	72	0.1 (.0037)
Hafnium-179m	72	100 (3.7)
Hafnium-180m	72	100 (3.7)
Hafnium-181	72	10 (.37)
Hafnium-182	72	0.1 (.0037)
Hafnium-182m	72	100 (3.7)
Hafnium-183	72	100 (3.7)
Hafnium-184	72	100 (3.7)
Holmium-155	67	1000 (37)
Holmium-157	67	1000 (37)
Holmium-159	67	1000 (37)
Holmium-161	67	1000 (37)
Holmium-162	67	1000 (37)
Holmium-162m	67	1000 (37)
Holmium-164	67	1000 (37)
Holmium-164m	67	1000 (37)
Holmium-166	67	100 (3.7)
Holmium-166m	67	1 (.037)
Holmium-167	67	100 (3.7)
Hydrogen-3	1	100 (3.7)
Indium-109	49	100 (3.7)
Indium-110 (4.9 hr)	49	10 (.37)
Indium-110 (69.1 min)	49	100 (3.7)
Indium-111	49	100 (3.7)
Indium-112	49	1000 (37)
Indium-113m	49	1000 (37)
Indium-114m	49	10 (.37)
Indium-115	49	0.1 (.0037)
Indium-115m	49	100 (3.7)
Indium-116m	49	100 (3.7)
Indium-117	49	1000 (37)
Indium-117m	49	100 (3.7)
Indium-119m	49	1000 (37)
Iodine-120	53	10 (.37)
Iodine-120m	53	100 (3.7)
Iodine-121	53	100 (3.7)
Iodine-123	53	10 (.37)
Iodine-124	53	0.1 (.0037)
Iodine-125	53	0.01 (.00037)

Iodine-126	53	0.01 (.00037)
Iodine-128	53	1000 (37)
Iodine-129	53	0.001 (.000037)
Iodine-130	53	1 (.037)
Iodine-131	53	0.01 (.00037)
Iodine-132	53	10 (.37)
Iodine-132m	53	10 (.37)
Iodine-133	53	0.1 (.0037)
Iodine-134	53	100 (3.7)
Iodine-135	53	10 (.37)
Iridium-182	77	1000 (37)
Iridium-184	77	100 (3.7)
Iridium-185	77	100 (3.7)
Iridium-186	77	10 (.37)
Iridium-187	77	100 (3.7)
Iridium-188	77	10 (.37)
Iridium-189	77	100 (3.7)
Iridium-190	77	10 (.37)
Iridium-190m	77	1000 (37)
Iridium-192	77	10 (.37)
Iridium-192m	77	100 (3.7)
Iridium-194	77	100 (3.7)
Iridium-194m	77	10 (.37)
Iridium-195	77	1000 (37)
Iridium-195m	77	100 (3.7)
Iron-52	26	100 (3.7)
Iron-55	26	100 (3.7)
Iron-59	26	10 (.37)
Iron-60	26	0.1 (.0037)
Krypton-74	36	10 (.37)
Krypton-76	36	10 (.37)
Krypton-77	36	10 (.37)
Krypton-79	36	100 (3.7)
Krypton-81	36	1000 (37)
Krypton-83m	36	1000 (37)
Krypton-85	36	1000 (37)
Krypton-85m	36	100 (3.7)
Krypton-87	36	10 (.37)
Krypton-88	36	10 (.37)
Lanthanum-131	57	1000 (37)
Lanthanum-132	57	100 (3.7)
Lanthanum-135	57	1000 (37)
Lanthanum-137	57	10 (.37)
Lanthanum-138	57	1 (.037)
Lanthanum-140	57	10 (.37)
Lanthanum-141	57	1000 (37)
Lanthanum-142	57	100 (3.7)
Lanthanum-143	57	1000 (37)
Lead-195m	82	1000 (37)
Lead-198	82	100 (3.7)
Lead-199	82	100 (3.7)
Lead-200	82	100 (3.7)
Lead-201	82	100 (3.7)
Lead-202	82	1 (.037)

Lead-202m	82	10 (.37)
Lead-203	82	100 (3.7)
Lead-205	82	100 (3.7)
Lead-209	82	1000 (37)
Lead-210	82	0.01 (.00037)
Lead-211	82	100 (3.7)
Lead-212	82	10 (.37)
Lead-214	82	100 (3.7)
Lutetium-169	71	10 (.37)
Lutetium-170	71	10 (.37)
Lutetium-171	71	10 (.37)
Lutetium-172	71	10 (.37)
Lutetium-173	71	100 (3.7)
Lutetium-174	71	10 (.37)
Lutetium-174m	71	10 (.37)
Lutetium-176	71	1 (.037)
Lutetium-176m	71	1000 (37)
Lutetium-177	71	100 (3.7)
Lutetium-177m	71	10 (.37)
Lutetium-178	71	1000 (37)
Lutetium-178m	71	1000 (37)
Lutetium-179	71	1000 (37)
Magnesium-28	12	10 (.37)
Manganese-51	25	1000 (37)
Manganese-52	25	10 (.37)
Manganese-52m	25	1000 (37)
Manganese-53	25	1000 (37)
Manganese-54	25	10 (.37)
Manganese-56	25	100 (3.7)
Mendelevium-257	101	100 (3.7)
Mendelevium-258	101	1 (.037)
Mercury-193	80	100 (3.7)
Mercury-193m	80	10 (.37)
Mercury-194	80	0.1 (.0037)
Mercury-195	80	100 (3.7)
Mercury-195m	80	100 (3.7)
Mercury-197	80	1000 (37)
Mercury-197m	80	1000 (37)
Mercury-199m	80	1000 (37)
Mercury-203	80	10 (.37)
Molybdenum-101	42	1000 (37)
Molybdenum-90	42	100 (3.7)
Molybdenum-93	42	100 (3.7)
Molybdenum-93m	42	10 (.37)
Molybdenum-99	42	100 (3.7)
Neodymium-136	60	1000 (37)
Neodymium-138	60	1000 (37)
Neodymium-139	60	1000 (37)
Neodymium-139m	60	100 (3.7)
Neodymium-141	60	1000 (37)
Neodymium-147	60	10 (.37)
Neodymium-149	60	100 (3.7)
Neodymium-151	60	1000 (37)
Neptunium-232	93	1000 (37)

Neptunium-233	93	1000 (37)
Neptunium-234	93	10 (.37)
Neptunium-235	93	1000 (37)
Neptunium-236 (1.2 E 5 yr)	93	0.1 (.0037)
Neptunium-236 (22.5 hr)	93	100 (3.7)
Neptunium-237	93	0.01 (.00037)
Neptunium-238	93	10 (.37)
Neptunium-239	93	100 (3.7)
Neptunium-240	93	100 (3.7)
Nickel-56	28	10 (.37)
Nickel-57	28	10 (.37)
Nickel-59	28	100 (3.7)
Nickel-63	28	100 (3.7)
Nickel-65	28	100 (3.7)
Nickel-66	28	10 (.37)
Niobium-88	41	100 (3.7)
Niobium-89 (122 min)	41	100 (3.7)
Niobium-89 (66 min)	41	100 (3.7)
Niobium-90	41	10 (.37)
Niobium-93m	41	100 (3.7)
Niobium-94	41	10 (.37)
Niobium-95	41	10 (.37)
Niobium-95m	41	100 (3.7)
Niobium-96	41	10 (.37)
Niobium-97	41	100 (3.7)
Niobium-98	41	1000 (37)
Osmium-180	76	1000 (37)
Osmium-181	76	100 (3.7)
Osmium-182	76	100 (3.7)
Osmium-185	76	10 (.37)
Osmium-189m	76	1000 (37)
Osmium-191	76	100 (3.7)
Osmium-191m	76	1000 (37)
Osmium-193	76	100 (3.7)
Osmium-194	76	1 (.037)
Palladium-100	46	100 (3.7)
Palladium-101	46	100 (3.7)
Palladium-103	46	100 (3.7)
Palladium-107	46	100 (3.7)
Palladium-109	46	1000 (37)
Phosphorus-32	15	0.1 (.0037)
Phosphorus-33	15	1 (.037)
Platinum-186	78	100 (3.7)
Platinum-188	78	100 (3.7)
Platinum-189	78	100 (3.7)
Platinum-191	78	100 (3.7)
Platinum-193	78	1000 (37)
Platinum-193m	78	100 (3.7)
Platinum-195m	78	100 (3.7)
Platinum-197	78	1000 (37)
Platinum-197m	78	1000 (37)
Platinum-199	78	1000 (37)
Platinum-200	78	100 (3.7)
Plutonium-234	94	1000 (37)

Plutonium-235	94	1000 (37)
Plutonium-236	94	0.1 (.0037)
Plutonium-237	94	1000 (37)
Plutonium-238	94	0.01 (.00037)
Plutonium-239	94	0.01 (.00037)
Plutonium-240	94	0.01 (.00037)
Plutonium-241	94	1 (.037)
Plutonium-242	94	0.01 (.00037)
Plutonium-243	94	1000 (37)
Plutonium-244	94	0.01 (.00037)
Plutonium-245	94	100 (3.7)
Polonium-203	84	100 (3.7)
Polonium-205	84	100 (3.7)
Polonium-207	84	10 (.37)
Polonium-210	84	0.01 (.00037)
Potassium-40	19	1 (.037)
Potassium-42	19	100 (3.7)
Potassium-43	19	10 (.37)
Potassium-44	19	100 (3.7)
Potassium-45	19	1000 (37)
Praseodymium-136	59	1000 (37)
Praseodymium-137	59	1000 (37)
Praseodymium-138m	59	100 (3.7)
Praseodymium-139	59	1000 (37)
Praseodymium-142	59	100 (3.7)
Praseodymium-142m	59	1000 (37)
Praseodymium-143	59	10 (.37)
Praseodymium-144	59	1000 (37)
Praseodymium-145	59	1000 (37)
Praseodymium-147	59	1000 (37)
Promethium-141	61	1000 (37)
Promethium-143	61	100 (3.7)
Promethium-144	61	10 (.37)
Promethium-145	61	100 (3.7)
Promethium-146	61	10 (.37)
Promethium-147	61	10 (.37)
Promethium-148	61	10 (.37)
Promethium-148m	61	10 (.37)
Promethium-149	61	100 (3.7)
Promethium-150	61	100 (3.7)
Promethium-151	61	100 (3.7)
Protactinium-227	91	100 (3.7)
Protactinium-228	91	10 (.37)
Protactinium-230	91	10 (.37)
Protactinium-231	91	0.01 (.00037)
Protactinium-232	91	10 (.37)
Protactinium-233	91	100 (3.7)
Protactinium-234	91	10 (.37)
RADIONUCLIDES $ _	-	1 (.037)
Radium-223	88	1 (.037)
Radium-224	88	10 (.37)
Radium-225	88	1 (.037)
Radium-226 **	88	0.1 (.0037)
Radium-227	88	1000 (37)

Radium-228	88	0.1 (.0037)
Radon-220	86	0.1 (.0037)
Radon-222	86	0.1 (.0037)
Rhenium-177	75	1000 (37)
Rhenium-178	75	1000 (37)
Rhenium-181	75	100 (3.7)
Rhenium-182 (12.7 hr)	75	10 (.37)
Rhenium-182 (64.0 hr)	75	10 (.37)
Rhenium-184	75	10 (.37)
Rhenium-184m	75	10 (.37)
Rhenium-186	75	100 (3.7)
Rhenium-186m	75	10 (.37)
Rhenium-187	75	1000 (37)
Rhenium-188	75	1000 (37)
Rhenium-188m	75	1000 (37)
Rhenium-189	75	1000 (37)
Rhodium-100	45	10 (.37)
Rhodium-101	45	10 (.37)
Rhodium-101m	45	100 (3.7)
Rhodium-102	45	10 (.37)
Rhodium-102m	45	10 (.37)
Rhodium-103m	45	1000 (37)
Rhodium-105	45	100 (3.7)
Rhodium-106m	45	10 (.37)
Rhodium-107	45	1000 (37)
Rhodium-99	45	10 (.37)
Rhodium-99m	45	100 (3.7)
Rubidium-79	37	1000 (37)
Rubidium-81	37	100 (3.7)
Rubidium-81m	37	1000 (37)
Rubidium-82m	37	10 (.37)
Rubidium-83	37	10 (.37)
Rubidium-84	37	10 (.37)
Rubidium-86	37	10 (.37)
Rubidium-87	37	10 (.37)
Rubidium-88	37	1000 (37)
Rubidium-89	37	1000 (37)
Ruthenium-103	44	10 (.37)
Ruthenium-105	44	100 (3.7)
Ruthenium-106	44	1 (.037)
Ruthenium-94	44	1000 (37)
Ruthenium-97	44	100 (3.7)
Samarium-141	62	1000 (37)
Samarium-141m	62	1000 (37)
Samarium-142	62	1000 (37)
Samarium-145	62	100 (3.7)
Samarium-146	62	0.01 (.00037)
Samarium-147	62	0.01 (.00037)
Samarium-151	62	10 (.37)
Samarium-153	62	100 (3.7)
Samarium-155	62	1000 (37)
Samarium-156	62	100 (3.7)
Scandium-43	21	1000 (37)
Scandium-44	21	100 (3.7)

Scandium-44m	21	10 (.37)
Scandium-46	21	10 (.37)
Scandium-47	21	100 (3.7)
Scandium-48	21	10 (.37)
Scandium-49	21	1000 (37)
Selenium-70	34	1000 (37)
Selenium-73	34	10 (.37)
Selenium-73m	34	100 (3.7)
Selenium-75	34	10 (.37)
Selenium-79	34	10 (.37)
Selenium-81	34	1000 (37)
Selenium-81m	34	1000 (37)
Selenium-83	34	1000 (37)
Silicon-31	14	1000 (37)
Silicon-32	14	1 (.037)
Silver-102	47	100 (3.7)
Silver-103	47	1000 (37)
Silver-104	47	1000 (37)
Silver-104m	47	1000 (37)
Silver-105	47	10 (.37)
Silver-106	47	1000 (37)
Silver-106m	47	10 (.37)
Silver-108m	47	10 (.37)
Silver-110m	47	10 (.37)
Silver-111	47	10 (.37)
Silver-112	47	100 (3.7)
Silver-115	47	1000 (37)
Sodium-22	11	10 (.37)
Sodium-24	11	10 (.37)
Strontium-80	38	100 (3.7)
Strontium-81	38	1000 (37)
Strontium-83	38	100 (3.7)
Strontium-85	38	10 (.37)
Strontium-85m	38	1000 (37)
Strontium-87m	38	100 (3.7)
Strontium-89	38	10 (.37)
Strontium-90	38	0.1 (.0037)
Strontium-91	38	10 (.37)
Strontium-92	38	100 (3.7)
Sulfur-35	16	1 (.037)
Tantalum-172	73	100 (3.7)
Tantalum-173	73	100 (3.7)
Tantalum-174	73	100 (3.7)
Tantalum-175	73	100 (3.7)
Tantalum-176	73	10 (.37)
Tantalum-177	73	1000 (37)
Tantalum-178	73	1000 (37)
Tantalum-179	73	1000 (37)
Tantalum-180	73	100 (3.7)
Tantalum-180m	73	1000 (37)
Tantalum-182	73	10 (.37)
Tantalum-182m	73	1000 (37)
Tantalum-183	73	100 (3.7)
Tantalum-184	73	10 (.37)

Tantalum-185	73	1000 (37)
Tantalum-186	73	1000 (37)
Technetium-101	43	1000 (37)
Technetium-104	43	1000 (37)
Technetium-93	43	100 (3.7)
Technetium-93m	43	1000 (37)
Technetium-94	43	10 (.37)
Technetium-94m	43	100 (3.7)
Technetium-96	43	10 (.37)
Technetium-96m	43	1000 (37)
Technetium-97	43	100 (3.7)
Technetium-97m	43	100 (3.7)
Technetium-98	43	10 (.37)
Technetium-99	43	10 (.37)
Technetium-99m	43	100 (3.7)
Tellurium-116	52	1000 (37)
Tellurium-121	52	10 (.37)
Tellurium-121m	52	10 (.37)
Tellurium-123	52	10 (.37)
Tellurium-123m	52	10 (.37)
Tellurium-125m	52	10 (.37)
Tellurium-127	52	1000 (37)
Tellurium-127m	52	10 (.37)
Tellurium-129	52	1000 (37)
Tellurium-129m	52	10 (.37)
Tellurium-131	52	1000 (37)
Tellurium-131m	52	10 (.37)
Tellurium-132	52	10 (.37)
Tellurium-133	52	1000 (37)
Tellurium-133m	52	1000 (37)
Tellurium-134	52	1000 (37)
Terbium-147	65	100 (3.7)
Terbium-149	65	100 (3.7)
Terbium-150	65	100 (3.7)
Terbium-151	65	10 (.37)
Terbium-153	65	100 (3.7)
Terbium-154	65	10 (.37)
Terbium-155	65	100 (3.7)
Terbium-156	65	10 (.37)
Terbium-156m (24.4 hr)	65	1000 (37)
Terbium-156m (5.0 hr)	65	1000 (37)
Terbium-157	65	100 (3.7)
Terbium-158	65	10 (.37)
Terbium-160	65	10 (.37)
Terbium-161	65	100 (3.7)
Thallium-194	81	1000 (37)
Thallium-194m	81	100 (3.7)
Thallium-195	81	100 (3.7)
Thallium-197	81	100 (3.7)
Thallium-198	81	10 (.37)
Thallium-198m	81	100 (3.7)
Thallium-199	81	100 (3.7)
Thallium-200	81	10 (.37)
Thallium-201	81	1000 (37)

Thallium-202	81	10 (.37)
Thallium-204	81	10 (.37)
Thorium (Irradiated)	90	***
Thorium (Natural)	90	**
Thorium-226	90	100 (3.7)
Thorium-227	90	1 (.037)
Thorium-228	90	0.01 (.00037)
Thorium-229	90	0.001 (.000037)
Thorium-230	90	0.01 (.00037)
Thorium-231	90	100 (3.7)
Thorium-232 **	90	0.001 (.000037)
Thorium-234	90	100 (3.7)
Thulium-162	69	1000 (37)
Thulium-166	69	10 (.37)
Thulium-167	69	100 (3.7)
Thulium-170	69	10 (.37)
Thulium-171	69	100 (3.7)
Thulium-172	69	100 (3.7)
Thulium-173	69	100 (3.7)
Thulium-175	69	1000 (37)
Tin-110	50	100 (3.7)
Tin-111	50	1000 (37)
Tin-113	50	10 (.37)
Tin-117m	50	100 (3.7)
Tin-119m	50	10 (.37)
Tin-121	50	1000 (37)
Tin-121m	50	10 (.37)
Tin-123	50	10 (.37)
Tin-123m	50	1000 (37)
Tin-125	50	10 (.37)
Tin-126	50	1 (.037)
Tin-127	50	100 (3.7)
Tin-128	50	1000 (37)
Titanium-44	22	1 (.037)
Titanium-45	22	1000 (37)
Tungsten-176	74	1000 (37)
Tungsten-177	74	100 (3.7)
Tungsten-178	74	100 (3.7)
Tungsten-179	74	1000 (37)
Tungsten-181	74	100 (3.7)
Tungsten-185	74	10 (.37)
Tungsten-187	74	100 (3.7)
Tungsten-188	74	10 (.37)
Uranium (Depleted)	92	***
Uranium (Irradiated)	92	***
Uranium (Natural)	92	**
Uranium Enriched 20% or greater	92	***
Uranium Enriched less than 20%	92	***
Uranium-230	92	1 (.037)
Uranium-231	92	1000 (37)
Uranium-232	92	0.01 (.00037)
Uranium-233	92	0.1 (.0037)
Uranium-234 **	92	0.1 (.0037)
Uranium-235 **	92	0.1 (.0037)

Uranium-236	92	0.1 (.0037)
Uranium-237	92	100 (3.7)
Uranium-238 **	92	0.1 (.0037)
Uranium-239	92	1000 (37)
Uranium-240	92	1000 (37)
Vanadium-47	23	1000 (37)
Vanadium-48	23	10 (.37)
Vanadium-49	23	1000 (37)
Xenon-120	54	100 (3.7)
Xenon-121	54	10 (.37)
Xenon-122	54	100 (3.7)
Xenon-123	54	10 (.37)
Xenon-125	54	100 (3.7)
Xenon-127	54	100 (3.7)
Xenon-129m	54	1000 (37)
Xenon-131m	54	1000 (37)
Xenon-133	54	1000 (37)
Xenon-133m	54	1000 (37)
Xenon-135	54	100 (3.7)
Xenon-135m	54	10 (.37)
Xenon-138	54	10 (.37)
Ytterbium-162	70	1000 (37)
Ytterbium-166	70	10 (.37)
Ytterbium-167	70	1000 (37)
Ytterbium-169	70	10 (.37)
Ytterbium-175	70	100 (3.7)
Ytterbium-177	70	1000 (37)
Ytterbium-178	70	1000 (37)
Yttrium-86	39	10 (.37)
Yttrium-86m	39	1000 (37)
Yttrium-87	39	10 (.37)
Yttrium-88	39	10 (.37)
Yttrium-90	39	10 (.37)
Yttrium-90m	39	100 (3.7)
Yttrium-91	39	10 (.37)
Yttrium-91m	39	1000 (37)
Yttrium-92	39	100 (3.7)
Yttrium-93	39	100 (3.7)
Yttrium-94	39	1000 (37)
Yttrium-95	39	1000 (37)
Zinc-62	30	100 (3.7)
Zinc-63	30	1000 (37)
Zinc-65	30	10 (.37)
Zinc-69	30	1000 (37)
Zinc-69m	30	100 (3.7)
Zinc-71m	30	100 (3.7)
Zinc-72	30	100 (3.7)
Zirconium-86	40	100 (3.7)
Zirconium-88	40	10 (.37)
Zirconium-89	40	100 (3.7)
Zirconium-93	40	1 (.037)
Zirconium-95	40	10 (.37)
Zirconium-97	40	10 (.37)

$ The RQs for all radionuclides apply to chemical compounds containing the radionuclides and elemental forms regardless of the diameter of pieces of solid material.

_ The RQ of one curie applies to all radionuclides not otherwise listed. Whenever the RQs in TABLE 1-HAZARDOUS SUBSTANCES OTHER THAN RADIONUCLIDES and this table conflict, the lowest RQ shall apply. For example, uranyl acetate and uranyl nitrate have RQs shown in TABLE 1 of 100 pounds, equivalent to about one-tenth the RQ level for uranium-238 in this table.

** The method to determine the RQs for mixtures or solutions of radionuclides can be found in paragraph 7 of the note preceding TABLE 1 of this appendix. RQs for the following four common radionuclide mixtures are provided: radium-226 in secular equilibrium with its daughters (0.053 curie); natural uranium (0.1 curie); natural uranium in secular equilibrium with its daughters (0.052 curie); and natural thorium in secular equilibrium with its daughters (0.011 curie).

*** Indicates that the name was added by RSPA because it appears in the list of radionuclides in 49 CFR 173.435. The reportable quantity (RQ), if not specifically listed elsewhere in this appendix, shall be determined in accordance with the procedures in paragraph 7 of this appendix.

[Amdt. 172-122, 55 FR 46798, Nov. 7, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING APPENDIX A TO §172.101, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

to §172.101-List of Marine Pollutants

1. This appendix lists potential marine pollutants as defined in §171.8 of this subchapter.

2. If a marine pollutant meets the definition of any hazard class or division as defined in this subchapter, other than Class 9, the class of the material must be determined in accordance with §173.2a of this subchapter.

3. This appendix contains two columns. The first column, entitled "S.M.P." (for severe marine pollutants), identifies whether a material is a severe marine pollutant. If the letters "PP" appear in this column for a material, the material is a severe marine pollutant, otherwise it is not. The second column, entitled "Marine Pollutant" , lists the marine pollutants.

4. If a material not listed in this appendix meets the criteria for a marine pollutant, as provided in the General Introduction of the IMDG Code, Guidelines for the Identification of Harmful Substances in Packaged Form, the material may be transported as a marine pollutant in accordance with the applicable requirements of this subchapter.

5. If approved by the Associate Administrator for Hazardous Materials Safety, a material listed in this appendix which does not meet the criteria for a marine pollutant, as provided in the General Introduction of the IMDG Code, Guidelines for the Identification of Harmful Substances in Packaged Form, is excepted from the requirements of this subchapter as a marine pollutant.

to §172.101-List of Marine Pollutants

S.M.P.	Marine Pollutant
(1)	(2)
-	Acetal
-	Acetaldehyde
-	Acetone cyanohydrin, stabilized
-	Acetylene tetrabromide
-	Acetylene tetrachloride
-	Acraldehyde, inhibited
-	Acrolein, inhibited
-	Acrylic aldehyde, inhibited
-	Alcohol C-12 - C-16 poly(1-6) ethoxylate
-	Alcohol C-13 - C-15 poly(1-6) ethoxylate
-	Alcohol C-6 - C-17 (secondary)poly(3-6) ethoxylate
-	Aldicarb
PP	Aldrin
-	Alkyl (c12-c14) dimethylamine
-	Alkyl (c7-c9) nitrates
-	Alkylbenzenesulphonates, branched and straight chain
-	Alkylphenols, liquid, n.o.s. *(including C2-C12 homologues)*
-	Alkylphenols, solid, n.o.s. (including C2-C12 homologues)
-	Allyl bromide
-	ortho-Aminoanisole
-	Aminocarb
-	Ammonium dinitro-o-cresolate
-	n-Amylbenzene
-	Amyl mercaptans
-	Anisole
PP	Azinphos-ethyl
PP	Azinphos-methyl
-	Barium cyanide
-	Bendiocarb
-	Benomyl
-	Benquinox
-	Benzaldehyde
-	Benzyl chlorocarbonate
-	Benzyl chloroformate
PP	Binapacryl
-	*N,N-Bis* (2-hydroxyethyl) oleamide (LOA)
PP	Brodifacoum
-	Bromine cyanide
-	Bromoacetone
-	Bromoallylene
-	Bromobenzene
-	ortho-Bromobenzyl cyanide
-	Bromocyane
-	Bromoform
PP	Bromophos-ethyl
-	3-Bromopropene
-	Bromoxynil

-	Butanedione
-	2-Butenal, stabilized
-	Butyl benzenes
-	Butyl benzyl phthalate
-	n-Butyl butyrate
-	*N-tert*-butyl-*N*-cyclopropyl-6-methylthio-1,3,5-triazine-2,4-diamine
-	Butyl mercaptans
-	Butylphenols, liquid
-	Butylphenols, solid
-	2,4-Di-tert-butylphenol
-	2,6-Di-tert-butylphenol
-	para-tertiary-butyltoluene
-	Butyraldehyde
PP	Cadmium compounds
-	Cadmium sulphide
-	Calcium arsenate
-	Calcium arsenate and calcium arsenite, mixtures, solid
-	Calcium cyanide
-	Calcium naphthenate
PP	Camphechlor
-	Camphor oil
-	Carbaryl
-	Carbendazim
-	Carbofuran
-	Carbon tetrabromide
-	Carbon tetrachloride
PP	Carbophenothion
-	Cartap hydrochloride
PP	Chlordane
-	Chlorfenvinphos
PP	Chlorinated paraffins (C-10 - C-13)
PP	Chlorinated paraffins (C14-C17), with more than 1% shorter chain length
-	Chlorine
-	Chlorine cyanide, inhibited
-	Chlormephos
-	Chloroacetone, stabilized
-	1-Chloro-2,3-Epoxypropane
-	2-Chloro-6-nitrotoluene
-	4-Chloro-2-nitrotoluene
-	Chloro-ortho-nitrotoluene
-	2-Chloro-5-trifluoromethylnitrobenzene
-	para-Chlorobenzyl chloride, liquid or solid
-	Chlorodinitrobenzenes, liquid or solid
-	1-Chloroheptane
-	1-Chlorohexane
-	Chloronitroanilines
-	Chloronitrotoluenes *liquid*
-	Chloronitrotoluenes, solid
-	1-Chlorooctane
PP	Chlorophenolates, liquid
PP	Chlorophenolates, solid
-	Chlorophenols, liquid
-	Chlorophenols, solid
-	Chlorophenyltrichlorosilane

-	alpha-Chloropropylene
-	Chlorotoluenes (ortho-, meta-, para-)
PP	Chlorpyriphos
PP	Chlorthiophos
-	Coal tar
-	Coal tar naphtha
-	Cocculus
-	Coconitrile
-	Copper acetoarsenite
-	Copper arsenite
-	Copper chloride
PP	Copper chloride solution
PP	Copper cyanide
PP	Copper metal powder
PP	Copper sulphate, anhydrous, hydrates
-	Coumachlor
PP	Coumaphos
-	Creosote (coal tar)
-	Creosote (wood tar)
-	Cresols *(o-; m-; p-)*
PP	Cresyl diphenyl phosphate
-	Cresylic acid
-	Cresylic acid sodium salt
-	Crotonaldehyde, stabilized
-	Crotonic aldehyde, stabilized
-	Crotoxyphos
-	Cumene
-	Cupric arsenite
PP	Cupric chloride
PP	Cupric cyanide
PP	Cupric sulfate
-	Cupriethylenediamine solution
PP	Cuprous chloride
-	Cyanide mixtures
-	Cyanide solutions
-	Cyanides, inorganic, n.o.s.
-	Cyanogen bromide
-	Cyanogen chloride, inhibited
-	Cyanophos
PP	1,5,9-Cyclododecatriene
PP	Cyhexatin
PP	Cymenes (o-;m-;p-)
PP	Cypermethrin
-	2,4-D
PP	DDT
-	*normal*-Decaldehyde
-	*normal*-Decanol
-	Decyl acrylate
-	Decycloxytetrahydrothiophene dioxide
-	DEF
-	Di-allate
-	Di-n-Butyl phthalate
PP	Dialifos
-	4,4'-Diaminodiphenylmethane

PP	Diazinon
-	1,3-Dibromobenzene
PP	Dichlofenthion
-	Dichloroanilines
-	1,3-Dichlorobenzene
-	1,2-Dichlorobenzene
-	1,4-Dichlorobenzene
-	Dichlorobenzene (meta; ortho; para)
-	2,2-Dichlorodiethyl ether
-	Dichlorodimethyl ether, symmetrical
-	Di-(2-chloroethyl) ether
-	1,1-Dichloroethylene, inhibited
-	1,6-Dichlorohexane
-	Dichlorophenols, liquid
-	Dichlorophenols, solid
-	2,4-Dichlorophenoxyacetic acid (see also 2,4D)
-	2,4-Dichlorophenoxyacetic acid diethanolamine salt
-	2,4-Dichlorophenoxyacetic acid dimethylamine salt
-	2,4-Dichlorophenoxyacetic acid triisopropylamine salt
-	Dichlorophenyltrichlorosilane
PP	Dichlorvos
-	Dicrotophos
PP	Dieldrin
-	Diethybenzenes (mixed isomers)
-	Diisopropylbenzenes
-	Diisopropylnaphthalene
PP	Dimethoate
-	Dimethyl disulphide
-	Dimethyl glyoxal (butanedione)
-	Dimethyl sulphide
PP	N,N-Dimethyldodecylamine
-	Dimethylhydrazine, symmetrical
-	Dimethylhydrazine, unsymmetrical
-	Dimethylphenols, liquid or solid
-	Dinitro-o-cresol, *solid*
-	Dinitro-o-cresol, solution
-	Dinitrochlorobenzenes, liquid or solid
-	Dinitrophenol, *dry or wetted with less than 15 per cent water, by mass*
-	Dinitrophenol solutions
-	Dinitrophenol, wetted *with not less than 15 per cent water, by mass*
-	Dinitrophenolates alkali metals, dry or wetted with less than 15 per cent water, by mass
-	Dinitrophenolates, wetted with not less than 15 per cent water, by mass
-	Dinobuton
-	Dinoseb
-	Dinoseb acetate
-	Dioxacarb
-	Dioxathion
-	Dipentene
-	Diphacinone
-	Diphenyl
-	Diphenyl ether
-	Diphenyl ether/biphenyl phenyl ether mixtures
-	Diphenyl/diphenyl ether (mixtures)
-	Diphenyl oxide and biphenyl phenyl ether mixtures

PP	Diphenylamine chloroarsine
PP	Diphenylchloroarsine, solid *or* liquid
-	Disulfoton
-	1,4-Di-tert-butylbenzene
-	DNOC
-	DNOC (pesticide)
-	Dodecyl diphenyl oxide disulphonate
-	Dodecyl hydroxypropyl sulfide
-	1-Dodecylamine
PP	Dodecylphenol
-	Drazoxolon
-	Edifenphos
PP	Endosulfan
PP	Endrin
-	Epibromohydrin
-	Epichlorohydrin
PP	EPN
-	EPTC (ISO)
PP	Esfenvalerate
PP	Ethion
-	Ethoprophos
-	Ethyl acrylate, inhibited
-	Ethyl chlorothioformate
-	Ethyl fluid
-	Ethyl mercaptan
-	1-Ethyl-2-methylbenzene
-	2-Ethylhexyl nitrate
-	5-Ethyl-2-picoline
-	Ethyl propenoate, inhibited
-	2-Ethyl-3-propylacrolein
-	Ethyl tetraphosphate
-	2-Ethylbutyraldehyde
-	Ethyldichloroarsine
-	Ethylene dibromide and methyl bromide mixtures, liquid
-	2-Ethylhexaldehyde
-	2-Ethylhexenal
-	Fenaminphos
PP	Fenbutatin oxide
PP	Fenitrothion
PP	Fenpropathrin
-	Fensulfothion
PP	Fenthion
PP	Fentin acetate
PP	Fentin hydroxide
-	Ferric arsenate
-	Ferric arsenite
-	Ferrous arsenate
PP	Fonofos
-	Formetanate
PP	Furathiocarb (ISO)
PP	gamma-BHC
-	Gasoline, leaded
PP	Heptachlor
-	Heptenophos

-	n-Heptaldehyde
-	n-Heptylbenzene
-	normal-Heptyl chloride
PP	Hexachlorobutadiene
PP	1,3-Hexachlorobutadiene
-	2,4-Hexadiene aldehyde
-	Hexaethyl tetraphosphate *liquid*
-	Hexaethyl tetraphosphate, solid
-	normal-Hexyl chloride
-	*normal*-Hexaldehyde
-	n-Hexylbenzene
-	Hydrocyanic acid, anhydrous, stabilized, containing less than 3% water
-	Hydrocyanic acid, anhydrous, stabilized, containing less than 3% water and absorbed in a porous inert material
-	Hydrocyanic acid, aqueous solutions *not more than 20% hydrocyanic acid*
-	Hydrogen cyanide solution in alcohol, with notmore than 45% hydrogen cyanide
-	Hydrogen cyanide, stabilized *with less than 3% water*
-	Hydrogen cyanide, stabilized with less than 3% water and absorbed in a porous inert material
-	Hydroxydimethylbenzenes, liquid or solid
-	Ioxynil
-	Iron oxide, spent
-	Iron sponge, spent
-	Isoamyl mercaptan
-	Isobenzan
-	Isobutyl aldehyde
-	Isobutyl butyrate
-	Isobutyl isobutyrate
-	Isobutyl propionate
-	Isobutylbenzene
-	Isobutyraldehyde
-	Isodecaldehyde
-	Isodecanol
-	Isodecyl acrylate
-	Isodecyl diphenyl phosphate
-	Isofenphos
-	Isononanol
-	Isooctanol
-	Isooctyl nitrate
-	Isoprocarb
-	Isopropenylbenzene
-	Isopropylbenzene
-	Isotetramethylbenzene
-	Isovaleraldehyde
PP	Isoxathion
-	Lead acetate
-	Lead arsenates
-	Lead arsenites
-	Lead compounds, soluble, n.o.s.
-	Lead cyanide
-	Lead nitrate
-	Lead perchlorate, solid or solution
-	Lead tetraethyl
-	Lead tetramethyl
PP	Lindane

-	London Purple
-	Magnesium arsenate
-	Malathion
-	Mancozeb (ISO)
-	Maneb
-	Maneb preparations *with not less than 60% maneb*
-	Maneb preparation, stabilized against self-heating
-	Maneb stabilized *or* Maneb preparations, stabilized *against self-heating*
-	Manganese ethylene-1,2-bis dithiocarbamate
-	Manganese ethylene-1,2-bis-dithiocarbamate, stabilized against self-heating
-	Mecarbam
-	Mephosfolan
-	Mercaptodimethur
PP	Mercuric acetate
PP	Mercuric ammonium chloride
PP	Mercuric arsenate
PP	Mercuric benzoate
PP	Mercuric bisulphate
PP	Mercuric bromide
PP	Mercuric chloride
PP	Mercuric cyanide
PP	Mercuric gluconate
-	Mercuric iodide
PP	Mercuric nitrate
PP	Mercuric oleate
PP	Mercuric oxide
PP	Mercuric oxycyanide, desensitized
PP	Mercuric potassium cyanide
PP	Mercuric Sulphate
PP	Mercuric thiocyanate
PP	Mercurol
PP	Mercurous acetate
PP	Mercurous bisulphate
PP	Mercurous bromide
PP	Mercurous chloride
PP	Mercurous nitrate
PP	Mercurous salicylate
PP	Mercurous sulphate
PP	Mercury acetates
PP	Mercury ammonium chloride
PP	Mercury based pesticide, liquid, flammable, toxic
PP	Mercury based pesticides, liquid, toxic, flammable
PP	Mercury based pesticides, liquid, toxic
PP	Mercury based pesticides, solid, toxic
PP	Mercury benzoate
PP	Mercury bichloride
PP	Mercury bisulphates
PP	Mercury bromides
PP	Mercury compounds, liquid, n.o.s.
PP	Mercury compounds, solid, n.o.s.
PP	Mercury cyanide
PP	Mercury gluconate
PP	Mercury (I) (mercurous) compounds (pesticides)
PP	Mercury (II) (mercuric) compounds (pesticides)

-	Mercury iodide
PP	Mercury nucleate
PP	Mercury oleate
PP	Mercury oxide
PP	Mercury oxycyanide, desensitized
PP	Mercury potassium cyanide
PP	Mercury potassium iodide
PP	Mercury salicylate
PP	Mercury sulfates
PP	Mercury thiocyanate
-	Metam-sodium
-	Methamidophos
-	Methanethiol
-	Methidathion
-	Methomyl
-	ortho-Methoxyaniline
-	Methyl bromide and ethylene dibromide mixtures, liquid
-	1-Methyl-2-ethylbenzene
-	1-Methyl-4-ethylbenzene
-	2-Methyl-5-ethylpyridine
-	Methyl mercaptan
-	2-Methyl-2-phenylpropane
-	Methyl salicylate
-	3-Methylacroleine, stabilized
-	2-Methylbutyraldehyde
-	Methylchlorobenzenes
-	Methylnaphthalenes, liquid
-	Methylnaphthalenes, solid
-	Methylnitrophenols
-	3-Methylpyradine
-	Methylstyrenes, inhibited
-	Methyltrithion
-	Methylvinylbenzenes, inhibited
PP	Mevinphos
-	Mexacarbate
-	Mirex
-	Monocrotophos
-	Motor fuel anti-knock mixtures
-	Motor fuel anti-knock mixtures or compounds
-	Nabam
-	Naled
-	Naphthalene, crude *or* refined
-	Naphthalene, molten
-	Naphthenic acids, liquid
-	Naphthenic acids, solid
PP	Nickel carbonyl
PP	Nickel cyanide
PP	Nickel tetracarbonyl
-	3-Nitro-4-chlorobenzotrifluoride
-	Nitrobenzene
-	Nitrobenzotrifluorides, liquid or solid
-	Nitrocresols
-	Nitrotolueunes (ortho-;meta-;para-), liquid
-	Nitrotoluenes (ortho-;meta-;para-), solid

-	Nitroxyluenes, liquid or solid
-	1-Nonanal
-	1-Nonanol
-	Nonylphenol
-	*normal*-Octaldehyde
-	1-Octanol
-	Oleylamine
PP	Organotin compounds, liquid, n.o.s.
PP	Organotin compounds (pesticides)
PP	Organotin compounds, solid, n.o.s.
PP	Organotin pesticides, liquid, flammable, toxic, n.o.s.*, flash point less than 23deg C*
PP	Organotin pesticides, liquid, toxic, flammable, n.o.s.
PP	Organotin pesticides, liquid, toxic, n.o.s.
PP	Organotin pesticides, solid, toxic, n.o.s.
-	Orthoarsenic acid
PP	Osmium tetroxide
-	Oxamyl
-	Oxydisulfoton
-	Paraoxon
PP	Parathion
PP	Parathion-methyl
PP	PCBs***
-	Pentachloroethane
PP	Pentachlorophenol
-	Pentalin
-	Pentanethiols
-	n-Pentylbenzene
-	Perchloroethylene
-	Perchloromethylmercaptan
-	Petrol, leaded
PP	Phenarsazine chloride
-	d-Phenothrin
PP	Phenthoate
-	1-Phenylbutane
-	2-Phenylbutane
-	Phenylcyclohexane
-	Phenylethylene, inhibited
PP	Phenylmercuric acetate
PP	Phenylmercuric compounds, n.o.s.
PP	Phenylmercuric hydroxide
PP	Phenylmercuric nitrate
-	2-Phenylpropene
PP	Phorate
PP	Phosalone
-	Phosmet
PP	Phosphamidon
PP	Phosphorus, white, molten
PP	Phosphorus, white *or* yellow dry *or* under water *or* in solution
PP	Phosphorus white, or yellow, molten
PP	Phosphorus, yellow, molten
-	Pindone (and salts of)
-	alpha-Pinene
-	Pirimicarb
PP	Pirimiphos-ethyl

PP	Polychlorinated biphenyls
PP	Polyhalogenated biphenyls, liquid *or* Terphenyls liquid
PP	Polyhalogenated biphenyls, solid *or* Terphenyls, solid
PP	Potassium cuprocyanide
-	Potassium cyanide, solid
-	Potassium cyanide, solution
PP	Potassium cyanocuprate (I)
PP	Potassium cyanomercurate
PP	Potassium mercuric iodide
-	Promecarb
-	Propachlor
-	Propanethiols
-	Propaphos
-	Propenal, inhibited
-	Propionaldehyde
-	Propoxur
-	n-Propylbenzene
-	Prothoate
-	Prussic acid, anhydrous, stabilized
-	Prussic acid, anhydrous, stabilized, absorbed in a porous inert material
PP	Pyrazophos
-	Quinalphos
PP	Quizalofop
PP	Quizalofop-p-ethyl
-	Rotenone
-	Salithion
-	Silver arsenite
-	Silver cyanide
-	Silver orthoarsenite
PP	Sodium copper cyanide, solid
PP	Sodium copper cyanide solution
PP	Sodium cuprocyanide, solid
PP	Sodium cuprocyanide, solution
-	Sodium cyanide, solid
-	Sodium cyanide, solution
-	Sodium dinitro-o-cresolate, *dry or wetted with less than 15 per cent water, by mass*
-	Sodium dinitro-ortho-cresolate, wetted with not less than 15 per cent water, by mass
PP	Sodium pentachlorophenate
-	Strychnine *or* Strychnine salts
-	Styrene monomer, inhibited
-	Sulfotep
PP	Sulprophos
-	Tallow nitrile
-	Temephos
-	TEPP
PP	Terbufos
-	Tetrabromoethane
-	Tetrabromomethane
-	1,1,2,2-Tetrachloroethane
-	Tetrachloroethylene
-	Tetrachloromethane
-	Tetrachlorophenol
-	Tetraethyl dithiopyrophosphate
PP	Tetraethyl lead, liquid

-	Tetramethrin
-	n-Tetramethylbenzenes
-	Tetramethyllead
-	Thallium chlorate
-	Thallium compounds, n.o.s.
-	Thallium compounds (pesticides)
-	Thallium nitrate
-	Thallium sulfate
-	Thallous chlorate
-	4-Thiapentanal
-	Thiocarbonyl tetrachloride
-	Triaryl phosphates, isopropylated
PP	Triaryl phosphates, n.o.s.
-	Triazophos
-	Tribromomethane
PP	Tributyltin compounds
-	Trichlorfon
-	Trichlorobenzenes, liquid
-	Trichlorobutene
-	Trichlorobutylene
-	Trichloromethane sulphuryl chloride
-	Trichloromethyl sulphochloride
-	Trichloronat
-	Tricresyl phosphate (less than 1% ortho-isomer)
PP	Tricresyl phosphate, not less than 1% ortho-isomer but not more than 3% orthoisomer
PP	Tricresyl phosphate *with more than 3 per cent ortho isomer*
-	Triethylbenzene
-	Triisopropylated phenyl phosphates
-	1,2,3-Trimethylbenzene
-	1,2,4-Trimethylbenzene
-	1,3,5-Trimethylbenzene
-	Trimethylene dichloride
PP	Triphenylphosphate
-	Triphenyl phosphate/tert-butylated triphenyl phosphates mixtures containing 5% to 10% triphenyl phosphates
PP	Triphenyl phosphate/tert-butylated triphenyl phosphates mixtures containing 10% to 48% triphenyl phosphates
PP	Triphenyltin compounds
-	Tritolyl phosphate (less than 1% ortho-isomer)
PP	Tritolyl phosphate (not less than 1% ortho-isomer)
-	Trixylenyl phosphate
-	Turpentine
-	1-Undecanol
-	*normal*-Valeraldehyde
-	Vinylbenzene, inhibited
-	Vinylidene chloride, inhibited
-	Vinyltoluenes, inhibited *mixed isomers*
-	Warfarin (and salts of)
PP	White phosphorus, dry
PP	White phosphorus, wet
-	White spirit, low (15-20%) aromatic
-	Xylenols
PP	Yellow phosphorus, dry
PP	Yellow phosphorus, wet

-	Zinc bromide
-	Zinc cyanide

[Amdt. 172-127, 57 FR 52935, Nov. 5, 1992]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING APPENDIX B TO §172.101, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§172.102 Special provisions.

(a) *General. When column 7 of the §172.101 table refers to a special provision for a hazardous material, the meaning and requirements of that provision are as set forth in this section. When a special provision specifies packaging or packaging requirements-*

(1) The special provision is in addition to the standard requirements for all packagings prescribed in §173.24 of this subchapter and any other applicable packaging requirements in subparts A and B of part 173 of this subchapter; and

(2) To the extent a special provision imposes limitations or additional requirements on the packaging provisions set forth in column 8 of the §172.101 table, packagings must conform to the requirements of the special provision.

(b) *Description of codes for special provisions. Special provisions contain packaging provisions, prohibitions, exceptions from requirements for particular quantities or forms of materials and requirements or prohibitions applicable to specific modes of transportation, as follows:*

(1) A code consisting only of numbers (for example, "11") is multi-modal in application and may apply to bulk and non-bulk packagings.

(2) A code containing the letter "A" refers to a special provision which applies only to transportation by aircraft.

(3) A code containing the letter "B" refers to a special provision which applies only to bulk packaging requirements. Unless otherwise provided in this subchapter, these special provisions do not apply to IM portable tanks.

(4) A code containing the letter "H" refers to a special provision which applies only to transportation by highway.

(5) A code containing the letter "N" refers to a special provision which applies only to non-bulk packaging requirements.

(6) A code containing the letter "R" refers to a special provision which applies only to transportation by rail.

(7) A code containing the letter "T" refers to a special provision which applies only to transportation in IM portable tanks.

(8) A code containing the letter "W" refers to a special provision which applies only to transportation by water.

(c) *Tables of special provisions. The following tables list, and set forth the requirements of, the special provisions referred to in column 7 of the §172.101 table.*

(1) Numeric provisions. These provisions are multi-modal and apply to bulk and non-bulk packagings:

Code/Special Provisions

1 This material is poisonous by inhalation (see §171.8 of this subchapter) in Hazard Zone A (see §173.116(a) or §173.133(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.

2 This material is poisonous by inhalation (see §171.8 of this subchapter) in Hazard Zone B (see §173.116(a) or §173.133(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.

3 This material is poisonous by inhalation (see §171.8 of this subchapter) in Hazard Zone C (see §173.116(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.

4 This material is poisonous by inhalation (see §171.8 of this subchapter) in Hazard Zone D (see §173.116(a) of this subchapter), and must be described as an inhalation hazard under the provisions of this subchapter.

5 If this material meets the definition for a material poisonous by inhalation (see §171.8 of this subchapter), a shipping name must be selected which identifies the inhalation hazard, in Division 2.3 or Division 6.1, as appropriate.

6 This material is poisonous-by-inhalation and must be described as an inhalation hazard under the provisions of this subchapter.

7 An ammonium nitrate fertilizer is a fertilizer formulation, containing 90% or more ammonium nitrate and no more than 0.2% organic combustible material (calculated as carbon), which does not meet the definition and criteria of a Class 1 (explosive) material (See §173.50 of this subchapter).

8 A hazardous substance that is not a hazardous waste may be shipped under the shipping description "Other regulated substances, liquid *or solid, n.o.s.", as appropriate. In addition, for solid materials, special provision B54 applies.*

9 Packaging for certain PCBs for disposal and storage is prescribed by EPA in 40 CFR 761.60 and 761.65.

10 An ammonium nitrate mixed fertilizer is a fertilizer formulation, containing less than 90% ammonium nitrate and other ingredients, which does not meet the definition and criteria of a Class 1 (explosive) material (See §173.50 of this subchapter).

11 The hazardous material must be packaged as either a liquid or a solid, as appropriate, depending on its physical form at 55 ^{o}C (131 ^{o}F) at atmospheric pressure.

12 In concentrations greater than 40 percent, this material has strong oxidizing properties and is capable of starting fires in contact with combustible materials. If appropriate, a package containing this material must conform to the additional labeling requirements of §172.402 of this subchapter.

13 The words "Inhalation Hazard" shall be entered on each shipping paper in association with the shipping description, shall be marked on each non-bulk package in association with the proper shipping name and identification number, and shall be

marked on two opposing sides of each bulk package. Size of marking on bulk package must conform to §172.302(b) of this subchapter. The requirements of §§172.203(m) and 172.505 of this subchapter do not apply.

14 Motor fuel antiknock mixtures are:

a. Mixtures of one or more organic lead mixtures (such as tetraethyl lead, triethylmethyl lead, diethyldimethyl lead, ethyltrimethyl lead, and tetramethyl lead) with one or more halogen compounds (such as ethylene dibromide and ethylene dichloride), hydrocarbon solvents or other equally efficient stabilizers; or

b. tetraethyl lead.

15 Chemical kits and first aid kits are boxes, cases, etc., containing small amounts of various compatible dangerous goods which are used for medical, analytical, or testing purposes and for which exceptions are provided in this subchapter. For transportation by aircraft, any hazardous materials forbidden in passenger aircraft may not be included in these kits. Inner packagings may not exceed 250 mL for liquids or 250 g for solids and must be protected from other materials in the kit. The total quantity of hazardous materials in any one kit may not exceed either 1 L or 1 kg. The packing group assigned to the kit as a whole must be the most stringent packing group assigned to any individual substance contained in the kit. Kits must be packed in wooden boxes (4C1, 4C2), plywood boxes (4D), reconstituted wood boxes (4F), fiberboard boxes (4G) or plastic boxes (4H1, 4H2); these packagings must meet the requirements appropriate to the packing group assigned to the kit as a whole. The total quantity of hazardous materials in any one package may not exceed either 10 L or 10 kg. Kits which are carried on board transport vehicles for first-aid or operating purposes are not subject to the requirements of this subchapter.

16 This description applies to smokeless powder and other solid propellants that are used as powder for small arms and have been classed as Division 1.3 and 4.1 in accordance with §173.56 of this subchapter.

18 This description is authorized only for fire extinguishers listed in §173.309(b) of this subchapter meeting the following conditions:

a. Each fire extinguisher may only have extinguishing contents that are nonflammable, non-poisonous, non-corrosive and commercially free from corroding components.

b. Each fire extinguisher must be charged with a nonflammable, non-poisonous, dry gas that has a dew-point at or below minus 46.7 ^{o}C (minus 52 ^{o}F) at 101 kPa (1 atmosphere) and is free of corroding components, to not more than the service pressure of the cylinder.

c. A fire extinguisher may not contain more than 30% carbon dioxide by volume or any other corrosive extinguishing agent.

d. Each fire extinguisher must be protected externally by suitable corrosion-resisting coating.

19 For domestic transportation only, the identification number "UN1075" may be used in place of the identification number specified in column (4) of the §172.101 table. The identification number used must be consistent on package markings, shipping papers and emergency response information.

21 This material must be stabilized by appropriate means (e.g., addition of chemical inhibitor, purging to remove oxygen) to prevent dangerous polymerization (see §173.21(f) of this subchapter).
22 If the hazardous material is in dispersion in organic liquid, the organic liquid must have a flash point above 50 ^{o}C (122 ^{o}F).
23 This material may be transported under the provisions of Division 4.1 only if it is so packed that the percentage of diluent will not fall below that stated in the shipping description at any time during transport. Quantities of not more than 500 g per package with not less than 10 percent water by mass may also be classed in Division 4.1, provided a negative test result is obtained when tested in accordance with test series 6(c) of the UN Manual of Tests and Criteria.
24 Alcoholic beverages containing more than 70 percent alcohol by volume must be transported as materials in Packing Group II. Alcoholic beverages containing more than 24 percent but not more than 70 percent alcohol by volume must be transported as materials in Packing Group III.
25 Until October 1, 1997, this material may be transported or offered for transportation in a packaging authorized under the regulations in effect on September 30, 1996.
26 This entry does not include ammonium permanganate, the transport of which is prohibited except when approved by the Associate Administrator for Hazardous Materials Safety.
27 Sodium carbonate peroxyhydrate is considered non-hazardous.
28 The dihydrated sodium salt of dichloroisocyanuric acid is not subject to the requirements of this subchapter.
29 Lithium cells and batteries and equipment containing or packed with lithium cells and batteries which do not comply with the provisions of §173.185 of this subchapter may be transported only if they are approved by the Associate Administrator for Hazardous Materials Safety.
30 Sulfur is not subject to the requirements of this subchapter if transported in a non-bulk packaging or if formed to a specific shape (e.g., prills, granules, pellets, pastilles, or flakes).
31 Materials which have undergone sufficient heat treatment to render them non-hazardous are not subject to the requirements of this subchapter.
32 Polymeric beads and molding compounds may be made from polystyrene, poly(methyl methacrylate) or other polymeric material.
33 Ammonium nitrites and mixtures of an inorganic nitrite with an ammonium salt are prohibited.
34 The commercial grade of calcium nitrate fertilizer, when consisting mainly of a double salt (calcium nitrate and ammonium nitrate) containing not more than 10 percent ammonium nitrate and at least 12 percent water of crystallization, is not subject to the requirements of this subchapter.
35 Antimony sulphides and oxides which do not contain more than 0.5 percent of arsenic calculated on the total mass do not meet the definition of Division 6.1.
36 The maximum net quantity per package is 5 liters (1 gallon) or 5 kg (11 pounds).
37 Unless it can be demonstrated by testing that the sensitivity of the substance in its

frozen state is no greater than in its liquid state, the substance must remain liquid during normal transport conditions. It must not freeze at temperatures above -15 ^{o}C (5 ^{o}F).

38 If this material shows a violent effect in laboratory tests involving heating under confinement, the labeling requirements of Special Provision 53 apply, and the material must be packaged in accordance with packing method OP6 in §173.225 of this subchapter. If the SADT of the technically pure substance is higher than 75 ^{o}C, the technically pure substance and formulations derived from it are not self-reactive materials and, if not meeting any other hazard class, are not subject to the requirements of this subchapter.

39 This substance may be carried under provisions other than those of Class 1 only if it is so packed that the percentage of water will not fall below that stated at any time during transport. When phlegmatized with water and inorganic inert material, the content of urea nitrate must not exceed 75 percent by mass and the mixture should not be capable of being detonated by test 1(a)(i) or test 1(a) (ii) in the UN Recommendations Tests and Criteria.

40 Polyester resin kits consist of two components: a base material (Class 3, Packing Group II or III) and an activator (organic peroxide), each separately packed in an inner packaging. The organic peroxide must be type D, E, or F, not requiring temperature control, and be limited to a quantity of 125 ml (4.22 ounces) per inner packaging if liquid, and 500 g (1 pound) if solid. The components may be placed in the same outer packaging provided they will not interact dangerously in the event of leakage. Packing group will be II or III, according to the criteria for Class 3, applied to the base material.

43 The nitrogen content of the nitrocellulose must not exceed 11.5 percent. Each single filter sheet must be packed between sheets of glazed paper. The portion of glazed paper between the filter sheets must not be less than 65 percent, by mass. The membrane filters/paper arrangement must not be liable to propagate a detonation as tested by one of the tests described in the UN Recommendations, Tests and Criteria, Part I, Test series 1(a). Packagings should be so constructed that explosion is not possible by reason of increased internal pressure. Nitrocellulose membrane filters covered by this entry, each with a mass not exceeding 0.5 g, are not subject to the requirements of this subchapter when contained individually in an article or a sealed packet.

44 The formulation must be prepared so that it remains homogeneous and does not separate during transport. Formulations with low nitrocellulose contents and neither showing dangerous properties when tested for their ability to detonate, deflagrate or explode when heated under defined confinement by the appropriate test methods and criteria in the UN Recommendations, Tests and Criteria, nor being a flammable solid when tested in accordance with appendix E to part 173 of this subchapter (chips, if necessary, crushed and sieved to a particle size of less than 1.25 mm) are not subject to this subchapter.

45 Temperature should be maintained between 18 ^{o}C (64.4 ^{o}F) and 40 ^{o}C (104 ^{o}F). Tanks containing solidified methacrylic acid must not be reheated during transport.

46 This material must be packed in accordance with packing method OP6 (see §173.225 of this subchapter). During transport, it must be protected from direct sunshine and stored (or kept) in a cool and well-ventilated place, away from all sources of heat.
47 Mixtures of solids which are not subject to this subchapter and flammable liquids may be transported under this entry without first applying the classification criteria of Division 4.1, provided there is no free liquid visible at the time the material is loaded or at the time the packaging or transport unit is closed. Each packaging must correspond to a design type that has passed a leakproofness test at the Packing Group II level. Small inner packagings consisting of sealed packets containing less than 10 ml of a Class 3 liquid in Packing Group II or III absorbed onto a solid material are not subject to this subchapter provided there is no free liquid in the packet.
48 Mixtures of solids which are not subject to this subchapter and toxic liquids may be transported under this entry without first applying the classification criteria of Division 6.1, provided there is no free liquid visible at the time the material is loaded or at the time the packaging or transport unit is closed. Each packaging must correspond to a design type that has passed a leakproofness test at the Packing Group II level. This entry may not be used for solids containing a Packing Group I liquid.
49 Mixtures of solids which are not subject to this subchapter and corrosive liquids may be transported under this entry without first applying the classification criteria of Class 8, provided there is no free liquid visible at the time the material is loaded or at the time the packaging or transport unit is closed. Each packaging must correspond to a design type that has passed a leakproofness test at the Packing Group II level.
50 Cases, cartridge, empty with primer which are made of metallic or plastic casings and meeting the classification criteria of Division 1.4 are not regulated for domestic transportation.
51 This description applies to items previously described as "Toy propellant devices, Class C" and includes reloadable kits. Model rocket motors containing 30 grams or less propellant are classed as Division 1.4S and items containing more than 30 grams of propellant but not more than 62.5 grams of propellant are classed as Division 1.4C.
52 Ammonium nitrate fertilizers may not meet the definition and criteria of Class 1 (explosive) material (see §173.50 of this subchapter).
53 Packages of these materials must bear the subsidiary risk label, "EXPLOSIVE", unless otherwise provided in this subchapter or through an approval issued by the Associate Administrator for Hazardous Materials Safety, or the competent authority of the country of origin. A copy of the approval shall accompany the shipping papers.
54 Maneb or maneb preparations not meeting the definition of Division 4.3 or any other hazard class are not subject to the requirements of this subchapter when transported by motor vehicle, rail car, or aircraft.
55 This device must be approved in accordance with §173.56 of this subchapter by the Associate Administrator for Hazardous Materials Safety.
56 A means to interrupt and prevent detonation of the detonator from initiating the detonating cord must be installed between each electric detonator and the detonating

cord ends of the jet perforating guns before the charged jet perforating guns are offered for transportation.

57 Maneb *or Maneb preparations stabilized against self-heating need not be classified in Division 4.2 when it can be demonstrated by testing that a volume of 1 m^3 of substance does not self-ignite and that the temperature at the center of the sample does not exceed 200 ^oC, when the sample is maintained at a temperature of not less than 75 ^oC # 2 ^oC for a period of 24 hours, in accordance with procedures set forth for testing self-heating materials in the UN Manual of Tests and Criteria.*

58 Aqueous solutions of Division 5.1 inorganic solid nitrate substances are considered as not meeting the criteria of Division 5.1 if the concentration of the substances in solution at the minimum temperature encountered in transport is not greater than 80% of the saturation limit.

59 Ferrocerium, stabilized against corrosion, with a minimum iron content of 10 percent is not subject to the requirements of this subchapter.

60 After September 30, 1997, an oxygen generator, chemical, that is shipped with its means of initiation attached must incorporate at least two positive means of preventing unintentional actuation of the generator, and be classed and approved by the Associate Administrator for Hazardous Materials Safety. The procedures for approval of a chemical oxygen generator that contains an explosive means of initiation (e.g., a primer or electric match) are specified in §173.56 of this subchapter. Each person who offers a chemical oxygen generator for transportation after September 30, 1997, shall: (1) ensure that it is offered in conformance with the conditions of the approval; (2) maintain a copy of the approval at each facility where the chemical oxygen generator is packaged; and (3) mark the approval number on the outside of the package.

61 A chemical oxygen generator is spent if its means of ignition and all or a part of its chemical contents have been expended.

64 The group of alkali metals includes lithium, sodium, potassium, rubidium, and caesium.

65 The group of alkaline earth metals includes magnesium, calcium, strontium, and barium.

66 Formulations of these substances containing not less than 30 percent non-volatile, non-flammable phlegmatizer are not subject to this subchapter.

70 Black powder that has been classed in accordance with the requirements of §173.56 of this subchapter may be reclassed and offered for domestic transportation as a Division 4.1 material if it is offered for transportation and transported in accordance with the limitations and packaging requirements of §173.170 of this subchapter.

74 During transport, this material must be protected from direct sunshine and stored or kept in a cool and well-ventilated place, away from all sources of heat.

77 For domestic transportation, a Division 5.1 subsidiary risk label is required only if a carbon dioxide and oxygen mixture contains more than 23.5% oxygen.

81 Polychlorinated biphenyl items, as defined in 40 CFR 761.3, for which specification packagings are impractical, may be packaged in non-specification packagings meeting the general packaging requirements of subparts A and B of part 173 of this

subchapter. Alternatively, the item itself may be used as a packaging if it meets the general packaging requirements of subparts A and B of part 173 of this subchapter.

101 The name of the particular substance or article must be specified.

102 The ends of the detonating cord must be tied fast so that the explosive cannot escape.The articles may be transported as in Division 1.4 Compatibility Group D (1.4D) if all of the conditions specified in §173.63(a) of this subchapter are met.

103 Detonators which will not mass detonate and undergo only limited propagation in the shipping package may be assigned to 1.4B classification code. Mass detonate means that more than 90 percent of the devices tested in a package explode practically simultaneously. Limited propagation means that if one detonator near the center of a shipping package is exploded, the aggregate weight of explosives, excluding ignition and delay charges, in this and all additional detonators in the outside packaging that explode may not exceed 25 grams.

105 The word "Agents" may be used instead of "Explosives" when approved by the Associate Administrator for Hazardous Materials Safety.

106 The recognized name of the particular explosive may be specified in addition to the type.

107 The classification of the substance is expected to vary especially with the particle size and packaging but the border lines have not been experimentally determined; appropriate classifications should be verified following the test procedures in §§173.57 and 173.58 of this subchapter.

108 Fireworks must be so constructed and packaged that loose pyrotechnic composition will not be present in packages during transportation.

109 Rocket motors must be nonpropulsive in transportation unless approved in accordance with §173.56 of this subchapter. A rocket motor to be considered "nonpropulsive" must be capable of unrestrained burning and must not appreciably move in any direction when ignited by any means.

110 Cartridges containing 3.2 grams or less of deflagrating (propellant) explosives installed in a fire extinguisher are not subject to the requirements of this subchapter.

111 Explosive substances of Division 1.1 Compatibility Group A (1.1A) are forbidden for transportation if dry or not desensitized, unless incorporated in a device.

113 The sample must be given a tentative approval by an agency or laboratory in accordance with §173.56 of this subchapter.

114 Jet perforating guns, charged, oil well, without detonator may be reclassed to Division 1.4 Compatibility Group D (1.4D) if the following conditions are met:

a. The total weight of the explosive contents of the shaped charges assembled in the guns does not exceed 90.5 kg (200 pounds) per vehicle; and

b. The guns are packaged in accordance with Packing Method US 1 as specified in §173.62 of this subchapter.

115 Boosters with detonator, detonator assemblies and boosters with detonators in which the total explosive charge per unit does not exceed 25 g, and which will not mass detonate and undergo only limited propagation in the shipping package may be assigned to 1.4B classification code. Mass detonate means more than 90 percent of the devices tested in a package explode practically simultaneously. Limited

propagation means that if one booster near the center of the package is exploded, the aggregate weight of explosives, excluding ignition and delay charges, in this and all additional boosters in the outside packaging that explode may not exceed 25 g.

116 Fuzes, detonating may be classed in Division 1.4 if the fuzes do not contain more than 25 g of explosive per fuze and are made and packaged so that they will not cause functioning of other fuzes, explosives or other explosive devices if one of the fuzes detonates in a shipping packaging or in adjacent packages.

117 If shipment of the explosive substance is to take place at a time that freezing weather is anticipated, the water contained in the explosive substance must be mixed with denatured alcohol so that freezing will not occur.

118 This substance may not be transported under the provisions of Division 4.1 unless specifically authorized by the Associate Administrator for Hazardous Materials Safety.

119 This substance, when in quantities of not more than 11.5 kg (25.3 pounds), with not less than 10 percent water, by mass, also may be classed in Division 4.1, provided a negative test result is obtained when tested in accordance with test series 6(c) of the UN Manual of Tests and Criteria.

120 The phlegmatized substance must be significantly less sensitive than dry PETN.

121 This substance, when containing less alcohol, water or phlegmatizer than specified, may not be transported unless approved by the Associate Administrator for Hazardous Materials Safety.

123 Any explosives, blasting, type C containing chlorates must be segregated from explosives containing ammonium nitrate or other ammonium salts.

125 Lactose or glucose or similar materials may be used as a phlegmatizer provided that the substance contains not less than 90%, by mass, of phlegmatizer. These mixtures may be classified in Division 4.1 when tested in accordance with test series 6(c) of the UN Manual of Tests and Criteria and approved by the Associate Administrator for Hazardous Materials Safety. Testing must be conducted on at least three packages as prepared for transport. Mixtures containing at least 98%, by mass, of phlegmatizer are not subject to the requirements of this subchapter. Packages containing mixtures with not less than 90% by mass, of phlegmatizer need not bear a POISON subsidiary risk label.

127 Mixtures containing oxidizing and organic materials transported under this entry may not meet the definition and criteria of a Class 1 material. (See §173.50 of this subchapter.)

128 Regardless of the provisions of §172.101(c)(12), aluminum smelting by-products and aluminum remelting by-products described under this entry, meeting the definition of Class 8, Packing Group II and III may be classed as a Division 4.3 material and transported under this entry. The presence of a Class 8 hazard must be communicated as required by this Part for subsidiary hazards.

129 These materials may not be classified and transported unless authorized by the Associate Administrator for Hazardous Materials Safety on the basis of results from Series 2 Test and a Series 6(c) Test from the UN Manual of Tests and Criteria on packages as prepared for transport. The packing group assignment and packaging

must be approved by the Associate Administrator for Hazardous Materials Safety on the basis of the criteria in §173.21 of this subchapter and the package type used for the Series 6(c) test.

130 Batteries, dry are not subject to the requirements of this subchapter only when they are offered for transportation in a manner that prevents the dangerous evolution of heat (for example, by the effective insulation of exposed terminals).

131 This material may not be offered for transportation unless approved by the Associate Administrator for Hazardous Materials Safety.

132 Ammonium nitrate fertilizers of this composition are not subject to the requirements of this subchapter if shown by a trough test (see United Nations Recommendations on the Transport of Dangerous Goods, Manual Tests and Criteria, Part III, sub-section 38.2) not to be liable to self-sustaining decomposition and provided that they do not contain an excess of nitrate greater than 10% by mass (calculated as potassium nitrate).

133 This description applies to articles which are used as life-saving vehicle air bag inflators or air bag modules or seat-belt pretensioners, containing a gas or a mixture of compressed gases classified under Division 2.2, and with or without small quantities of pyrotechnic material. For units with pyrotechnic material, initiated explosive effects must be contained within the pressure vessel (cylinder) such that the unit may be excluded from Class 1 in accordance with paragraphs 1.11(b) and 16.6.1.4.7(a)(ii) of the UN Manual of Tests and Criteria, Part 1. In addition, units must be designed or packaged for transport so that when engulfed in a fire there will be no fragmentation of the pressure vessel or projection hazard. This may be determined by analysis or test. The pressure vessel must be in conformance with the requirements of this subchapter for the gas(es) contained in the pressure vessel or as specifically authorized by the Associate Administrator for Hazardous Materials Safety.

134 This entry only applies to vehicles, machinery and equipment which are powered by wet batteries or sodium batteries and which are transported with these batteries installed. Examples of such items are electrically-powered cars, lawn mowers, wheelchairs and other mobility aids. Self-propelled vehicles which also contain an internal combustion engine must be consigned under the entry "Vehicle, flammable gas powered" or "Vehicle, flammable liquid powered", as appropriate.

135 The entries "Vehicle, flammable gas powered" or "Vehicle, flammable liquid powered", as appropriate, must be used when internal combustion engines are installed in a vehicle.

136 This entry only applies to machinery and apparatus containing hazardous materials as an integral element of the machinery or apparatus. It may not be used to describe machinery or apparatus for which a proper shipping name exists in the §172.101 Table. Machinery or apparatus may only contain hazardous materials for which exceptions are referenced in Column 8 of the §172.101 Table and are provided in Part 173, Subpart D, of this subchapter. Hazardous materials shipped under this entry are excepted from the labeling requirements of this subchapter unless offered for transportation or transported by aircraft. For transportation by aircraft, the

machinery or apparatus must be labeled according to each of the hazardous materials contained in the machinery or apparatus. This includes the primary hazard label and any applicable subsidiary risk labels, except that a subsidiary risk label is not required for any subsidiary hazard already indicated by the primary or subsidiary hazard label applied for another substance in the machinery or apparatus. Orientation markings as prescribed in §172.312 are required only when necessary to ensure that liquid hazardous materials remain in their intended orientation. The machinery or apparatus or the packagings in which they are contained shall be marked "Dangerous goods in machinery" or "Dangerous goods in apparatus", as appropriate, and with the appropriate identification number. For transportation by aircraft, machinery or apparatus may not contain any material forbidden for transportation by passenger aircraft. Hazardous materials in machinery or apparatus are not subject to the placarding requirements of subpart F of this part. The Associate Administrator for Hazardous Materials Safety may except from the requirements of this subchapter equipment, machinery and apparatus provided:

a. It is shown that it does not pose a significant risk in transportation;
b. The quantities of hazardous materials do not exceed those specified in §173.4 of this subchapter for the applicable class(es) of hazardous materials contained in §173.4 of this subchapter; and
c. The equipment, machinery or apparatus conforms with §173.222 of this subchapter.

137 Cotton, dry is not subject to the requirements of this subchapter when it is baled in accordance with ISO 8115, "Cotton Bales-Dimensions and Density" to a density of at least 360 kg/m^3 (22.4lb/ft^3) and it is transported in a freight container or closed transport vehicle.

138 Lead compounds which, when mixed in a ratio of 1:1000 with 0.07M (Molar concentration) hydrochloric acid and stirred for one hour at a temperature of 23 ^{o}C +2 ^{o}C, exhibit a solubility of 5% or less are considered insoluble.

(2) *"A" codes. These provisions apply only to transportation by aircraft:*

Code/Special Provisions

A1 Single packagings are not permitted on passenger aircraft.

A2 Single packagings are not permitted on aircraft.

A3 For combination packagings, if glass inner packagings (including ampoules) are used, they must be packed with absorbent material in tightly closed metal receptacles before packing in outer packagings.

A4 Liquids having an inhalation toxicity of Packing Group I are not permitted on aircraft.

A5 Solids having an inhalation toxicity of Packing Group I are not permitted on passenger aircraft and may not exceed a maximum net quantity per package of 15 kg (33 pounds) on cargo aircraft.

A6 For combination packagings, if plastic inner packagings are used, they must be packed in tightly closed metal receptacles before packing in outer packagings.

A7 Steel packagings must be corrosion-resistant or have protection against corrosion.

A8 For combination packagings, if glass inner packagings (including ampoules) are used, they must be packed with cushioning material in tightly closed metal receptacles before packing in outer packagings.

A9 For combination packagings, if plastic bags are used, they must be packed in tightly closed metal receptacles before packing in outer packagings.

A10 When aluminum or aluminum alloy construction materials are used, they must be resistant to corrosion.

A11 For combination packagings, when metal inner packagings are permitted, only specification cylinders constructed of metals which are compatible with the hazardous material may be used.

A13 Non-bulk packagings conforming to §173.197 of this subchapter not exceeding 16 kilograms (35 pounds) gross mass containing only used sharps are permitted for transportation by aircraft. Maximum liquid content in each inner packaging may not exceed 50 milliliters (1.7 ounces).

A14 Non-bulk packagings of regulated medical waste conforming to §173.197 of this subchapter not exceeding 16 kilograms (35 pounds) gross mass for solid waste or 12 liters (3 gallons) total volume for liquid waste may be transported by passenger and cargo aircraft when means of transportation other than air are impracticable or not available.

A19 Combination packagings consisting of outer fiber drums or plywood drums, with inner plastic packagings, are not authorized for transportation by aircraft.

A20 Plastic bags as inner receptacles of combination packagings are not authorized for transportation by aircraft.

A29 Combination packagings consisting of outer expanded plastic boxes with inner plastic bags are not authorized for transportation by aircraft.

A30 Ammonium permanganate is not authorized for transportation on aircraft.

A34 Aerosols containing a corrosive liquid in Packing Group II charged with a gas are not permitted for transportation by aircraft.

A35 This includes any material which is not covered by any of the other classes but which has an anesthetic, narcotic, noxious or other similar properties such that, in the event of spillage or leakage on an aircraft, extreme annoyance or discomfort could be caused to crew members so as to prevent the correct performance of assigned duties.

A37 This entry applies only to a material meeting the definition in §171.8 of this subchapter for self-defense spray.

A51 When transported by cargo-only aircraft, an oxygen generator must conform to the provisions of an approval issued under Special Provision 60 and be contained in a packaging prepared and originally offered for transportation by the approval holder.

A52 A cylinder containing Oxygen, compressed, may not be loaded into a passenger-carrying aircraft or in an inaccessible cargo location on a cargo-only aircraft unless it is placed in an overpack or outer packaging that conforms to the performance criteria of Air Transport Association (ATA) Specification 300 for Type I shipping containers.

(3) *"B" codes. These provisions apply only to bulk packagings:*

Code/Special Provisions

B1 If the material has a flash point at or above 38 ^oC (100 ^oF) and below 93 ^oC (200 ^oF), then the bulk packaging requirements of §173.241 of this subchapter are applicable. If the material has a flash point of less than 38 ^oC (100 ^oF), then the bulk packaging requirements of §173.242 of this subchapter are applicable.
B2 MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks are not authorized.
B3 MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks and DOT 57 portable tanks are not authorized.
B4 MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks are not authorized.
B5 Only ammonium nitrate solutions with 35 percent or less water that will remain completely in solution under all conditions of transport at a maximum lading temperature of 116 ^oC (240 ^oF) are authorized for transport in the following bulk packagings: MC 307, MC 312, DOT 407 and DOT 412 cargo tanks with at least 172 kPa (25 psig) design pressure. The packaging shall be designed for a working temperature of at least 121 ^oC (250 ^oF). Only Specifications MC 304, MC 307 or DOT 407 cargo tank motor vehicles are authorized for transportation by vessel.
B6 Packagings shall be made of steel.
B7 Safety relief devices are not authorized on multi-unit tank car tanks. Openings for safety relief devices on multi-unit tank car tanks shall be plugged or blank flanged.
B8 Packagings shall be made of nickel, stainless steel, or steel with nickel, stainless steel, lead or other suitable corrosion resistant metallic lining.
B9 Bottom outlets are not authorized.
B10 MC 300, MC 301, MC 302, MC 303, MC 305, and MC 306 and DOT 406 cargo tanks, and DOT 57 portable tanks are not authorized.
B11 Tank car tanks must have a test pressure of at least 2,068.5 kPa (300 psi). Cargo and portable tanks must have a design pressure of at least 1,207 kPa (175 psig).
B13 A nonspecification cargo tank motor vehicle authorized in §173.247 of this subchapter must be at least equivalent in design and in construction to a DOT 406 cargo tank or MC 306 cargo tank (if constructed before August 31, 1995), except as follows:
a. Packagings equivalent to MC 306 cargo tanks are excepted from §§178.340-10, certification; 178.341-4, vents; and 178.341-5, emergency flow control.
b. Packagings equivalent to DOT 406 cargo tanks are excepted from §§178.345-7(d)(5), circumferential reinforcements; 178.345-14, marking; 178.345-15, certification; 178.346-10, pressure relief; and 178.346-11, outlets.
c. Packagings are excepted from the design stress limits at elevated temperatures, as described in the ASME Code. However, the design stress limits may not exceed 25 percent of the stress, as specified in the Aluminum Association's "Aluminum Standards and Data" (7th Edition June 1982), for 0 temper at the maximum design temperature of the cargo tank.
B14 Each bulk packaging, except a tank car or a multi-unit-tank car tank, must be insulated with an insulating material so that the overall thermal conductance at 15.5 ^oC (60 ^oF) is no more than 1.5333 kilojoules per hour per square meter per degree

Celsius (0.075 Btu per hour per square foot per degree Fahrenheit) temperature differential. Insulating materials must not promote corrosion to steel when wet. Notwithstanding the requirements in §171.14(b)(4)(ii) of this subchapter, compliance with this provision is delayed until October 1, 1994, for a bulk packaging containing a material poisonous by inhalation which, when in contact with moisture, becomes highly corrosive to the tank and could cause a degree of corrosion under an insulation blanket that would have an adverse effect on tank integrity.

B15 Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance.

B16 The lading must be completely covered with nitrogen, inert gas or other inert materials.

B18 Open steel hoppers or bins are authorized.

B23 Tanks must be made of steel that is rubber lined or unlined. Unlined tanks must be passivated before being placed in service. If unlined tanks are washed out with water, they must be repassivated prior to return to service. Lading in unlined tanks must be inhibited so that the corrosive effect on steel is not greater than that of hydrofluoric acid of 65 percent concentration.

B25 Packagings must be made from monel or nickel or monel-lined or nickel-lined steel.

B26 Tanks must be insulated. Insulation must be at least 100 mm (3.9 inches) except that the insulation thickness may be reduced to 51 mm (2 inches) over the exterior heater coils. Interior heating coils are not authorized. The packaging may not be loaded with a material outside of the packaging's design temperature range. In addition, the material also must be covered with an inert gas or the container must be filled with water to the tank's capacity. After unloading, the residual material also must be covered with an inert gas or the container must be filled with water to the tank's capacity.

B27 Tanks must have a service pressure of 1,034 kPa (150 psig). Tank car tanks must have a test pressure rating of 1,379 kPa (200 psi). Lading must be blanketed at all times with a dry inert gas at a pressure not to exceed 103 kPa (15 psig).

B28 Packagings must be made of stainless steel.

B30 MC 312, MC 330, MC 331 and DOT 412 cargo tanks and DOT 51 portable tanks must be made of stainless steel, except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads for cargo tanks and portable tanks must be the greater of 7.62 mm (0.300 inch) or the thickness required for a tank with a design pressure at least equal to 1.5 times the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F). In addition, MC 312 and DOT 412 cargo tank motor vehicles must:

a. Be ASME Code (U) stamped for 100% radiography of all pressure-retaining welds;

b. Have accident damage protection which conforms with §178.345-8 of this subchapter;

c. Have a MAWP or design pressure of at least 87 psig: and

d. Have a bolted manway cover.

B32 MC 312, MC 330, MC 331, DOT 412 cargo tanks and DOT 51 portable tanks must be made of stainless steel, except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads for cargo tanks and portable tanks must be the greater of 6.35 mm (0.250 inch) or the thickness required for a tank with a design pressure at least equal to 1.3 times the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F). In addition, MC 312 and DOT 412 cargo tank motor vehicles must:

a. Be ASME Code (U) stamped for 100% radiography of all pressure-retaining welds;

b. Have accident damage protection which conforms with §178.345-8 of this subchapter;

c. Have a MAWP or design pressure of at least 87 psig; and

d. Have a bolted manway cover.

B33 MC 300, MC 301, MC 302, MC 303, MC 305, MC 306, and DOT 406 cargo tanks equipped with a 1 psig normal vent used to transport gasoline must conform to table 1 of this Special Provision. Based on the volatility class determined by using ASTM D439 and the Reid vapor pressure (RVP) of the particular gasoline, the maximum lading pressure and maximum ambient temperature permitted during the loading of gasoline may not exceed that listed in table I.

Table I-Maximum Ambient Temperature-Gasoline

ASTM D439 volatility class	Maximum lading and ambient temperature (see note 1)
A	131 ^{o}F
(RVP<=9.0 psia)	-
B	124 ^{o}F
(RVP<=10.0 psia)	-
C	116 ^{o}F
(RVP<=11.5 psia)	-
D	107 ^{o}F
(RVP<=13.5 psia)	-
E	100 ^{o}F
(RVP<=15.0 psia)	-

AANote 1: Based on maximum lading pressure of 1 psig at top of cargo tank.

B35 Tank cars containing hydrogen cyanide may be alternatively marked "Hydrocyanic acid, liquefied" if otherwise conforming to marking requirements in subpart D of this part. Tank cars marked "HYDROCYANIC ACID" prior to October 1, 1991 do not need to be remarked.

B37 The amount of nitric oxide charged into any tank car tank may not exceed 1,379 kPa (200 psig) at 21 ^{o}C (70 ^{o}F).

B42 Tank cars must have a test pressure of 34.47 Bar (500 psig) or greater and conform to Class 105J. Each tank car must have a safety relief device having a start-to-discharge pressure of 10.34 Bar (150 psig). The tank car specification may be marked to indicate a test pressure of 13.79 Bar (200 psig).

B44 All parts of valves and safety relief devices in contact with lading must be of a material which will not cause formation of acetylides.
B45 Safety relief valves must be equipped with stainless steel or platinum frangible discs approved by the AAR Committee on Tank Cars.
B46 The detachable protective housing for the loading and unloading valves of multi-unit tank car tanks must withstand tank test pressure and must be approved by the Associate Administrator for Hazardous Materials Safety.
B47 A safety relief device with a start-to-discharge pressure setting of 310 kPa (45 psig) is permitted.
B48 Portable tanks in sodium metal service may be visually inspected at least once every 5 years instead of being retested hydrostatically. Date of the visual inspection must be stenciled on the tank near the other required markings.
B49 Tanks equipped with interior heater coils are not authorized. Single unit tank car tanks must have a safety relief valve set at no more than 1551 kPa (225 psig).
B50 Each valve outlet of a multi-unit tank car tank must be sealed by a threaded solid plug or a threaded cap with inert luting or gasket material. Valves must be of stainless steel and the caps, plugs, and valve seats must be of a material that will not deteriorate as a result of contact with the lading.
B52 Notwithstanding the provisions of §173.24b of this subchapter, non-reclosing pressure relief devices are authorized on DOT 57 portable tanks.
B53 Except for IBCs, packagings must be made of either aluminum or steel.
B54 Open-top, sift-proof rail cars are also authorized.
B55 Water-tight, sift-proof, closed-top, metal-covered hopper cars, equipped with a venting arrangement (including flame arrestors) approved by the Associate Administrator for Hazardous Materials Safety are also authorized.
B56 Water-tight, sift-proof, closed-top, metal-covered hopper cars are also authorized if the particle size of the hazardous material is not less than 149 microns.
B57 Class 115A tank car tanks used to transport chloroprene must be equipped with a safety vent of a diameter not less than 305 mm (12 inches) with a maximum rupture disc pressure of 45 psi.
B59 Water-tight, sift-proof, closed-top, metal-covered hopper cars are also authorized provided that the lading is covered with a nitrogen blanket.
B60 DOT Specification 106A500X multi-unit tank car tanks that are not equipped with a safety relief device of any type are authorized. For the transportation of phosgene, the outage must be sufficient to prevent tanks from becoming liquid full at 55 ^{o}C (130 ^{o}F).
B61 Written procedures covering details of tank car appurtenances, dome fittings, safety devices, and marking, loading, handling, inspection, and testing practices must be approved by the Associate Administrator for Hazardous Materials Safety before any single unit tank car tank is offered for transportation.
B64 Each single unit tank car tank built after December 31, 1990 must be equipped with a tank head puncture resistance system that conforms to §179.16 of this subchapter.
B65 Tank cars must have a test pressure of 34.47 Bar (500 psig) or greater and conform to Class 105A. Each tank car must have a pressure relief device having a

start-to-discharge pressure of 15.51 Bar (225 psig). The tank car specification may be marked to indicate a test pressure of 20.68 Bar (300 psig).

B66 Each tank must be equipped with gas tight valve protection caps. Outage must be sufficient to prevent tanks from becoming liquid full at 55 ^{o}C (130 ^{o}F). Specification 110A500W tanks must be stainless steel.

B67 All valves and fittings must be protected by a securely attached cover made of metal not subject to deterioration by the lading, and all valve openings, except safety valve, must be fitted with screw plugs or caps to prevent leakage in the event of valve failure.

B68 Sodium must be in a molten condition when loaded and allowed to solidify before shipment. Outage must be at least 5 percent at 98 ^{o}C (208 ^{o}F). Bulk packagings must have exterior heating coils fusion welded to the tank shell which have been properly stress relieved. The only tank car tanks authorized are Class DOT 105 tank cars having a test pressure of 2,069 kPa (300 psig) or greater.

B69 Dry sodium cyanide or potassium cyanide may be shipped in sift-proof weather-resistant metal covered hopper cars, covered motor vehicles, portable tanks or non-specification bins. Bins must be approved by the Associate Administrator for Hazardous Materials Safety. Flexible intermediate bulk containers (FIBCs) may also be used under conditions approved by the Associate Administrator for Hazardous Materials Safety.

B70 If DOT 103ANW tank car tank is used: All cast metal in contact with the lading must have 96.7 percent nickel content; and the lading must be anhydrous and free from any impurities.

B71 Tank cars must have a test pressure of 20.68 Bar (300 psig) or greater and conform to Class 105, 112, 114 or 120.

B72 Tank cars must have a test pressure of 34.47 Bar (500 psig) or greater and conform to Class 105J, 106, or 110.

B74 Tank cars must have a test pressure of 20.68 Bar (300 psig) or greater and conform to Class 105S, 106, 110, 112J, 114J or 120S.

B76 Tank cars must have a test pressure of 20.68 Bar (300 psig) or greater and conform to Class 105S, 112J, 114J or 120S. Each tank car must have a safety relief device having a start-to-discharge pressure of 10.34 Bar (150 psig). The tank car specification may be marked to indicate a test pressure of 13.79 Bar (200 psig).

B77 Other packaging are authorized when approved by the Associate Administrator for Hazardous Materials Safety.

B78 Tank cars must have a test pressure of 4.14 Bar (60 psig) or greater and conform to Class 103, 104, 105, 109, 111, 112, 114 or 120. Heater pipes must be of welded construction designed for a test pressure of 500 pounds per square inch. A 25 mm (1 inch) woven lining of asbestos or other approved material must be placed between the bolster slabbing and the bottom of the tank. If a tank car tank is equipped with a safety vent of the frangible disc type, the frangible disc must be perforated with a 3.2 mm (0.13 inch) diameter hole. If a tank car tank is equipped with a safety relief valve, the tank car tank must also be equipped with a vacuum relief valve.

B80 Each cargo tank must have a minimum design pressure of 276 kPa (40 psig).

B81 Venting and pressure relief devices for tank car tanks and cargo tanks must be approved by the Associate Administrator for Hazardous Materials Safety.
B82 Cargo tanks and portable tanks are not authorized.
B83 Bottom outlets are prohibited on tank car tanks transporting sulfuric acid in concentrations over 65.25 percent.
B84 Packagings must be protected with non-metallic linings impervious to the lading or have a suitable corrosion allowance for sulfuric acid or spent sulfuric acid in concentration up to 65.25 percent.
B85 Cargo tanks must be marked with the name of the lading in accordance with the requirements of §172.302(b).
B90 Steel tanks conforming or equivalent to ASME specifications which contain solid or semisolid residual motor fuel antiknock mixture (including rust, scale, or other contaminants) may be shipped by rail freight or highway. The tank must have been designed and constructed to be capable of withstanding full vacuum. All openings must be closed with gasketed blank flanges or vapor tight threaded closures.
B100 Intermediate bulk containers are not authorized.
B101 When intermediate bulk containers are used, only those constructed of metal are authorized.
B103 If an intermediate bulk container is used, the package must be transported in a closed freight container or transport vehicle.
B104 Intermediate bulk containers must be provided with a device to allow venting during transport. The inlet to the pressure relief valve must communicate with the vapor space of the packaging and lading during transport.
B105 Authorized only in rigid intermediate bulk containers.
B106 Authorized in intermediate bulk containers that are vapor tight.
B108 Authorized in sift-proof, water-resistant flexible, fiberboard or wooden intermediate bulk containers; packed in a closed transport vehicle.
B109 Not authorized in flexible intermediate bulk containers.
B110 This material also may be packaged in IBCs authorized in §173.242(d) of this subchapter.
B115 Rail cars, highway trailers, roll-on/roll-off bins, or other non-specification bulk packagings are authorized. Packagings must be sift-proof, prevent liquid water from reaching the hazardous material, and be provided with sufficient venting to preclude dangerous accumulation of flammable, corrosive, or toxic gaseous emissions such as methane, hydrogen, and ammonia. The material must be loaded dry.

(4) *"H" codes. These provisions apply only to transportation by highway. [Reserved]*
(5) "N" codes. These provisions apply only to non-bulk packagings:

Code/Special Provisions

N3 Glass inner packagings are permitted in combination or composite packagings only if the hazardous material is free from hydrofluoric acid.
N4 For combination or composite packagings, glass inner packagings, other than ampoules, are not permitted.
N5 Glass materials of construction are not authorized for any part of a packaging which

is normally in contact with the hazardous material.
N6 Battery fluid packaged with electric storage batteries, wet or dry, must conform to the packaging provisions of §173.159 (g) or (h) of this subchapter.
N7 The hazard class or division number of the material must be marked on the package in accordance with §172.302 of this subchapter. However, the hazard label corresponding to the hazard class or division may be substituted for the marking.
N8 Nitroglycerin solution in alcohol may be transported under this entry only when the solution is packed in metal cans of not more than 1 L capacity each, overpacked in a wooden box containing not more than 5 L. Metal cans must be completely surrounded with absorbent cushioning material. Wooden boxes must be completely lined with a suitable material impervious to water and nitroglycerin.
N10 Lighters and their inner packagings, which have been approved by the Associate Administrator for Hazardous Materials Safety (see §173.21(i) of this subchapter), must be packaged in one of the following outer packagings at the Packing Group II level: 4C1 or 4C2 wooden boxes; 4D plywood boxes; 4F reconstituted wood boxes; 4G fiberboard boxes; or 4H1 or 4H2 plastic boxes.
N11 This material is excepted for the specification packaging requirements of this subchapter if the material is packaged in strong, tight non-bulk packaging meeting the requirements of subparts A and B of part 173 of this subchapter.
N12 Plastic packagings are not authorized.
N25 Steel single packagings are not authorized.
N32 Aluminum materials of construction are not authorized for single packagings.
N33 Aluminum drums are not authorized.
N34 Aluminum construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material.
N36 Aluminum or aluminum alloy construction materials are permitted only for halogenated hydrocarbons that will not react with aluminum.
N37 This material may be shipped in an integrally-lined fiber drum (1G) which meets the general packaging requirements of subpart B of part 173 of this subchapter, the requirements of part 178 of this subchapter at the packing group assigned for the material and to any other special provisions of column 7 of the §172.101 table.
N40 This material is not authorized in the following packagings:
  a. A combination packaging consisting of a 4G fiberboard box with inner receptacles of glass or earthenware;
  b. A single packaging of a 4C2 sift-proof, natural wood box; or
  c. A composite packaging 6PG2 (glass, porcelain or stoneware receptacles within a fiberboard box).
N41 Metal construction materials are not authorized for any part of a packaging which is normally in contact with the hazardous material.
N42 1A1 drums made of carbon steel with thickness of body and heads of not less than 1.3 mm (0.050 inch) and with a corrosion-resistant phenolic lining are authorized for stabilized benzyl chloride if tested and certified to the Packing Group I performance level at a specific gravity of not less than 1.8.
N43 Metal drums are permitted as single packagings only if constructed of nickel or

monel.

N45 Copper cartridges are authorized as inner packagings if the hazardous material is not in dispersion.

N65 Outage must be sufficient to prevent cylinders or spheres from becoming liquid full at 55 ^{o}C (130 ^{o}F). The vacant space (outage) may be charged with a nonflammable nonliquefied compressed gas if the pressure in the cylinder or sphere at 55 ^{o}C (130 ^{o}F) does not exceed 125 percent of the marked service pressure.

N72 Packagings must be examined by the Bureau of Explosives and approved by the Associate Administrator for Hazardous Materials Safety.

N73 Packagings consisting of outer wooden or fiberboard boxes with inner glass, metal or other strong containers; metal or fiber drums; kegs or barrels; or strong metal cans are authorized and need not conform to the requirements of part 178 of this subchapter.

N74 Packages consisting of tightly closed inner containers of glass, earthenware, metal or polyethylene, capacity not over 0.5 kg (1.1 pounds) securely cushioned and packed in outer wooden barrels or wooden or fiberboard boxes, not over 15 kg (33 pounds) net weight, are authorized and need not conform to the requirements of part 178 of this subchapter.

N75 Packages consisting of tightly closed inner packagings of glass, earthenware or metal, securely cushioned and packed in outer wooden barrels or wooden or fiberboard boxes, capacity not over 2.5 kg (5.5 pounds) net weight, are authorized and need not conform to the requirements of part 178 of this subchapter.

N76 For materials of not more than 25 percent active ingredient by weight, packages consisting of inner metal packagings not greater than 250 ml (8 ounces) capacity each, packed in strong outer packagings together with sufficient absorbent material to completely absorb the liquid contents are authorized and need not conform to the requirements of part 178 of this subchapter.

N77 For materials of not more than two percent active ingredients by weight, packagings need not conform to the requirements of part 178 of this subchapter, if liquid contents are absorbed in an inert material.

N78 Packages consisting of inner glass, earthenware, or polyethylene or other nonfragile plastic bottles or jars not over 0.5 kg (1.1 pounds) capacity each, or metal cans not over five pounds capacity each, packed in outer wooden boxes, barrels or kegs, or fiberboard boxes are authorized and need not conform to the requirements of part 178 of this subchapter. Net weight of contents in fiberboard boxes may not exceed 29 kg (64 pounds). Net weight of contents in wooden boxes, barrels or kegs may not exceed 45 kg (99 pounds).

N79 Packages consisting of tightly closed metal inner packagings not over 0.5 kg (1.1 pounds) capacity each, packed in outer wooden or fiberboard boxes, or wooden barrels, are authorized and need not conform to the requirements of part 178 of this subchapter. Net weight of contents may not exceed 15 kg (33 pounds).

N80 Packages consisting of one inner metal can, not over 2.5 kg (5.5 pounds) capacity, packed in an outer wooden or fiberboard box, or a wooden barrel, are authorized and need not conform to the requirements of part 178 of this subchapter.

N82 See §173.306 of this subchapter for classification criteria for flammable aerosols.

(6) *"R" codes. These provisions apply only to transportation by rail. [Reserved]*

(7) "T" codes. These provisions apply only to transportation in IM portable tanks. They are divided into two groupings, one of which appears as IM Tank Configurations in paragraph (c)(7)(i) of this section, and the second of which imposes specific requirements and appears in paragraph (c)(7)(ii) of this section.

(i) IM Tank Configurations. Column 1 lists the code for the special provisions as specified in column 7 of the §172.101 table. Column 2 specifies the IM tank type, either IM 101 (§§178.270 and 178.271 of this subchapter) or IM 102 (§§178.270 and 178.272 of this subchapter). Column 3 specifies the minimum test pressure, in bars (1 bar = 14.5 psig), at which the periodic hydrostatic testing required by §173.32b of this subchapter must be conducted. Column 4 specifies either the section referenced for requirements for bottom openings or "Prohibited", which means bottom openings are prohibited. Column 5 specifies the section reference for requirements applicable to pressure relief devices.

IM Tank Configurations

Code	IM tank type	Minimum test Pressure (bars)	Bottom outlets	Pressure relief devices
(1)	(2)	(3)	(4)	(5)
-	-	-	-	-
T1	102	1.5	§173.32c(g)(1)	§178.270-11(a)(1),(2)
T2	102	1.5	§173.32c(g)(2)	§178.270-11(a)(1),(2)
T7	101	2.65	§173.32c(g)(1)	§178.270-11(a)(1),(2)
T8	101	2.65	§173.32c(g)(2)	§178.270-11(a)(1),(2)
T9	101	2.65	Prohibited	§178.270-11(a)(1),(2)
T11	101	2.65	§173.32c(g)(2)	§178.270-11(a)(3)
T12	101	2.65	Prohibited	§178.270-11(a)(3)
T13	101	4	§173.32c(g)(1)	§178.270-11(a)(1),(2)
T14	101	4	§173.32c(g)(2)	§178.270-11(a)(1),(2)
T15	101	4	Prohibited	§178.270-11(a)(1),(2)
T16	101	4	§173.32c(g)(1)	§178.270-11(a)(3)
T17	101	4	§173.32c(g)(2)	§178.270-11(a)(3)
T18	101	4	Prohibited	§178.270-11(a)(3)
T20	101	6	§173.32c(g)(2)	§178.270-11(a)(1),(2)
T21	101	6	Prohibited	§178.270-11(a)(1),(2)
T22	101	6	§173.32c(g)(1)	§178.270-11(a)(1)(2)
T23	101	6	§173.32c(g)(2)	§178.270-11(a)(3)
T24	101	6	Prohibited	§178.270-11(a)(3)
T28	101	10	Prohibited	§178.270-11(a)(1),(2)
T39	101	10	Prohibited	§178.270-11(a)(3)
T43	101	9	Prohibited	§178.270-11(a)(3)

(ii) *IM Tank special provisions.*

Code/Special Provisions

T25 This hazardous material is not permitted for transport in IM portable tanks.

T26 Each tank must have a minimum shell thickness of 6.35 mm (0.250 inch) mild steel.

T27 Each tank must have a minimum shell thickness of 8.0 mm (0.315 inch) mild steel.

T28 See entry for T28 in the IM Tank Configuration Table in paragraph (c)(7)(i) of this section.

T29 The lading must be completely covered with nitrogen, inert gas or other inert materials.

T30 IM 102 portable tanks without bottom openings or with bottom openings conforming to §173.32c(g)(1) of this subchapter are authorized for a hazardous material with a flash point of O ^{o}C (32 ^{o}F) or greater and a vapor pressure not greater than 65.5 kPa (9.5 psia) at 65.6 ^{o}C (150 ^{o}F).

T31 IM 102 portable tanks without bottom openings or with bottom openings conforming to §173.32c(g)(2) of this subchapter are authorized for a hazardous material with a flash point of 0 ^{o}C (32 ^{o}F) or greater and a vapor pressure not greater than 65 kPa (9.4 psia) at 65.6 ^{o}C (150 ^{o}F).

T32 Each tank must have a minimum shell thickness of 10.0 mm (0.394 inch) mild steel with at least 5.0 mm (0.197 inch) lead lining.

T33 Dry phosphorus is not permitted. For transport in a molten state, the tank must be insulated in accordance with Note T38. Air must be eliminated from the interior of the tank. The tank may be heated, however, interior heating coils are prohibited.

T34 The IM Tank authorization is limited to aqueous solutions containing not more than 40% dimethylamine.

T35 Each tank must be equipped with reclosing (spring loaded) pressure relief valves set to discharge at pressures determined according to the pressure characteristics of the organic peroxide lading.

T36 Each tank must be equipped with pressure relief devices with sufficient venting capacity to prevent the tank from bursting.

T37 IM portable tanks are only authorized for the shipment of hydrogen peroxide solutions in water containing 72 percent or less hydrogen peroxide by weight. Pressure relief devices shall be designed to prevent the entry of foreign matter, the leakage of liquid and the development of any dangerous excess pressure. In addition, the tank shall be designed so that internal surfaces may be effectively cleaned and passivated. Each tank must be equipped with pressure relief devices conforming to the following requirements:

Concentration of hydrogen peroxide solution	Total venting capacity in standard cubic feet per hour (S.C.F.H.) per pound of hydrogen peroxide

	solution
52 percent or less	11
Over 52 percent but not greater than 60 percent	22
Over 60 percent but not greater than 72 percent	32

T38 Each tank must be insulated with an insulating material so that the overall thermal conductance at 15.5 °C (60 °F) is no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour per square foot per degree Fahrenheit) temperature differential. Insulating materials must not promote corrosion to steel when wet.

T39 See entry for T39 in the IM Tank Configuration Table in paragraph (c)(7)(i) of this section.

T40 Each tank must have a minimum shell thickness of 10.0 mm (0.39 inch) mild steel.

T41 Each tank must have a minimum shell thickness of 12.0 mm (0.47 inch) mild steel.

T42 Transport in IM portable tanks is permitted only under conditions approved by the Associate Administrator for Hazardous Materials Safety.

T43 See entry for T43 in the IM Tank Configuration Table in paragraph (c)(7)(i) of this section.

T44 DOT Specification IM 101 portable tanks shall be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads must be the greater of 7.62 mm (0.300 inch) or the thickness required for a tank with a design pressure at least equal to 1.5 times the vapor pressure of the lading at 46 °C (115 °F).

T45 DOT Specification IM 101 portable tanks shall be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this subchapter. Thickness of stainless steel for tank shell and heads must be the greater of 6.35 mm (0.250 inch) or the thickness required for a tank with a design pressure at least equal to 1.3 times the vapor pressure of the lading at 46 °C (115 °F).

T46 IM portable tanks in sodium metal service are not required to be hydrostatically retested.

T47 Temperature must be maintained between 18 °C (64.4 °F) and 40 °C (104 °F) when carried in tanks. Tanks containing solidified methyacrylic acid may not be reheated during transport.

(8) *"W" codes. These provisions apply only to transportation by water:*

Code/Special Provisions

W41 When offered for transportation by water, this material must be packaged in bales and be securely and tightly bound with rope, wire or similar means.

[Amdt. 172-123, 55 FR 52582, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §172.102, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45397, Aug. 19, 1999, §172.102 was amended by adding special provision "61" to paragraph (c)(1) and special provision "A52" to paragraph (c)(2), effective Mar. 1, 2000.

[CFR] PART 172 SUBPART C - Shipping Papers

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART C]

Subpart C - Shipping Papers

§172.200 Applicability.

(a) *Description of hazardous materials required. Except as otherwise provided in this subpart, each person who offers a hazardous material for transportation shall describe the hazardous material on the shipping paper in the manner required by this subpart.*

(b) This subpart does not apply to any material, other than a hazardous substance, hazardous waste or marine pollutant, that is-

(1) Identified by the letter "A" in column 1 of the §172.101 table, except when the material is offered or intended for transportation by air; or

(2) Identified by the letter "W" in column 1 of the §172.101 table, except when the material is offered or intended for transportation by water; or

(3) An ORM-D, except when the material is offered or intended for transportation by air.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976, as amended by Amdt. 172-58, 45 FR 34697, May 22, 1980; Amdt. 172-74, 47 FR 43065, Sept. 30, 1982; Amdt. 172-112, 53 FR 17160, May 13, 1988; Amdt. 172-127, 57 FR 52938, Nov. 5, 1992]

§172.201 General entries.

(a) *Contents. When a description of hazardous material is required to be included on a shipping paper, that description must conform to the following requirements:*

(1) When a hazardous material and a material not subject to the requirements of this subchapter are described on the same shipping paper, the hazardous material

description entries required by §172.202 and those additional entries that may be required by §172.203:

(i) Must be entered first, or

(ii) Must be entered in a color that clearly contrasts with any description on the shipping paper of a material not subject to the requirements of this subchapter, except that a description on a reproduction of a shipping paper may be highlighted, rather than printed, in a contrasting color (the provisions of this paragraph apply only to the basic description required by §172.202(a)(1) and (2), and (3)), or

(iii) Must be identified by the entry of an "X" placed before the proper shipping name in a column captioned "HM." (The "X" may be replaced by "RQ," if appropriate.)

(2) The required shipping description on a shipping paper and all copies thereof used for transportation purposes, must be legible and printed (manually or mechanically) in English.

(3) Unless it is specifically authorized or required in this subchapter, the required shipping description may not contain any code or abbreviation.

(4) A shipping paper may contain additional information concerning the material provided the information is not inconsistent with the required description. Unless otherwise permitted or required by this subpart, additional information must be placed after the basic description required by §172.202(a).

(b) [Reserved]

(c) *Continuation page. A shipping paper may consist of more than one page, if each page is consecutively numbered and the first page bears a notation specifying the total number of pages included in the shipping paper. For example, "Page 1 of 4 pages."*

(d) Emergency response telephone number. Except as provided in §172.604(c), a shipping paper must contain an emergency response telephone number, as prescribed in subpart G of this part.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976, as amended by Amdt. 172-29B, 41 FR 57067, Dec. 30, 1976; Amdt. 172-58, 45 FR 34697, May 22, 1980; Amdt. 172-58, 45 FR 74664, Nov. 10, 1980; Amdt. 172-90, 49 FR 10510, Mar. 20, 1984; Amdt. 172-116, 54 FR 27144, June 27, 1989; Amdt. 172-123, 55 FR 52589, Dec. 21, 1990; Amdt. 172-147, 61 FR 18932, Apr. 29, 1996; Amdt. 172-149, 61 FR 27172, May 30, 1996]

§172.202 Description of hazardous material on shipping papers.

(a) The shipping description of a hazardous material on the shipping paper must include:

(1) The proper shipping name prescribed for the material in column 2 of the §172.101 table;

(2) The hazard class or division prescribed for the material as shown in column 3 of the §172.101 table (class names or subsidiary hazard class or division number may be entered following the numerical hazard class, or following the basic description). The hazard class need not be included for the entry "Combustible liquid, n.o.s.";

(3) The identification number prescribed for the material as shown in column 4 of the §172.101 table;

(4) The packing group, in Roman numerals, prescribed for the material in column 5 of the §172.101 table, if any. The packing group may be preceded by the letters "PG" (e.g., "PG II"); and

(5) Except for empty packagings (see §173.29 of this subchapter), cylinders for Class 2 (compressed gases) materials, and bulk packagings, the total quantity (by net or gross mass, capacity, or as otherwise appropriate), including the unit of measurement, of the hazardous material covered by the description (e.g., "800 lbs", "55 gal.", "3629 kg", or "208 L"). For cylinders for Class 2 (compressed gases) materials and bulk packagings, some indication of total quantity must be shown (e.g., "10 cylinders" or "1 cargo tank").

(b) Except as provided in this subpart, the basic description specified in paragraphs (a) (1), (2), (3) and (4) of this section must be shown in sequence with no additional information interspersed. For example: "Gasoline, 3, UN 1203, PG II".

(c) The total quantity of the material covered by one description must appear before or after, or both before and after, the description required and authorized by this subpart. The type of packaging and destination marks may be entered in any appropriate manner before or after the basic description. Abbreviations may be used to express units of measurement and types of packagings.

(d) Technical and chemical group names may be entered in parentheses between the proper shipping name and hazard class or following the basic description. An appropriate modifier, such as "contains" or "containing," and/or the percentage of the technical constituent may also be used. For example: "Flammable liquids, n.o.s. (contains Xylene and Benzene), 3, UN 1993, II".

(e) Except for those materials in the UN Recommendations, the ICAO Technical Instructions, or the IMDG Code, a material that is not a hazardous material according to this subchapter may not be offered for transportation or transported when its description on a shipping paper includes a hazard class or an identification number specified in §172.101.

[Amdt. 172-101, 45 FR 74665, Nov. 10, 1980, as amended by Amdt. 172-103, 51 FR 5970, Feb. 18, 1986; Amdt. 172-123, 55 FR 52589, Dec. 21, 1990; 56 FR 66252, Dec. 20, 1991; Amdt. 172-127, 57 FR 52938, Nov. 5, 1992; Amdt. 172-130, 58 FR 51531, Oct. 1, 1993]

§172.203 Additional description requirements.

(a) *Exemptions. Each shipping paper issued in connection with a shipment made under an exemption must bear the notation "DOT-E" followed by the exemption number assigned and so located that the notation is clearly associated with the description to which the exemption applies.*

(b) Limited quantities. The description for a material offered for transportation as "limited quantity," as authorized by this subchapter, must include the words "Limited Quantity" or "Ltd Qty" following the basic description.

(c) Hazardous substances. (1) Except for Class 7 (radioactive) materials described in accordance with paragraph (d) of this section, if the proper shipping name for a material that is a hazardous substance does not identify the hazardous substance by name, the name of the hazardous substance must be entered in parentheses in association with the basic description. If the material contains two or more hazardous substances, at least two hazardous substances, including the two with the lowest reportable quantities (RQs), must be identified. For a hazardous waste, the waste code (e.g., D001), if appropriate, may be used to identify the hazardous substance.

(2) The letters "RQ" shall be entered on the shipping paper either before or after, the basic description required by §172.202 for each hazardous substance (see definition in §171.8 of this subchapter). For example: "RQ, Allyl alcohol, 6.1, UN 1098, I"; or "Environmentally hazardous substance, solid, n.o.s., 9, UN 3077, III, RQ (Adipic acid)".

(d) *Radioactive material. The description for a shipment of a Class 7 (radioactive) material must include the following additional entries as appropriate:*

(1) The words "RADIOACTIVE MATERIAL" unless these words are contained in the proper shipping name.

(2) The name of each radionuclide in the Class 7 (radioactive) material that is listed in §173.435 of this subchapter. For mixtures of radionuclides, the radionuclides that must be shown must be determined in accordance with §173.433(f) of this subchapter. Abbreviations, e.g., "^{9}9Mo", are authorized.

(3) A description of the physical and chemical form of the material, if the material is not in special form (generic chemical description is acceptable for chemical form).

(4) The activity contained in each package of the shipment in terms of the appropriate SI units (e.g., Becquerel, Terabecquerel, etc.) or in terms of the appropriate SI units followed by the customary units (e.g., Curies, millicuries, etc.). Alternatively, for domestic transportation, the activity in a package of Class 7 (radioactive) materials may be described solely in terms of curies until April 1, 1997. Abbreviations are authorized. Except for plutonium-238, plutonium-239, and plutonium-241, the weight in grams or kilograms of fissile radionuclides may be inserted instead of activity units. For plutonium-238, plutonium-239, and plutonium-241 the weight in grams or kilograms of fissile radionuclides may be inserted in addition to the activity units. For the shipment of a package containing a highway route controlled quantity of Class 7 (radioactive) materials (see §173.403 of this subchapter) the words "Highway route controlled quantity" must be entered in association with the basic description.

(5) The category of label applied to each package in the shipment. For example: "RADIOACTIVE WHITE-I."

(6) The transport index assigned to each package in the shipment bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels.

(7) For a shipment of fissile Class 7 (radioactive) materials:

(i) The words "Fissile Excepted" if the package is excepted pursuant to §173.453 of this subchapter;

(ii) For a fissile material, controlled shipment, the additional notation: "Warning-Fissile material, controlled shipment. Do not load more than * * * packages per vehicle." (Asterisks to be replaced by appropriate number.) "In loading and storage areas, keep at least 6 meters (20 feet) from other packages bearing radioactive labels"; and

(iii) If a fissile material, controlled shipment is to be transported by water, the supplementary notation must also include the following statement: "For shipment by water, only one fissile material, controlled shipment is permitted in each hold."

(8) For a package approved by the U.S. Department of Energy (DOE) or U.S. Nuclear Regulatory Commission (USNRC), a notation of the package identification marking as prescribed in the applicable DOE or USNRC approval. (See §173.471 of the subchapter.)

(9) For an export shipment or a shipment in a foreign made package, a notation of the package identification marking as prescribed in the applicable International Atomic Energy Agency (IAEA) Certificate of Competent Authority which has been issued for the package. (See §173.473 of the subchapter.)

(10) For a shipment required by this subchapter to be consigned as exclusive use:

(i) An indication that the shipment is consigned as exclusive use; or

(ii) If all the descriptions on the shipping paper are consigned as exclusive use, then the statement "Exclusive Use Shipment" may be entered only once on the shipping paper in a clearly visible location.

(11) For a shipment of low specific activity material or surface contaminated objects, the appropriate group notation of LSA-I, LSA-II, LSA-III, SCO-I, or SCO-II.

(e) *Empty packagings. (1) The description on the shipping paper for a packaging containing the residue of a hazardous material may include the words "RESIDUE: Last Contained * * *" in association with the basic description of the hazardous material last contained in the packaging.*

(2) The description on the shipping paper for a tank car containing the residue of a hazardous material must include the phrase, "RESIDUE: LAST CONTAINED * * *" before the basic description.

(f) *Transportation by air. When a package containing a hazardous material is offered for transportation by air and this subchapter prohibits its transportation aboard passenger-carrying aircraft, the words "Cargo aircraft only" must be entered after the basic description.*

(g) Transportation by rail. (1) A shipping paper prepared by a rail carrier for a rail car, freight container, transport vehicle or portable tank that contains hazardous materials must include the reporting mark and number when displayed on the rail car, freight container, transport vehicle or portable tank.

(2) The shipping paper for each DOT-113 tank car containing a Division 2.1 material or its residue must contain an appropriate notation, such as "DOT 113", and the statement "Do not hump or cut off car while in motion."

(3) When shipments of elevated temperature materials are transported under the exception permitted in §173.247(h)(3) of this subchapter, the shipping paper must contain an appropriate notation, such as "Maximum operating speed 15 mph.".

(h) *Transportation by highway. Following the basic description for a hazardous material in a Specification MC 330 or MC 331 cargo tank, there must be entered for-*

(1) Anhydrous ammonia. (i) The words "0.2 PERCENT WATER" to indicate the suitability for shipping anhydrous ammonia in a cargo tank made of quenched and tempered steel as authorized by §173.315(a), Note 14 of this subchapter, or

(ii) The words "NOT FOR Q and T TANKS" when the anhydrous ammonia does not contain 0.2 percent or more water by weight.

(2) *Liquefied petroleum gas. (i) The word "NONCORROSIVE" or "NONCOR" to indicate the suitability for shipping "Noncorrosive" liquefied petroleum gas in a cargo tank made of quenched and tempered steel as authorized by §173.315(a), Note 15 of this subchapter, or*

(ii) The words "NOT FOR Q and T TANKS" for grades of liquefied petroleum gas other than "Noncorrosive".

(i) *Transportation by water. Each shipment by water must have the following additional shipping paper entries:*

(1) Identification of the type of packagings such as barrels, drums, cylinders, and boxes.

(2) The number of each type of package including those in a freight container or on a pallet.

(3) The gross mass of each type of package or the individual gross mass of each package.

(4) The name of the shipper.

(j)[Reserved]

(k) *Technical names for "n.o.s." and other generic descriptions. Unless otherwise excepted, if a material is described on a shipping paper by one of the proper shipping names identified by the letter "G" in column (1) of the §172.101 table, the technical name of the hazardous material must be entered in parentheses in association with the basic description. For example "Corrosive liquid, n.o.s., (Caprylyl chloride), 8, UN 1760, II", or "Corrosive liquid, n.o.s., 8, UN 1760, II (contains Caprylyl chloride)". The word "contains" may be used in association with the technical name, if appropriate. For organic peroxides which may qualify for more than one generic listing depending on concentration, the technical name must include the actual concentration being shipped or the concentration range for the appropriate generic listing. For example, "Organic peroxide type B, solid, 5.2, UN 3102 (dibenzoyl peroxide, 52-100%)" or "Organic peroxide type E, solid, 5.2, UN 3108 (dibenzoyl peroxide, paste, <52%)". Shipping descriptions for toxic materials that meet the criteria of Division 6.1, PG I or II (as specified in §173.132(a) of this subchapter) or Division 2.3 (as specified in §173.115(c) of this subchapter) and are identified by the letter "G" in Column (1) of the §172.101 Table, must have the technical name of the toxic constituent entered in parentheses in association with the basic description.*

(1) If a hazardous material is a mixture or solution of two or more hazardous materials, the technical names of at least two components most predominately contributing to the hazards of the mixture or solution must be entered on the shipping paper as required by paragraph (k) of this section. For example, "Flammable liquid, corrosive, n.o.s., 3, UN 2924, II (contains Methanol, Potassium hydroxide)".

(2) The provisions of this paragraph do not apply-

(i) To a material that is a hazardous waste and described using the proper shipping name "Hazardous waste, liquid *or solid, n.o.s.", classed as a miscellaneous Class 9, provided the EPA hazardous waste number is included on the shipping paper in association with the basic description, or provided the material is described in accordance with the provisions of §172.203(c) of this part.*

(ii) To a material for which the hazard class is to be determined by testing under the criteria in §172.101(c)(11).

(iii) If the n.o.s. description for the material (other than a mixture of hazardous materials of different classes meeting the definitions of more than one hazard class) contains the name of the chemical element or group which is primarily responsible for the material being included in the hazard class indicated.

(iv) If the n.o.s. description for the material (which is a mixture of hazardous materials of different classes meeting the definition of more than one hazard class) contains the name of the chemical element or group responsible for the material meeting the definition of one of these classes. In such cases, only the technical name of the component that is not appropriately identified in the n.o.s. description shall be entered in parentheses.

(l) *Marine pollutants. (1) If the proper shipping name for a material which is a marine pollutant does not identify by name the component which makes the material a marine pollutant, the name of that component must appear in parentheses in association with the basic description. Where two or more components which make a material a marine pollutant are present, the names of at least two of the components most predominantly contributing to the marine pollutant designation must appear in parentheses in association with the basic description.*

(2) The words "Marine Pollutant" shall be entered in association with the basic description for a material which is a marine pollutant.

(3) Except for transportation by vessel, marine pollutants subject to the provisions of 49 CFR 130.11 are excepted from the requirements of paragraph (l) of this section if a phrase indicating the material is an oil is placed in association with the basic description.

(m) *Poisonous materials. Notwithstanding the hazard class to which a material is assigned-*

(1) If a liquid or solid material in a package meets the definition of a Division 6.1, Packing Group I or II, according to this subchapter, and the fact that it is a poison is not disclosed in the shipping name or class entry, the word "`Poison' or `Toxic"' shall be entered on the shipping paper in association with the shipping description.

(2) For materials which are poisonous by inhalation (see §171.8 of this subchapter), the words "Poison-Inhalation Hazard"or "Toxic-Inhalation Hazard" and the words "Zone A", "Zone B", "Zone C", or "Zone D", for gases or "Zone A" or "Zone B" for liquids, as appropriate, shall be entered on the shipping paper immediately following the shipping description. The word "Poison"or "Toxic" need not be repeated if it otherwise appears in the shipping description.

(n) *Elevated temperature materials. Except for molten sulfur or molten aluminum, if a liquid material in a package meets the definition of an elevated temperature material in §171.8 of this subchapter, and the fact that it is an elevated temperature material is not* *disclosed in the shipping name, the word "HOT" must immediately precede the proper shipping name of the material on the shipping paper.*

(o) Organic peroxides and self-reactive materials. The description on a shipping paper for a Division 4.1 (self-reactive) material or a Division 5.2 (organic peroxide) material must include the following additional information, as appropriate:

(1) If notification or competent authority approval is required, the shipping paper must contain a statement of approval of the classification and conditions of transport.

(2) For Division 4.1 (self-reactive) and Division 5.2 (organic peroxide) materials that require temperature control during transport, the control and emergency temperature must be included on the shipping paper.

(3) The word "SAMPLE" must be included in association with the basic description when a sample of a Division 4.1 (self-reactive) material (see §173.224(c)(4) of this subchapter) or Division 5.2 (organic peroxide) material (see §173.225(c)(4) of this subchapter) is offered for transportation or transported.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §172.203, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§172.204 Shipper's certification.

(a) *General. Except as provided in paragraphs (b) and (c) of this section, each person who offers a hazardous material for transportation shall certify that the material is offered for transportation in accordance with this subchapter by printing (manually or mechanically) on the shipping paper containing the required shipping description the certification contained in paragraph (a)(1) of this section or the certification (declaration) containing the language contained in paragraph (a)(2) of this section.*

(1) "This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

Note: In line one of the certification the words "herein-named" may be substituted for the words "above-named".

(2) "I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations."

(b) *Exceptions. (1) Except for a hazardous waste, no certification is required for a hazardous material offered for transportation by motor vehicle and transported:*

(i) In a cargo tank supplied by the carrier, or

(ii) By the shipper as a private carrier except for a hazardous material that is to be reshipped or transferred from one carrier to another.
(2) No certification is required for the return of an empty tank car which previously contained a hazardous material and which has not been cleaned or purged.
(c) *Transportation by air-(1) General. Certification containing the following language may be used in place of the certification required by paragraph (a) of this section:*

I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and in proper condition for carriage by air according to applicable national governmental regulations.

(2) *Certificate in duplicate. Each person who offers a hazardous material to an aircraft operator for transportation by air shall provide two copies of the certification required in this section. (See §175.30 of this subchapter.)*
(3) Passenger and cargo aircraft. Each person who offers for transportation by air a hazardous material authorized for air transportation shall add to the certification required in this section the following statement:

This shipment is within the limitations prescribed for passenger aircraft/cargo aircraft only (delete nonapplicable).

(4) *Radioactive material. Each person who offers any radioactive material for transportation aboard a passenger-carrying aircraft shall sign (mechanically or manually) a printed certificate stating that the shipment contains radioactive material intended for use in, or incident to, research, or medical diagnosis or treatment.*
(d) Signature. The certifications required by paragraph (a) or (c) of this section:
(1) Must be legibly signed by a principal, officer, partner, or employee of the shipper or his agent; and
(2) May be legibly signed manually, by typewriter, or by other mechanical means.

[Amdt. 172-29A, 41 FR 40677, Sept. 20, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §172.204, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§172.205 Hazardous waste manifest.
(a) No person may offer, transport, transfer, or deliver a hazardous waste (waste) unless an EPA Form 8700-22 and 8700-22A (when necessary) hazardous waste manifest (manifest) is prepared in accordance with 40 CFR 262.20 and is signed, carried, and given as required of that person by this section.

(b) The shipper (generator) shall prepare the manifest in accordance with 40 CFR part 262.
(c) The original copy of the manifest must be dated by, and bear the handwritten signature of, the person representing:
(1) The shipper (generator) of the waste at the time it is offered for transportation, and
(2) The initial carrier accepting the waste for transportation.
(d) A copy of the manifest must be dated by, and bear the handwritten signature of the person representing:
(1) Each subsequent carrier accepting the waste for transportation, at the time of acceptance, and
(2) The designated facility receiving the waste, upon receipt.
(e) A copy of the manifest bearing all required dates and signatures must be:
(1) Given to a person representing each carrier accepting the waste for transportation,
(2) Carried during transportation in the same manner as required by this subchapter for shipping papers,
(3) Given to a person representing the designated facility receiving the waste,
(4) Returned to the shipper (generator) by the carrier that transported the waste from the United States to a foreign destination with a notation of the date of departure from the United States, and
(5) Retained by the shipper (generator) and by the initial and each subsequent carrier for three years from the date the waste was accepted by the initial carrier. Each retained copy must bear all required signatures and dates up to and including those entered by the next person who received the waste.
(f) *Transportation by rail. Notwithstanding the requirements of paragraphs (d) and (e) of this section, the following requirements apply:*
(1) When accepting hazardous waste from a non-rail transporter, the initial rail transporter must:
(i) Sign and date the manifest acknowledging acceptance of the hazardous waste;
(ii) Return a signed copy of the manifest to the non-rail transporter;
(iii) Forward at least three copies of the manifest to:
(A) The next non-rail transporter, if any;
(B) The designated facility, if the shipment is delivered to that facility by rail; or
(C) The last rail transporter designated to handle the waste in the United States; and
(iv) Retain one copy of the manifest and rail shipping paper in accordance with 40 CFR 263.22.
(2) Rail transporters must ensure that a shipping paper containing all the information required on the manifest (excluding the EPA identification numbers, generator certification and signatures) and, for exports, an EPA Acknowledgment of Consent accompanies the hazardous waste at all times. Intermediate rail transporters are not required to sign either the manifest or shipping paper.
(3) When delivering hazardous waste to the designated facility, a rail transporter must:
(i) Obtain the date of delivery and handwritten signature of the owner or operator of the designated facility on the manifest or the shipping paper (if the manifest has not been received by the facility); and

(ii) Retain a copy of the manifest or signed shipping paper in accordance with 40 CFR 263.22.
(4) When delivering hazardous waste to a non-rail transporter, a rail transporter must:
(i) Obtain the date of delivery and the handwritten signature of the next non-rail transporter on the manifest; and
(ii) Retain a copy of the manifest in accordance with 40 CFR 263.22.
(5) Before accepting hazardous waste from a rail transporter, a non-rail transporter must sign and date the manifest and provide a copy to the rail transporter.
(g) The person delivering a hazardous waste to an initial rail carrier shall send a copy of the manifest, dated and signed by a representative of the rail carrier, to the person representing the designated facility.
(h) A hazardous waste manifest required by 40 CFR part 262, containing all of the information required by this subpart, may be used as the shipping paper required by this subpart.

[Amdt. 172-58, 45 FR 34698, May 22, 1980, as amended by Amdt. 172-90, 49 FR 10510, Mar. 20, 1984; 49 FR 11184, Mar. 26, 1984; Amdt. 172-248, 61 FR 28675, June 5, 1996]

[CFR] PART 172 SUBPART D - Marking

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART D]

Subpart D - Marking

§172.300 Applicability.

(a) Each person who offers a hazardous material for transportation shall mark each package, freight container, and transport vehicle containing the hazardous material in the manner required by this subpart.
(b) When assigned the function by this subpart, each carrier that transports a hazardous material shall mark each package, freight container, and transport vehicle containing the hazardous material in the manner required by this subpart.

[Amdt. 172-101, 45 FR 74666, Nov. 10, 1980]

§172.301 General marking requirements for non-bulk packagings.

(a) *Proper shipping name and identification number. (1) Except as otherwise provided by this subchapter, each person who offers for transportation a hazardous material in a non-bulk packaging shall mark the package with the proper shipping name and identification number (preceded by "UN" or "NA", as appropriate) for the material as shown in the §172.101 table. Identification numbers are not required on packages which contain only limited quantities, as defined in §171.8 of this subchapter, or ORM-D materials.*

(2) The proper shipping name for a hazardous waste (as defined in §171.8 of this subchapter) is not required to include the word "waste" if the package bears the EPA marking prescribed by 40 CFR 262.32.

(3) *Large quantities of a single hazardous material in non-bulk packages. A transport vehicle or freight container containing only a single hazardous material in non-bulk packages must be marked, on each side and each end as specified in the §§172.332 or 172.336, with the identification number specified for the hazardous material in the §172.101 Table, subject to the following provisions and limitations:*

(i) Each package is marked with the same proper shipping name and identification number;

(ii) The aggregate gross weight of the hazardous material is 4,000 kg (8,820 pounds) or more;

(iii) All of the hazardous material is loaded at one loading facility;

(iv) The transport vehicle or freight container contains no other material, hazardous or otherwise; and

(v) The identification number marking requirement of this paragraph (a)(3) does not apply to Class 1, Class 7, or to non-bulk packagings for which identification numbers are not required.

(b) *Technica1 names. In addition to the marking required by paragraph (a) of this section, each non-bulk packaging containing hazardous materials subject to the provisions of §172.203(k) of this part shall be marked with the technical name in parentheses in association with the proper shipping name in accordance with the requirements and exceptions specified for display of technical descriptions on shipping papers in §172.203(k) of this part.*

(c) Exemption packagings. The outside of each package authorized by an exemption shall be plainly and durably marked "DOT-E" followed by the exemption number assigned.

(d) Consignee's or consignor's name and address. Each person who offers for transportation a hazardous material in a non-bulk package shall mark that package with the name and address of the consignor or consignee except when the package is-

(1) Transported by highway only and will not be transferred from one motor carrier to another; or

(2) Part of a carload lot, truckload lot or freight container load, and the entire contents of the rail car, truck or freight container are shipped from one consignor to one consignee.

(e) *Previously marked packagings. A package which has been previously marked as* *required for the material it contains and on which the marking remains legible, need not be remarked. (For empty packagings, see §173.29 of this subchapter.)*

[Amdt. 172-123, 55 FR 52590, Dec. 21, 1990, as amended by Amdt. 172-151, 62 FR 1227, Jan. 8, 1997; 62 FR 39404, July 22, 1997; 63 FR 16075, Apr. 1, 1998]

§172.302 General marking requirements for bulk packagings.

(a) *Identification numbers. Except as otherwise provided in this subpart, no person may offer for transportation or transport a hazardous material in a bulk packaging unless the packaging is marked as required by §172.332 with the identification number specified for the material in the §172.101 table-*

(1) On each side and each end, if the packaging has a capacity of 3,785 L (1,000 gallons) or more;

(2) On two opposing sides, if the packaging has a capacity of less than 3,785 L (1,000 gallons); or

(3) For cylinders permanently installed on a tube trailer motor vehicle, on each side and each end of the motor vehicle.

(b) *Size of markings. Except as otherwise provided, markings required by this subpart on bulk packagings must-*

(1) Have a width of at least 6.0 mm (0.24 inch) and a height of at least 100 mm (3.9 inches) for rail cars;

(2) Have a width of at least 4.0 mm (0.16 inch) and a height of at least 25 mm (one inch) for portable tanks with capacities of less than 3,785 L (1,000 gallons) and intermediate bulk containers; and

(3) Have a width of at least 6.0 mm (0.24 inch) and a height of at least 50 mm (2.0 inches) for cargo tanks and other bulk packagings.

(c) *Exemption packagings. The outside of each bulk package used under the terms of an exemption shall be plainly and durably marked "DOT-E" followed by the exemption number assigned.*

(d) Each bulk packaging marked with a proper shipping name, common name or identification number as required by this subpart must remain marked when it is emptied unless it is-

(1) Sufficiently cleaned of residue and purged of vapors to remove any potential hazard; or

(2) Refilled, with a material requiring different markings or no markings, to such an extent that any residue remaining in the packaging is no longer hazardous.

(e) Additional requirements for marking portable tanks, cargo tanks, tank cars, multi-unit tank car tanks, and other bulk packagings are prescribed in §§172.326, 172.328, 172.330, and 172.331, respectively, of this subpart.

(f) A bulk packaging marked prior to October 1, 1991, in conformance to the regulations of this subchapter in effect on September 30, 1991, need not be remarked if the key words of the proper shipping name are identical to those currently specified in the §172.101 table. For example, a tank car marked "ANHYDROUS AMMONIA" need not be remarked "ANHYDROUS AMMONIA, LIQUEFIED".

(g) A rail car, freight container, truck body or trailer in which the lading has been fumigated with any hazardous material, or is undergoing fumigation, must be marked as specified in §173.9 of this subchapter.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended at 56 FR 66254, Dec. 20, 1991; Amdt. 172-150, 61 FR 50624, Sept. 26, 1996; Amdt. 172-151, 62 FR 1228, Jan. 8, 1997; 62 FR 39398, July 22, 1997]

§172.303 Prohibited marking.

(a) No person may offer for transportation or transport a package which is marked with the proper shipping name or identification number of a hazardous material unless the package contains the identified hazardous material or its residue.

(b) This section does not apply to-

(1) Transportation of a package in a transport vehicle or freight container if the package is not visible during transportation and is loaded by the shipper and unloaded by the shipper or consignee.

(2) Markings on a package which are securely covered in transportation.

(3) The marking of a shipping name on a package when the name describes a material not regulated under this subchapter.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended at 56 FR 66254, Dec. 20, 1991]

§172.304 Marking requirements.

(a) The marking required in this subpart-

(1) Must be durable, in English and printed on or affixed to the surface of a package or on a label, tag, or sign.

(2) Must be displayed on a background of sharply contrasting color;

(3) Must be unobscured by labels or attachments; and

(4) Must be located away from any other marking (such as advertising) that could substantially reduce its effectiveness.

(b) [Reserved]

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-29B, 41 FR 57067, Dec. 30, 1976]

§172.306 [Reserved]

§172.308 Authorized abbreviations.

(a) Abbreviations may not be used in a proper shipping name marking except as authorized in this section.

(b) The abbreviation "ORM" may be used in place of the words "Other Regulated Material."

(c) Abbreviations which appear as authorized descriptions in column 2 of the §172.101 table (e.g., "TNT" and "PCB") are authorized.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended by Amdt. 172-145, 60 FR 49110, Sept. 21, 1995]

§172.310 Class 7 (radioactive) materials.

In addition to any other markings required by this subpart, each package containing Class 7 (radioactive) materials must be marked as follows:

(a) Each package with a gross mass greater than 50 kilograms (110 pounds) must have the its gross mass marked on the outside of the package.

(b) Each packaging must be marked on the outside of the package, in letters at least 13 mm (0.5 inch) high, with the words "TYPE A" or "TYPE B" as appropriate. A packaging which does not conform to Type A or Type B requirements may not be so marked.

(c) Each Type B, Type B(U) or Type B(M) packaging must be marked on the outside of the package with a radiation symbol that conforms to the requirements of appendix B to part 172.

(d) Each package destined for export shipment must also be marked "USA" in conjunction with the specification marking, or other package certificate identification. (See §§173.471, 173.472, and 173.473 of this subchapter).

[Amdt 172-143, 60 FR 50304, Sept. 28, 1995, as amended by 172-143, 61 FR 20749, May 8, 1996]

§172.312 Liquid hazardous materials in non-bulk packagings.

(a) Except as provided in this section, each non-bulk combination package having inner packagings containing liquid hazardous materials must be:

(1) Packed with closures upward, and

(2) Legibly marked, with package orientation markings that conform pictorially to the illustration shown in this paragraph, on two opposite vertical sides of the package with

the arrows pointing in the correct upright direction. Depicting a rectangular border around the arrows is optional.

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(b) Arrows for purposes other than indicating proper package orientation may not be displayed on a package containing a liquid hazardous material.

(c) The requirements of paragraph (a) of this section do not apply to-

(1) A non-bulk package with inner packagings which are cylinders.

(2) Except when offered or intended for transportation by aircraft, packages containing flammable liquids in inner packagings of one liter or less prepared in accordance with §173.150 (b) or (c) of this subchapter.

(3) When offered or intended for transportation by aircraft, packages containing flammable liquids in inner packagings of 120 ml (4 fluid oz.) or less prepared in accordance with §173.150 (b) or (c) of this subchapter when packed with sufficient absorption material between the inner and outer packagings to completely absorb the liquid contents.

(4) Liquids contained in manufactured articles (e.g., alcohol or mercury in thermometers) which are leak-tight in all orientations.

(5) A non-bulk package with hermetically-sealed inner packagings.

[Amdt. 172-123, 55 FR 52591, Dec. 21, 1990, as amended at 56 FR 66254, Dec. 20, 1991; 57 FR 45458, Oct. 1, 1992; 64 FR 51918, Sept. 27, 1999]

§172.313 Poisonous hazardous materials.

In addition to any other markings required by this subpart:

(a) A material poisonous by inhalation (see §171.8 of this subchapter) shall be marked "Inhalation Hazard" in association with the required labels or placards, as appropriate, and shipping name when required. The marking must be on two opposing sides of a bulk packaging. (See §172.302(b) of this subpart for size of markings on bulk packages.) When the words "Inhalation Hazard" appear on the label, as prescribed in §§172.416 and 172.429, or placard, as prescribed in §§172.540 and 172.555, the "Inhalation Hazard" marking is not required on the package.

(b) Each non-bulk plastic outer packaging used as a single or composite packaging for materials meeting the definition of Division 6.1 (in §173.132 of this subchapter) shall be permanently marked, by embossment or other durable means, with the word "POISON" in letters at least 6.3 mm (0.25 inch) in height. Additional text or symbols related to hazard warning may be included in the marking. The marking shall be located within 150 mm (6 inches) of the closure of the packaging.

(c) A transport vehicle or freight container containing a material poisonous by inhalation in non-bulk packages shall be marked, on each side and each end as specified in §172.332 or §172.336, with the identification number specified for the hazardous material in the §172.101 table, subject to the following provisions and limitations:

(1) The material is in Hazard Zone A or B;

(2) The transport vehicle or freight container is loaded at one facility with 1,000 kg (2,205 pounds) or more aggregate gross weight of the material in non-bulk packages marked with the same proper shipping name and identification number; and

(3) If the transport vehicle or freight container contains more than one material meeting the provisions of this paragraph (c), it shall be marked with the identification number for one material, determined as follows:

(i) For different materials in the same hazard zone, with the identification number of the material having the greatest aggregate gross weight; and

(ii) For different materials in both Hazard Zones A and B, with the identification number for the Hazard Zone A material.

(d) For a packaging containing a Division 6.1 PG III material, "PG III" may be marked adjacent to the POISON label. (See §172.405(c).)

[Amdt. 172-123, 55 FR 52592, Dec. 21, 1990, as amended at 57 FR 46624, Oct. 9, 1992; Amdt. 172-151, 62 FR 1228, Jan. 8, 1997; 62 FR 39398, 39405, July 22, 1997; 63 FR 16075, Apr. 1, 1998; 64 FR 10776, Mar. 5, 1999]

§172.316 Packagings containing materials classed as ORM-D.

(a) Each non-bulk packaging containing a material classed as ORM-D must be marked on at least one side or end with the ORM-D designation immediately following or below the proper shipping name of the material. The ORM designation must be placed within a rectangle that is approximately 6.3 mm (0.25 inches) larger on each side than the designation. The designation for ORM-D must be:

(1) ORM-D-AIR for an ORM-D that is prepared for air shipment and packaged in accordance with the provisions of §173.27 of this subchapter.

(2) ORM-D for an ORM-D other than as described in paragraph (a)(1) of this section.

(b) When the ORM-D marking including the proper shipping name can not be affixed on the package surface, it may be on an attached tag.

(c) The marking ORM-D is the certification by the person offering the packaging for transportation that the material is properly described, classed, packaged, marked and labeled (when appropriate) and in proper condition for transportation according to the applicable regulations of this subchapter. This form of certification does not preclude the requirement for a certificate on a shipping paper when required by subpart C of this part.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-123, 55 FR

52592, Dec. 21, 1990; 56 FR 66254, Dec. 20, 1991]

§172.320 Explosive hazardous materials.

(a) Except as otherwise provided in paragraphs (b), (c), (d) and (e) of this section, each package containing a Class 1 material must be marked with the EX-number for each substance, article or device contained therein.

(b) Except for fireworks approved in accordance with §173.56(j) of this subchapter, a package of Class 1 materials may be marked, in lieu of the EX-number required by paragraph (a) of this section, with a national stock number issued by the Department of Defense or identifying information, such as a product code required by regulations for commercial explosives specified in 27 CFR part 55, if the national stock number or identifying information can be specifically associated with the EX-number assigned.

(c) When more than five different Class 1 materials are packed in the same package, the package may be marked with only five of the EX-numbers, national stock numbers, product codes, or combination thereof.

(d) The requirements of this section do not apply if the EX-number, product code or national stock number of each explosive item described under a proper shipping description is shown in association with the shipping description required by §172.202(a) of this part. Product codes and national stock numbers must be traceable to the specific EX-number assigned by the Associate Administrator for Hazardous Materials Safety.

(e) The requirements of this section do not apply to the following Class 1 materials:

(1) Those being shipped to a testing agency in accordance with §173.56(d) of this subchapter;

(2) Those being shipped in accordance with §173.56(e) of this subchapter, for the purposes of developmental testing;

(3) Those which meet the requirements of §173.56(h) of this subchapter and therefore are not subject to the approval process of §173.56 of this subchapter;

(4) Until October 1, 1993, those which are shipped under §171.19 of this subchapter; and

(5) Those that are transported in accordance with §173.56(c)(2) of this subchapter and, therefore, are covered by a national security classification currently in effect.

[Amdt. 172-123, 56 FR 66254, Dec. 20, 1991, as amended by Amdt. 172-139, 59 FR 67487, Dec. 29, 1994]

§172.322 Marine pollutants.

(a) For vessel transportation of each non-bulk packaging that contains a marine pollutant-

(1) If the proper shipping name for a material which is a marine pollutant does not

identify by name the component which makes the material a marine pollutant, the name of that component must be marked on the package in parentheses in association with the marked proper shipping name. Where two or more components which make a material a marine pollutant are present, the names of at least two of the components most predominantly contributing to the marine pollutant designation must appear in parentheses in association with the marked proper shipping name; and

(2) The MARINE POLLUTANT mark shall be placed in association with the hazard warning labels required by subpart E of this part or, in the absence of any labels, in association with the marked proper shipping name.

(b) A bulk packaging that contains a marine pollutant must-

(1) Be marked with the MARINE POLLUTANT mark on at least two opposing sides or two ends other than the bottom if the packaging has a capacity of less than 3,785 L (1,000 gallons). The mark must be visible from the direction it faces. The mark may be displayed in black lettering on a square-on-point configuration having the same outside dimensions as a placard; or

(2) Be marked on each end and each side with the MARINE POLLUTANT mark if the packaging has a capacity of 3,785 L (1,000 gallons) or more. The mark must be visible from the direction it faces. The mark may be displayed in black lettering on a square-on-point configuration having the same outside dimensions as a placard.

(c) A transport vehicle or freight container that contains a package subject to the marking requirements of paragraph (a) or (b) of this section must be marked with the MARINE POLLUTANT mark. The mark must appear on each side and each end of the transport vehicle or freight container, and must be visible from the direction it faces. This requirement may be met by the marking displayed on a freight container or portable tank loaded on a motor vehicle or rail car. This mark may be displayed in black lettering on a white square-on-point configuration having the same outside dimensions as a placard.

(d) The MARINE POLLUTANT mark is not required-

(1) On a combination package containing a severe marine pollutant (see appendix B to §172.101), in inner packagings each of which contains:

(i) 0.5 liters (17 ounces) or less net capacity for liquids; or

(ii) 500 grams (17.6 ounces) or less net capacity for solids.

(2) On a combination packaging containing a marine pollutant, other than a severe marine pollutant, in inner packagings each of which contains:

(i) 5 liters (1.3 gallons) or less net capacity for liquids; or

(ii) 5 kilograms (11 pounds) or less net capacity for solids.

(3) Except for transportation by vessel, on a bulk packaging, freight container or transport vehicle that bears a label or placard specified in subparts E or F of this part.

(e) *MARINE POLLUTANT mark. The MARINE POLLUTANT mark must conform to the following:*

(1) Except for size, the MARINE POLLUTANT mark must appear as follows:

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(2) The symbol, letters and border must be black and the background white, or the symbol, letters, border and background must be of contrasting color to the surface to which the mark is affixed. Each side of the mark must be-

(i) At least 100 mm (3.9 inches) for marks applied to:

(A) Non-bulk packagings, except in the case of packagings which, because of their size, can only bear smaller marks; or

(B) Bulk packagings with a capacity of less than 3785 L (1,000 gallons); or

(ii) At least 250 mm (9.8 inches) for marks applied to all other bulk packagings.

[Amdt. 172-127, 57 FR 52938, Nov. 5, 1992, as amended by Amdt. 172-136, 59 FR 38064, July 26, 1994; Amdt. 172-145, 60 FR 49110, Sept. 21, 1995]

§172.324 Hazardous substances in non-bulk packagings.

For each non-bulk package that contains a hazardous substance-

(a) Except for packages of radioactive material labeled in accordance with §172.403, if the proper shipping name of a material that is a hazardous substance does not identify the hazardous substance by name, the name of the hazardous substance must be marked on the package, in parentheses, in association with the proper shipping name. If the material contains two or more hazardous substances, at least two hazardous substances, including the two with the lowest reportable quantities (RQs), must be identified. For a hazardous waste, the waste code (e.g., D001), if appropriate, may be used to identify the hazardous substance.

(b) The letters "RQ" shall be marked on the package in association with the proper shipping name.

[Amdt. 172-108, 52 FR 4843, Feb. 17, 1987, as amended by Amdt. 172-119, 54 FR 39505, Sept. 26, 1989; Amdt. 172-122, 55 FR 46825, Nov. 7, 1990; Amdt. 172-123, 55 FR 52592, Dec. 21, 1990; Amdt. 172-127, 57 FR 52939, Nov. 5, 1992; Amdt. 172-149, 61 FR 27172, May 30, 1996]

§172.325 Elevated temperature materials.

(a) Except as provided in paragraph (b) of this section, a bulk packaging containing an elevated temperature material must be marked on two opposing sides with the word "HOT" in black or white Gothic lettering on a contrasting background. The marking must be displayed on the packaging itself or in black lettering on a plain white square-on-point configuration having the same outside dimensions as a placard. (See §172.302(b) for size of markings on bulk packagings.)

(b) Bulk packagings containing molten aluminum or molten sulfur must be marked "MOLTEN ALUMINUM" or "MOLTEN SULFUR", respectively, in the same manner as prescribed in paragraph (a) of this section.

(c) If the identification number is displayed on a white-square-on-point display configuration, as prescribed in §172.336(b), the word "HOT" may be displayed in the upper corner of the same white-square-on-point display configuration. The word "HOT" must be in black letters having a height of at least 50 mm (2.0 inches). Except for size, these markings shall be as illustrated for an Elevated temperature material, liquid, n.o.s.:

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[Amdt. 172-125, 58 FR 3348, Jan. 8, 1993, as amended by Amdt. 172-139, 59 FR 67487, Dec. 29, 1994]

§172.326 Portable tanks.

(a) *Shipping name. No person may offer for transportation or transport a portable tank containing a hazardous material unless it is legibly marked on two opposing sides with the proper shipping name specified for the material in the §172.101 table.*

(b) Owner's name. The name of the owner or of the lessee, if applicable, must be displayed on a portable tank that contains a hazardous material.

(c) Identification numbers. (1) If the identification number markings required by §172.302(a) are not visible, a transport vehicle or freight container used to transport a portable tank containing a hazardous material must be marked on each side and each end as required by §172.332 with the identification number specified for the material in the §172.101 table.

(2) Each person who offers a portable tank containing a hazardous material to a motor carrier, for transportation in a transport vehicle or freight container, shall provide the motor carrier with the required identification numbers on placards, orange panels, or the white square-on-point configuration, as appropriate, for each side and each end of the transport vehicle or freight container from which identification numbers on the portable tank are not visible.

[Amdt. 172-123, 55 FR 52592, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991]

§172.328 Cargo tanks.

(a) *Providing and affixing identification numbers. Unless a cargo tank is already marked with the identification numbers required by this subpart, the identification numbers must be provided or affixed as follows:*

(1) A person who offers a hazardous material to a motor carrier for transportation in a cargo tank shall provide the motor carrier the identification numbers on placards or shall affix orange panels containing the required identification numbers, prior to or at the time the material is offered for transportation.

(2) A person who offers a cargo tank containing a hazardous material for transportation shall affix the required identification numbers on panels or placards prior to or at the time the cargo tank is offered for transportation.

(3) For a cargo tank transported on or in a transport vehicle or freight container, if the identification number marking on the cargo tank required by §172.302(a) would not normally be visible during transportation-

(i) The transport vehicle or freight container must be marked as required by §172.332 on each side and each end with the identification number specified for the material in the §172.101 table; and

(ii) When the cargo tank is permanently installed within an enclosed cargo body of the transport vehicle or freight container, the identification number marking required by §172.302(a) need only be displayed on each side and end of a cargo tank that is visible when the cargo tank is accessed.

(b) *Required markings: Gases. Except for certain nurse tanks which must be marked as specified in §173.315(m) of this subchapter, each cargo tank transporting a Class 2 material subject to this subchapter must be marked, in lettering no less than 50 mm (2.0 inches), on each side and each end with-*

(1) The proper shipping name specified for the gas in the §172.101 table; or

(2) An appropriate common name for the material (e.g., "Refrigerant Gas").

(c) *QT/NQT markings. Each MC 330 and MC 331 cargo tank must be marked near the specification plate, in letters no less than 50 mm (2.0 inches) in height, with-*

(1) "QT", if the cargo tank is constructed of quenched and tempered steel; or

(2) "NQT", if the cargo tank is constructed of other than quenched and tempered steel.

[Amdt. 172-123, 55 FR 52592, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; Amdt. 172-151, 62 FR 1228, Jan. 8, 1997; 62 FR 39045, July 22, 1997]

§172.330 Tank cars and multi-unit tank car tanks.

(a) *Shipping name and identification number. No person may offer for transportation or transport a hazardous material-*

(1) In a tank car unless the following conditions are met:

(i) The tank car must be marked on each side and each end as required by §172.302 with the identification number specified for the material in the §172.101 table; and

(ii) A tank car containing any of the following materials must be marked on each side with the key words of the proper shipping name specified for the material in the §172.101 table, or with a common name authorized for the material in this subchapter (e.g., "Refrigerant Gas"):

Acrolein, inhibited
Ammonia, anhydrous, liquefied
Ammonia solutions (more than 50% ammonia)
Bromine *or Bromine solutions*
Bromine chloride
Chloroprene, inhibited
Dispersant gas *or Refrigerant gas (as defined in §173.115 of this subchapter)*
Division 2.1 materials
Division 2.2 materials (in Class DOT 107 tank cars only)
Division 2.3 materials
Formic acid
Hydrocyanic acid, aqueous solutions
Hydrofluoric acid, solution
Hydrogen cyanide, stabilized (less than 3% water)
Hydrogen fluoride, anhydrous
Hydrogen peroxide, aqueous solutions (greater than 20% hydrogen peroxide)
Hydrogen peroxide, stabilized
Hydrogen peroxide and peroxyacetic acid mixtures
Nitric acid (other than red fuming)
Phosphorus, amorphous
Phosphorus, white dry *or Phosphorus, white, under water or Phosphorus white, in solution, or Phosphorus, yellow dry or Phosphorus, yellow, under water or Phosphorus, yellow, in solution*
Phosphorus white, molten
Potassium nitrate and sodium nitrate mixtures
Potassium permanganate
Sulfur trioxide, inhibited
Sulfur trioxide, uninhibited

(2) In a multi-unit tank car tank, unless the tank is marked on two opposing sides, in letters and numerals no less than 50 mm (2.0 inches) high-

(i) With the proper shipping name specified for the material in the §172.101 table or with a common name authorized for the material in this subchapter (e.g., "Refrigerant Gas"); and

(ii) With the identification number specified for the material in the §172.101 table, unless marked in accordance with §§172.302(a) and 172.332 of this subpart.

(b) A motor vehicle or rail car used to transport a multi-unit tank car tank containing a hazardous material must be marked on each side and each end, as required by §172.332, with the identification number specified for the material in the §172.101 table.

[Amdt. 172-123, 55 FR 52593, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; 57 FR 45458, Oct. 1, 1992; Amdt. 172-148, 61 FR 28676, June 5, 1996; Amdt. 172-148, 61 FR 50254, Sept. 25, 1996]

§172.331 Bulk packagings other than portable tanks, cargo tanks, tank cars and multi-unit tank car tanks.

(a) Each person who offers a hazardous material to a motor carrier for transportation in a bulk packaging shall provide the motor carrier with the required identification numbers on placards or plain white square-on-point display configurations, as authorized, or shall affix orange panels containing the required identification numbers to the packaging prior to or at the time the material is offered for transportation, unless the packaging is already marked with the identification number as required by this subchapter.

(b) Each person who offers a bulk packaging containing a hazardous material for transportation shall affix to the packaging the required identification numbers on orange panels, square-on-point configurations or placards, as appropriate, prior to, or at the time the packaging is offered for transportation unless it is already marked with identification numbers as required by this subchapter.

(c) For a bulk packaging contained in or on a transport vehicle or freight container, if the identification number marking on the bulk packaging (e.g., an IBC) required by §172.302(a) is not visible, the transport vehicle or freight container must be marked as required by §172.332 on each side and each end with the identification number specified for the material in the §172.101 table.

[Amdt. 172-123, 55 FR 52593, Dec. 21, 1994, as amended by Amdt. 172-151, 62 FR 1228, Jan. 8, 1997; 62 FR 39398, July 22, 1997]

§172.332 Identification number markings.

(a) *General. When required by §§172.301, 172.302, 172.313, 172.326, 172.328, 172.330, or 172.331 of this subpart, identification numbers must be displayed on orange panels or placards as specified in this section or, when appropriate, on plain white square-on-point configurations as prescribed in §172.336(b).*

(b) Orange panels. Display of an identification number on an orange panel shall be in conformance with the following:

(1) The orange panel must be 160 mm (6.3 inches) high by 400 mm (15.7 inches) wide with a 15 mm (0.6 inches) black outer border. The identification number shall be displayed in 100 mm (3.9 inches) black Helvetica Medium numerals on the orange panel. Measurements may vary from those specified plus or minus 5 mm (0.2 inches).

(2) The orange panel may be made of any durable material prescribed for placards in §172.519, and shall be of the orange color specified for labels or placards in appendix A

to this part.

(3) The name and hazard class of a material may be shown in the upper left border of the orange panel in letters not more than 18 points high.

(4) Except for size and color, the orange panel and identification numbers shall be as illustrated for Liquefied petroleum gas:

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EC02MR91.013

(c) *Placards. Display of an identification number on a hazard warning placard shall be in conformance with the following:*

(1) The identification number shall be displayed across the center area of the placard in 88 mm (3.5 inches) black Alpine Gothic or Alternate Gothic No. 3 numerals on a white background 100 mm (3.9 inches) high and approximately 215 mm (8.5 inches) wide and may be outlined with a solid or dotted line border.

(2) The top of the 100 mm (3.9 inches) high white background shall be approximately 40 mm (1.6 inches) above the placard horizontal center line.

(3) An identification number may be displayed only on a placard corresponding to the primary hazard class of the hazardous material.

(4) For a COMBUSTIBLE placard used to display an identification number, the entire background below the white background for the identification number must be white during transportation by rail and may be white during transportation by highway.

(5) The name of the hazardous material and the hazard class may be shown in letters not more than 18 points high immediately within the upper border of the space on the placard bearing the identification number of the material.

(6) If an identification number is placed over the word(s) on a placard, the word(s) should be substantially covered to maximize the effectiveness of the identification number.

(d) Except for size and color, the display of an identification number on a placard shall be as illustrated for Acetone:

[ILLUSTRATION GOES HERE]

EC02MR91.014

[Amdt. 172-101, 45 FR 74667, Nov. 10, 1980, as amended by Amdt. 172-81, 48 FR 28099, June 20, 1983; Amdt. 172-110, 52 FR 29527, Aug. 10, 1987; Amdt. 172-123, 55 FR 52593, Dec. 21, 1990; 56 FR 66255, Dec. 20, 1991; Amdt. 172-151, 62 FR 1228, Jan. 8, 1997]

§172.334 Identification numbers; prohibited display.

(a) No person may display an identification number on a RADIOACTIVE, EXPLOSIVES 1.1, 1.2, 1.3, 1.4, 1.5 or 1.6, DANGEROUS, or subsidiary hazard placard.

(b) No person may display an identification number on a placard, orange panel or white square-on-point display configuration unless-

(1) The identification number is specified for the material in §172.101;

(2) The identification number is displayed on the placard, orange panel or white square-on-point configuration authorized by §172.332 or §172.336(b), as appropriate, and any placard used for display of the identification number corresponds to the hazard class of the material specified in §172.504;

(3) Except as provided under §172.336 (c)(4) or (c)(5), the package, freight container, or transport vehicle on which the number is displayed contains the hazardous material associated with that identification number in §172.101.

(c) Except as required by §172.332(c)(4) for a combustible liquid, the identification number of a material may be displayed only on the placards required by the tables in §172.504.

(d) Except as provided in §172.336, a placard bearing an identification number may not be used to meet the requirements of subpart F of this part unless it is the correct identification number for all hazardous materials of the same class in the transport vehicle or freight container on which it is displayed.

(e) Except as specified in §172.338, an identification number may not be displayed on an orange panel on a cargo tank unless affixed to the cargo tank by the person offering the hazardous material for transportation in the cargo tank.

(f) If a placard is required by §172.504, an identification number may not be displayed on an orange panel unless it is displayed in proximity to the placard.

(g) No person shall add any color, number, letter, symbol, or word other than as specified in this subchapter, to any identification number marking display which is required or authorized by this subchapter.

[Amdt. 172-101, 45 FR 74667, Nov. 10, 1980, as amended by Amdt. 172-104, 51 FR 23078, June 25, 1986; Amdt. 172-110, 52 FR 29528, Aug. 10, 1987; Amdt. 172-123, 55 FR 52593, Dec. 21, 1990; 56 FR 66255, Dec. 20, 1991; Amdt. 172-127, 59 FR 49133, Sept. 26, 1994]

§172.336 Identification numbers; special provisions.

(a) When not required or prohibited by this subpart, identification numbers may be displayed on a transport vehicle or a freight container in the manner prescribed by this subpart.

(b) For hazardous materials in hazard classes for which hazard warning placards are not specified, identification numbers, when required, must be displayed on either orange panels (see §172.332(b)) or on a plain white square-on-point display configuration having the same outside dimensions as a placard. In addition, for materials in hazard classes for which placards are specified and identification number displays are required, but for which identification numbers may not be displayed on the placards authorized for the material (see §172.334(a)), identification numbers must be displayed on orange panels or on the plain white square-on-point display configuration in association with the required placards. An identification number displayed on a white square-on-point display configuration is not considered to be a placard.

(1) The 100 mm (3.9 inch) by 215 mm (8.5 inches) area containing the identification number shall be located as prescribed by §172.332 (c)(1) and (c)(2) and may be outlined with a solid or dotted line border.

(2) [Reserved]

(c) Identification numbers are not required:

(1) On the ends of a portable tank, cargo tank or tank car having more than one compartment if hazardous materials having different identification numbers are being transported therein. In such a circumstance, the identification numbers on the sides of the tank shall be displayed in the same sequence as the compartments containing the materials they identify.

(2) On a cargo tank containing only gasoline, if the cargo tank is marked "Gasoline" on each side and rear in letters no less than 50 mm (2 inches) high, or is placarded in accordance with §172.542(c).

(3) On a cargo tank containing only fuel oil, if the cargo tank is marked "Fuel Oil" on each side and rear in letters no less than 50 mm (2 inches) high, or is placarded in accordance with §172.544(c).

(4) For each of the different liquid petroleum distillate fuels, including gasoline and gasohol in a compartmented cargo tank or tank car, if the identification number is displayed for the distillate fuel having the lowest flash point.

(5) For each of the different liquid petroleum distillate fuels, including gasoline and gasohol transported in a cargo tank, if the identification number is displayed for the liquid petroleum distillate fuel having the lowest flash point.

(6) On nurse tanks meeting the provisions of §173.315(m) of this subchapter.

[Amdt. 172-101, 45 FR 74667, Nov. 10, 1980, as amended by Amdt. 172-74, 47 FR 40365, Sept. 30, 1982; Amdt. 172-109, 52 FR 13038, Apr. 20, 1987; Amdt. 172-110, 52 FR 29528, Aug. 10, 1987; Amdt. 172-123, 55 FR 52593, Dec. 21, 1990; 56 FR 66255, Dec. 20, 1991]

§172.338 Replacement of identification numbers.

If more than one of the identification number markings on placards, orange panels, or white square-on-point display configurations that are required to be displayed are lost, damaged or destroyed during transportation, the carrier shall replace all the missing or damaged identification numbers as soon as practicable. However, in such a case, the numbers may be entered by hand on the appropriate placard, orange panel or white square-on-point display configuration providing the correct identification numbers are entered legibly using an indelible marking material. When entered by hand, the identification numbers must be located in the white display area specified in §172.332. This section does not preclude required compliance with the placarding requirements of subpart F of this subchapter.

[Amdt. 172-110, 52 FR 29528, Aug. 10, 1987]

[CFR] PART 172 SUBPART E - Labeling

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART E]

Subpart E - Labeling

§172.400 General labeling requirements.

(a) Except as specified in §172.400a, each person who offers for transportation or transports a hazardous material in any of the following packages or containment devices, shall label the package or containment device with labels specified for the material in the §172.101 table and in this subpart:

(1) A non-bulk package;

(2) A bulk packaging, other than a cargo tank, portable tank, or tank car, with a volumetric capacity of less than $18m^3$ (640 cubic feet), unless placarded in accordance with subpart F of this part;

(3) A portable tank of less than 3785 L (1000 gallons) capacity, unless placarded in accordance with subpart F of this part;

(4) A DOT Specification 106 or 110 multi-unit tank car tank, unless placarded in accordance with subpart F of this part; and

(5) An overpack, freight container or unit load device, of less than 18 m^3 (640 cubic feet), which contains a package for which labels are required, unless placarded or marked in accordance with §172.512 of this part.

(b) Labeling is required for a hazardous material which meets one or more hazard class definitions, in accordance with column 6 of the §172.101 table and the following table:

Hazard class or division	Label name	Label design or

		section reference
1.1	EXPLOSIVES 1.1	172.411
1.2	EXPLOSIVES 1.2	172.411
1.3	EXPLOSIVES 1.3	172.411
1.4	EXPLOSIVES 1.4	172.411
1.5	EXPLOSIVES 1.5	172.411
1.6	EXPLOSIVES 1.6	172.411
2.1	FLAMMABLE GAS	172.417
2.2	NONFLAMMABLE GAS	172.415
2.3	POISON GAS	172.416
3 (flammable liquid) Combustible liquid	FLAMMABLE LIQUID (none)	172.419
4.1	FLAMMABLE SOLID	172.420
4.2	SPONTANEOUSLY COMBUSTIBLE	172.422
4.3	DANGEROUS WHEN WET	172.423
5.1	OXIDIZER	172.426
5.2	ORGANIC PEROXIDE	172.427
6.1 (inhalation hazard, Zone A or B)	POISON INHALATION HAZARD	172.429
6.1 (other than inhalation hazard, Zone A or B)	POISON	172.430
6.2	INFECTIOUS SUBSTANCE[1]	172.432
7 (see §172.403)	RADIOACTIVE WHITE-I	172.436
7	RADIOACTIVE YELLOW-II	172.438
7	RADIOACTIVE YELLOW-III	172.440
7 (empty packages, see §173.428 of this subchapter)	EMPTY	172.450
8	CORROSIVE	172.442
9	CLASS 9	172.446

[1]The ETIOLOGIC AGENT label specified in regulations of the Department of Health and Human Services at 42 CFR 72.3 may apply to packages of infectious substances.

[Amdt. 172-123, 55 FR 52593, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; Amdt. 172-151, 62 FR 1228, Jan. 8, 1997; 64 FR 10776, Mar. 5, 1999; 64 FR 51918, Sept. 27, 1999]

§172.400a Exceptions from labeling.

(a) Notwithstanding the provisions of §172.400, a label is not required on-

(1) A cylinder, or a Dewar flask conforming to §173.320 of this subchapter containing a Division 2.1 or Division 2.2 gas that is-

(i) Not poisonous;

(ii) Carried by a private or contract motor carrier;

(iii) Not overpacked; and

(iv) Durably and legibly marked in accordance with CGA Pamphlet C-7, appendix A.

(2) A package or unit of military explosives (including ammunition) shipped by or on behalf of the DOD when in-

(i) Freight containerload, carload or truckload shipments, if loaded and unloaded by the shipper or DOD; or

(ii) Unitized or palletized break-bulk shipments by cargo vessel under charter to DOD if at least one required label is displayed on each unitized or palletized load.

(3) A package containing a hazardous material other than ammunition that is-

(i) Loaded and unloaded under the supervision of DOD personnel, and

(ii) Escorted by DOD personnel in a separate vehicle.

(4) A compressed gas cylinder permanently mounted in or on a transport vehicle.

(5) A freight container, aircraft unit load device or portable tank, which-

(i) Is placarded in accordance with subpart F of this part, or

(ii) Conforms to paragraph (a)(3) or (b)(3) of §172.512.

(6) An overpack or unit load device in or on which labels representative of each hazardous material in the overpack or unit load device are visible.

(7) A package of low specific activity radioactive material, when transported under §173.427(a)(6)(vi) of this subchapter.

(b) Certain exceptions to labeling requirements are provided for small quantities and limited quantities in applicable sections in part 173 of this subchapter.

(c) Notwithstanding the provisions of §172.402(a), a subsidiary hazard label is not required on a package containing a Class 8 (corrosive) material which has a subsidiary hazard of Division 6.1 (poisonous) if the toxicity of the material is based solely on the corrosive destruction of tissue rather than systemic poisoning.

[Amdt. 172-123, 55 FR 52594, Dec. 21, 1990, as amended by Amdt. 172-132, 58 FR 50501, Sept. 27, 1993; 172-130, 58 FR 51531, Oct. 1, 1993; Amdt. 172-139, 59 FR 67490, Dec. 29, 1994; Amdt. 172-145, 60 FR 49110, Sept. 21, 1995; 63 FR 52849, Oct. 1, 1998; 64 FR 10776, Mar. 5, 1999]

§172.401 Prohibited labeling.

(a) Except as otherwise provided in this section, no person may offer for transportation and no carrier may transport a package bearing a label specified in this subpart unless:

(1) The package contains a material that is a hazardous material, and

(2) The label represents a hazard of the hazardous material in the package.

(b) No person may offer for transportation and no carrier may transport a package bearing any marking or label which by its color, design, or shape could be confused with or conflict with a label prescribed by this part.

(c) The restrictions in paragraphs (a) and (b) of this section, do not apply to packages labeled in conformance with:

(1) Any United Nations recommendation, including the class number (see §172.407), in the document entitled *"Transport of Dangerous Goods.";*

(2) The International Maritime Organization (IMO) requirements, including the class number (see §172.407), in the document entitled "International Maritime Dangerous Goods Code";

(3) The ICAO Technical Instructions; or

(4) The TDG Regulations.

(d) The provisions of paragraph (a) of this section do not apply to a packaging bearing a label if that packaging is:

(1) Unused or cleaned and purged of all residue;

(2) Transported in a transport vehicle or freight container in such a manner that the packaging is not visible during transportation; and

(3) Loaded by the shipper and unloaded by the shipper or consignee.

[Amdt. 172-9, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-75, 47 FR 44471, Oct. 7, 1982; Amdt. 172-77, 47 FR 54822, Dec. 6, 1982; Amdt. 172-94, 49 FR 38134, Sept. 27, 1984; Amdt. 172-100, 50 FR 41521, Oct. 11, 1985; Amdt. 172-123, 55 FR 52594, Dec. 21, 1990; Amdt. 172-132, 58 FR 50501, Sept. 27, 1993]

§172.402 Additional labeling requirements.

(a) *Subsidiary hazard labels. Each package containing a hazardous material-*

(1) Shall be labeled with primary and subsidiary hazard labels as specified in column 6 of the §172.101 table (unless excepted in paragraph (a)(2) of this section); and

(2)For other than Class 1 or Class 2 materials (for subsidiary labeling requirements for Class 1 or Class 2 materials see paragraph (e) or paragraphs (f) and (g), respectively, of this section), if not already labeled under paragraph (a)(1) of this section, shall be labeled with subsidiary hazard labels in accordance with the following table:

Subsidiary Hazard Labels

Subsidiary hazard level (packing group)	Subsidiary Hazard (Class or Division)						
-	3	4.1	4.2	4.3	5.1	6.1	8
I	X	***	***	X	X	X	X
II	X	X	X	X	X	X	X
III	*	X	X	X	X	X	X

X-Required for all modes.

*-Required for all modes, except for a material with a flash point at or above 38 ^{o}C (100 ^{o}F) transported by rail or highway.

**-Reserved

***-Impossible as subsidiary hazard.

(b) *Display of hazard class on labels. The appropriate hazard class or, for Division 5.1 or 5.2 the division number, shall be displayed in the lower corner of a primary hazard label and may not be displayed on a subsidiary label.*

(c) Cargo Aircraft Only label. Each person who offers for transportation or transports by aircraft a package containing a hazardous material which is authorized on cargo aircraft only shall label the package with a CARGO AIRCRAFT ONLY label specified in §172.448 of this subpart.

(d) Class 7 (Radioactive) Materials. Except as otherwise provided in this paragraph, each package containing a Class 7 material that also meets the definition of one or more additional hazard classes must be labeled as a Class 7 material as required by §172.403 of this subpart and for each additional hazard. A subsidiary hazard label is not required on a package containing a Class 7 material that conforms to criteria specified in §173.4 of this subchapter, except §173.4(a)(1)(iv) of this subchapter.

(e) Class 1 (explosive) Materials. In addition to the label specified in column 6 of the §172.101 table, each package of Class 1 material that also meets the definition for:

(1) Division 6.1, Packing Groups I or II, shall be labeled POISON or POISON INHALATION HAZARD, as appropriate.

(2) Class 7, shall be labeled in accordance with §172.403 of this subpart.

(f) *Division 2.2 materials. In addition to the label specified in column 6 of the §172.101 table, each package of Division 2.2 material that also meets the definition for an oxidizing gas (see §171.8 of this subchapter) must be labeled OXIDIZER.*

(g) Division 2.3 materials. In addition to the label specified in column 6 of the §172.101 table, each package of Division 2.3 material that also meets the definition for:

(1) Division 2.1, must be labeled Flammable Gas;

(2) Division 5.1, must be labeled Oxidizer; and

(3) Class 8, must be labeled Corrosive.

[Amdt. 172-123, 55 FR 52594, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; Amdt. 172-139, 59 FR 67490, Dec. 29, 1994; Amdt. 172-140, 60 FR 26805, May 18, 1995; Amdt. 172-149, 61 FR 27173, May 30, 1996; 62 FR 39405, July 22, 1997]

§172.403 Class 7 (radioactive) material.

(a) Unless excepted from labeling by §§173.421 through 173.428 of this subchapter, each package of radioactive material must be labeled as provided in this section.

(b) The proper label to affix to a package of Class 7 (radioactive) material is based on the radiation level at the surface of the package and the transport index. The proper category of label must be determined in accordance with paragraph (c) of this section. The label to be applied must be the highest category required for any of the two determining conditions for the package. RADIOACTIVE WHITE-I is the lowest category and RADIOACTIVE YELLOW-III is the highest. For example, a package with a transport index of 0.8 and a maximum surface radiation level of 0.6 millisievert (60 millirems) per hour must bear a RADIOACTIVE YELLOW-III label.

(c) Category of label to be applied to Class 7 (radioactive) materials packages:

Transport index	Maximum radiation level at any point on the external surface	Label category
0[2]	Less than or equal to 0.005 mSv/h (0.5 mrem/h)	WHITE-I.
More than 0 but not more than 1	Greater than 0.005 mSv/h (0.5 mrem/h) but less than or equal to 0.5 mSv/h (50 mrem/h)	YELLOW-II.
More than 1 but not more than 10	Greater than 0.5 mSv/h (50 mrem/h) but less than or equal to 2 mSv/h (200 mrem/h)	YELLOW-III.
More than 10	Greater than 2 mSv/h (200 mrem/h) but less than or equal to 10 mSv/h (1,000 mrem/h)	YELLOW-III (Must be shipped under exclusive use provisions; see 173.441(b) of this subchapter).

[1]Any package containing a "highway route controlled quantity" (§173.403 of this subchapter) must be labelled as RADIOACTIVE YELLOW-III.

[2]If the measured TI is not greater than 0.05, the value may be considered to be zero.

(d) *EMPTY label. See §173.428(d) of this subchapter for EMPTY labeling requirements.*

(e) [Reserved]

(f) Each package required by this section to be labeled with a RADIOACTIVE label must have two of these labels, affixed to opposite sides of the package. (See §172.406(e)(3) for freight container label requirements).

(g) The following applicable items of information must be entered in the blank spaces on the RADIOACTIVE label by legible printing (manual or mechanical), using a durable weather resistant means of marking:

(1) *Contents. The name of the radionuclides as taken from the listing of radionuclides in §173.435 of this subchapter (symbols which conform to established radiation protection terminology are authorized, i.e.,* ^{99}Mo, ^{60}Co*, etc.). For mixtures of radionuclides, with consideration of space available on the label, the radionuclides that must be shown must be determined in accordance with §173.433(f) of this subchapter.*

(2) Activity. Activity units must be expressed in appropriate SI units (e.g., Becquerels (Bq), Terabecquerels (TBq), etc.) or in both appropriate SI units and appropriate customary units (Curies (Ci), milliCuries (mCi), microcuries (uCi), etc.). Alternatively, for domestic transport the activity may be expressed solely in terms of curies until April 1, 1997. Abbreviations are authorized. Except for plutonium-238, plutonium-239, and plutonium-241, the weight in grams or kilograms of fissile radionuclides may be inserted instead of activity units. For plutonium-238, plutonium-239, and plutonium-241, the weight in grams or kilograms of fissile radionuclides may be inserted in addition to the activity units.

(3) Transport index. (See §173.403 of this subchapter.)

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-29A, 41 FR 40679, Sept. 20, 1976; Amdt. 172-78, 48 FR 10226, Mar. 10, 1983; 48 FR 13431, Mar.

31, 1983; 48 FR 31217, July 7, 1983; Amdt. 172-85, 48 FR 50459, Nov. 1, 1983; Amdt. 172-114, 53 FR 38274, Sept. 29, 1988; Amdt. 172-123, 55 FR 52594, Dec. 21, 1990; Amdt. 172-143, 60 FR 50305, Sept. 28, 1995; Amdt. 172-143, 61 FR 20750, May 8, 1996]

§172.404 Labels for mixed and consolidated packaging.

(a) *Mixed packaging. When hazardous materials having different hazard classes are packed within the same packaging, or within the same outside container or overpack as described in §173.25 and authorized by §173.21 of this subchapter, the packaging, outside container or overpack must be labeled as required for each class of hazardous material contained therein.*

(b) Consolidated packaging. When two or more packages containing compatible hazardous material (see §173.21 of this subchapter) are placed within the same outside container or overpack, the outside container or overpack must be labeled as required for each class of hazardous material contained therein.

§172.405 Authorized label modifications.

(a) For Classes 1, 2, 3, 4, 5, 6, and 8, text indicating a hazard (for example FLAMMABLE LIQUID) is not required on a primary or subsidiary label when-

(1) The label otherwise conforms to the provisions of this subpart, and

(2) The hazard class or, for Division 5.1 or 5.2 the division number, is displayed in the lower corner of the label, if the label corresponds to the primary hazard class of the hazardous material.

(b) For a package containing Oxygen, compressed, or Oxygen, refrigerated liquid, the OXIDIZER label specified in §172.426 of this subpart, modified to display the word "OXYGEN" instead of "OXIDIZER", and the class number "2" instead of "5.1", may be used in place of the NON-FLAMMABLE GAS and OXIDIZER labels. Notwithstanding the provisions of paragraph (a) of this section, the word "OXYGEN" must appear on the label.

(c) For a package containing a Division 6.1, Packing Group III material, the POISON label specified in §172.430 may be modified to display the text "PG III" instead of "POISON" or "TOXIC" below the mid line of the label. Also see §172.313(d).

[Amdt. 172-123, 55 FR 52594, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; 57 FR 45458, Oct. 1, 1992; 64 FR 10776, Mar. 5, 1999]

§172.406 Placement of labels.

(a) *General. (1) Except as provided in paragraphs (b) and (e) of this section, each* *label required by this subpart must-*

(i) Be printed on or affixed to a surface (other than the bottom) of the package or containment device containing the hazardous material; and

(ii) Be located on the same surface of the package and near the proper shipping name marking, if the package dimensions are adequate.

(2) Except as provided in paragraph (e) of this section, duplicate labeling is not required on a package or containment device (such as to satisfy redundant labeling requirements).

(b) *Exceptions. A label may be printed on or placed on a securely affixed tag, or may be affixed by other suitable means to:*

(1) A package that contains no radioactive material and which has dimensions less than those of the required label;

(2) A cylinder; and

(3) A package which has such an irregular surface that a label cannot be satisfactorily affixed.

(c) *Placement of multiple labels. When primary and subsidiary hazard labels are required, they must be displayed next to each other. Placement conforms to this requirement if labels are within 150 mm (6 inches) of one another.*

(d) Contrast with background. Each label must be printed on or affixed to a background of contrasting color, or must have a dotted or solid line outer border.

(e) Duplicate labeling. Generally, only one of each different required label must be displayed on a package. However, duplicate labels must be displayed on at least two sides or two ends (other than the bottom) of-

(1) Each package or overpack having a volume of 1.8 m^3 (64 cubic feet) or more;

(2) Each non-bulk package containing a radioactive material;

(3) Each DOT 106 or 110 multi-unit tank car tank. Labels must be displayed on each end;

(4) Each portable tank of less than 3,785 L (1000 gallons) capacity; and

(5) Each freight container or aircraft unit load device having a volume of 1.8 m^3 (64 cubic feet) or more, but less than 18 m^3 (640 cubic feet). One of each required label must be displayed on or near the closure.

(f) *Visibility. A label must be clearly visible and may not be obscured by markings or attachments.*

[Amdt. 172-123, 55 FR 52594, Dec. 21, 1990, as amended at 56 FR 66255, Dec. 20, 1991; Amdt. 172-130, 58 FR 51531, Oct. 1, 1993]

§172.407 Label specifications.

(a) *Durability. Each label, whether printed on or affixed to a package, must be durable and weather resistant. A label on a package must be able to withstand, without deterioration or a substantial change in color, a 30-day exposure to conditions incident to transportation that reasonably could be expected to be encountered by the labeled* *package.*

(b) Design. (1) Except for size and color, the printing, inner border, and symbol on each label must be as shown in §§172.411 through 172.448 of this subpart, as appropriate.

(2) The dotted line border shown on each label is not part of the label specification, except when used as an alternative for the solid line outer border to meet the requirements of §172.406(d) of this subpart.

(c) *Size. (1) Each diamond (square-on-point) label prescribed in this subpart must be at least 100 mm (3.9 inches) on each side with each side having a solid line inner border 5.0 to 6.3 mm (0.2 to 0.25 inches) from the edge.*

(2) The CARGO AIRCRAFT ONLY label must be a rectangle measuring at least 110 mm (4.3 inches) in height by 120 mm (4.7 inches) in width. The word "DANGER" must be shown in letters measuring at least 12.7 mm (0.5 inches) in height.

(3) Except as otherwise provided in this subpart, the hazard class number, or division number, as appropriate, must be at least 6.3 mm (0.25 inches) and not greater than 12.7 mm (0.5 inches).

(4) When text indicating a hazard is displayed on a label, the label name must be shown in letters measuring at least 7.6 mm (0.3 inches) in height. For SPONTANEOUSLY COMBUSTIBLE or DANGEROUS WHEN WET labels, the words "Spontaneously" and "When Wet" must be shown in letters measuring at least 5.1 mm (0.2 inches) in height.

(5) The symbol on each label must be proportionate in size to that shown in the appropriate section of this subpart.

(d) *Color. (1) The background color on each label must be as prescribed in §§172.411 through 172.448 of this subpart, as appropriate.*

(2) The symbol, text, numbers, and border must be shown in black on a label except that-

(i) White may be used on a label with a one color background of green, red or blue; and

(ii) White must be used for the text and class number for the CORROSIVE label.

(3) Black and any color on a label must be able to withstand, without substantial change, a 72-hour fadeometer test (for a description of equipment designed for this purpose, see ASTM G 23-69 (1975) or ASTM G 26-70).

(4) (i) A color on a label, upon visual examination, must fall within the color tolerances-

(A) Displayed on color charts conforming to the technical specifications for charts set forth in table 1 or 2 in appendix A to this part; or

(B) For labels printed on packaging surfaces, specified in table 3 in appendix A to this part.

(ii) Color charts conforming to appendix A to this part are on display in Room 8421, Nassif Building, 400 Seventh Street, SW., Washington DC 20590-0001.

(5) The specified label color must extend to the edge of the label in the area designated on each label except the CORROSIVE, RADIOACTIVE YELLOW-II AND RADIOACTIVE YELLOW-III labels on which the color must extend only to the inner

border.

(e) *Form identification. A label may contain form identification information, including the name of its maker, provided that information is printed outside the solid line inner border in no larger than 10-point type.*

(f) Exceptions. A label conforming to specifications in the UN Recommendations may be used in place of a corresponding label which conforms to the requirements of this subpart.

(g) Trefoil symbol. The trefoil symbol on the RADIOACTIVE WHITE-I, RADIOACTIVE YELLOW-II, and RADIOACTIVE YELLOW-III labels must meet the appropriate specifications in appendix B of this part.

[Amdt. 172-123, 55 FR 52595, Dec. 21, 1990, as amended at 56 FR 66256, Dec. 20, 1991; Amdt. 172-143, 60 FR 50305, Sept. 28, 1995; 64 FR 10776, Mar. 5, 1999]

§172.411 EXPLOSIVE 1.1, 1.2, 1.3, 1.4, 1.5 and 1.6 labels, and EXPLOSIVE Subsidiary label.

(a) Except for size and color, the EXPLOSIVE 1.1, EXPLOSIVE 1.2 and EXPLOSIVE 1.3 labels must be as follows:

(b) In addition to complying with §172.407, the background color on the EXPLOSIVE 1.1, EXPLOSIVE 1.2 and EXPLOSIVE 1.3 labels must be orange. The "**" shall be replaced with the appropriate division number and compatibility group. The compatibility group letter must be the same size as the division number and must be shown as a capitalized Roman letter.

(c) Except for size and color, the EXPLOSIVE 1.4, EXPLOSIVE 1.5, EXPLOSIVE 1.6 labels, and EXPLOSIVE Subsidiary label must be as follows:

EXPLOSIVE 1.4:

EXPLOSIVE 1.5:

EXPLOSIVE 1.6:

EXPLOSIVE Subsidiary label:

(d) In addition to complying with §172.407, the background color on the EXPLOSIVE 1.4, EXPLOSIVE 1.5, EXPLOSIVE 1.6, and EXPLOSIVE Subsidiary label must be orange. Except for the EXPLOSIVE subsidiary label, the "*" shall be replaced with the appropriate compatibility group. The compatibility group letter must be shown as a capitalized Roman letter. Except for the EXPLOSIVE subsidiary label, division numerals must measure at least 30 mm (1.2 inches) in height and at least 5 mm (0.2 inches) in width.

[Amdt. 172-123, 56 FR 66256, Dec. 20, 1991, as amended by Amdt. 172-139, 59 FR 67490, Dec. 29, 1994]

§172.415 NON-FLAMMABLE GAS label.

(a) Except for size and color, the NON-FLAMMABLE GAS label must be as follows:

(b) In addition to complying with §172.407, the background color on the NON-FLAMMABLE GAS label must be green.

[Amdt. 172-123, 56 66256, Dec. 20, 1991]

§172.416 POISON GAS label.

(a) Except for size and color, the POISON GAS label must be as follows:

(b) In addition to complying with §172.407, the background on the POISON GAS label and the symbol must be white. The background of the upper diamond must be black and the lower point of the upper diamond must be 14 mm (0.54 inches) above the horizontal center line.

[62 FR 39405, July 22, 1997]

§172.417 FLAMMABLE GAS label.

(a) Except for size and color, the FLAMMABLE GAS label must be as follows:

(b) In addition to complying with §172.407, the background color on the FLAMMABLE GAS label must be red.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991]

§172.419 FLAMMABLE LIQUID label.

(a) Except for size and color the FLAMMABLE LIQUID label must be as follows:

(b) In addition to complying with §172.407, the background color on the FLAMMABLE

LIQUID label must be red.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991]

§172.420 FLAMMABLE SOLID label.

(a) Except for size and color, the FLAMMABLE SOLID label must be as follows:

(b) In addition to complying with §172.407, the background on the FLAMMABLE SOLID label must be white with vertical red stripes equally spaced on each side of a red stripe placed in the center of the label. The red vertical stripes must be spaced so that, visually, they appear equal in width to the white spaces between them. The symbol (flame) and text (when used) must be overprinted. The text "FLAMMABLE SOLID" may be placed in a white rectangle.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991]

§172.422 SPONTANEOUSLY COMBUSTIBLE label.

(a) Except for size and color, the SPONTANEOUSLY COMBUSTIBLE label must be as follows:

(b) In addition to complying with §172.407, the background color on the lower half of the SPONTANEOUSLY COMBUSTIBLE label must be red and the upper half must be white.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991, as amended at 57 FR 45458, Oct. 1, 1992]

§172.423 DANGEROUS WHEN WET label.

(a) Except for size and color, the DANGEROUS WHEN WET label must be as follows:

(b) In addition to complying with §172.407, the background color on the DANGEROUS WHEN WET label must be blue.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991]

§172.426 OXIDIZER label.

(a) Except for size and color, the OXIDIZER label must be as follows:

(b) In addition to complying with §172.407, the background color on the OXIDIZER label must be yellow.

[Amdt. 172-123, 56 FR 66257, Dec. 20, 1991]

§172.427 ORGANIC PEROXIDE label.

(a) Except for size and color, the ORGANIC PEROXIDE label must be as follows:

(b) In addition to complying with §172.407, the background color on the ORGANIC PEROXIDE label must be yellow.

[Amdt. 172-123, 56 FR 66258, Dec. 20, 1991]

§172.429 POISON INHALATION HAZARD label.

(a) Except for size and color, the POISON INHALATION HAZARD label must be as follows:

(b) In addition to complying with §172.407, the background on the POISON INHALATION HAZARD label and the symbol must be white. The background of the upper diamond must be black and the lower point of the upper diamond must be 14 mm (0.54 inches) above the horizontal center line.

[62 FR 39406, July 22, 1997]

§172.430 POISON label.

(a) Except for size and color, the POISON label must be as follows:

(b) In addition to complying with §172.407, the background on the POISON label must be white. The word "TOXIC" may be used in lieu of the word "POISON".

[Amdt. 172-123, 56 FR 66258, Dec. 20, 1991, as amended by Amdt. 172-139, 59 FR 67490, Dec. 29, 1994]

§172.431 [Reserved]

§172.432 INFECTIOUS SUBSTANCE label.

(a) Except for size and color, the INFECTIOUS SUBSTANCE label must be as follows:

(b) In addition to complying with §172.407, the background on the INFECTIOUS SUBSTANCE label must be white.

[Amdt. 172-123, 56 FR 66258, Dec. 20, 1991]

§172.436 RADIOACTIVE WHITE-I label.

(a) Except for size and color, the RADIOACTIVE WHITE-I label must be as follows:

(b) In addition to complying with §172.407, the background on the RADIOACTIVE WHITE-I label must be white. The printing and symbol must be black, except for the "I" which must be red.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.438 RADIOACTIVE YELLOW-II label.

(a) Except for size and color, the RADIOACTIVE YELLOW-II must be as follows:

(b) In addition to complying with §172.407, the background color on the RADIOACTIVE YELLOW-II label must be yellow in the top half and white in the lower half. The printing and symbol must be black, except for the "II" which must be red.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.440 RADIOACTIVE YELLOW-III label.

(a) Except for size and color, the RADIOACTIVE YELLOW-III label must be as follows:

(b) In addition to complying with §172.407, the background color on the RADIOACTIVE YELLOW-III label must be yellow in the top half and white in the lower half. The printing and symbol must be black, except for the "III" which must be red.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.442 CORROSIVE label.

(a) Except for size and color, the CORROSIVE label must be as follows:

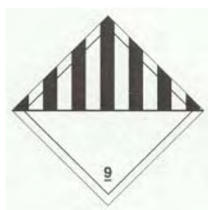
(b) In addition to complying with §172.407, the background on the CORROSIVE label must be white in the top half and black in the lower half.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.444 [Reserved]

§172.446 CLASS 9 label.

(a) Except for size and color, the "CLASS 9" (miscellaneous hazardous materials) label must be as follows:



(b) In addition to complying with §172.407, the background on the CLASS 9 label must be white with seven black vertical stripes on the top half. The black vertical stripes must be spaced, so that, visually, they appear equal in width to the six white spaces between them. The lower half of the label must be white with the class number "9" underlined and centered at the bottom.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.448 CARGO AIRCRAFT ONLY label.

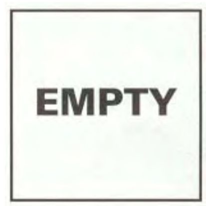
(a) Except for size and color, the CARGO AIRCRAFT ONLY label must be as follows:

(b) The CARGO AIRCRAFT ONLY label must be black on an orange background.

[Amdt. 172-123, 56 FR 66259, Dec. 20, 1991]

§172.450 EMPTY label.

(a) Each EMPTY label, except for size, must be as follows:



(1) Each side must be at least 6 inches (152 mm.) with each letter at least 1 inch (25.4 mm.) in height.

(2) The label must be white with black printing.

(b) [Reserved]

[CFR] PART 172 SUBPART F - Placarding

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART F]

Subpart F - Placarding

§172.500 Applicability of placarding requirements.

(a) Each person who offers for transportation or transports any hazardous material subject to this subchapter shall comply with the applicable placarding requirements of this subpart.

(b) This subpart does not apply to-

(1) Infectious substances;
(2) Hazardous materials classed as ORM-D;
(3) Hazardous materials authorized by this subchapter to be offered for transportation as Limited Quantities when identified as such on shipping papers in accordance with §172.203(b);
(4) Hazardous materials prepared in accordance with §173.13 of this subchapter;
(5) Hazardous materials which are packaged as small quantities under the provisions of §173.4 of this subchapter; and
(6) Combustible liquids in non-bulk packagings.

[Amdt. 172-123, 55 FR 52599, Dec. 21, 1990, as amended by Amdt. 172-149, 61 FR 27173, May 30, 1996]

§172.502 Prohibited and permissive placarding.

(a) *Prohibited placarding. Except as provided in paragraph (b) of this section, no person may affix or display on a packaging, freight container, unit load device, motor vehicle or rail car-*
(1) Any placard described in this subpart unless-
(i) The material being offered or transported is a hazardous material;
(ii) The placard represents a hazard of the hazardous material being offered or transported; and
(iii) Any placarding conforms to the requirements of this subpart.
(2) Any sign, advertisement, slogan (such as "Drive Safely"), or device that, by its color, design, shape or content, could be confused with any placard prescribed in this subpart.
(b) *Exceptions. (1) The restrictions in paragraph (a) of this section do not apply to a bulk packaging, freight container, unit load device, transport vehicle or rail car which is placarded in conformance with the TDG Regulations, the IMDG Code or the UN Recommendations.*
(2) The restrictions of paragraph (a) of this section do not apply to the display of an identification number on a white square-on-point configuration in accordance with §172.336(b) of this part.
(3) The restrictions in paragraph (a)(2) of this section do not apply until October 1, 2001 to a safety sign or safety slogan (e.g., "Drive Safely" or "Drive Carefully"), which was permanently marked on a transport vehicle, bulk packaging, or freight container on or before August 21, 1997.
(c) *Permissive placarding. Placards may be displayed for a hazardous material, even when not required, if the placarding otherwise conforms to the requirements of this subpart.*

[Amdt. 172-123, 55 FR 52599, Dec. 21, 1990, as amended at 56 FR 66259, Dec. 20, 1991; Amdt. 172-151, 62 FR 1230, Jan. 8, 1997; 62 FR 39389 and 39407, July 22, 1997]

§172.503 Identification number display on placards.

For procedures and limitations pertaining to the display of identification numbers on placards, see §172.334.

[Amdt. 172-58, 45 FR 34701, May 22, 1980]

§172.504 General placarding requirements.

(a) *General. Except as otherwise provided in this subchapter, each bulk packaging, freight container, unit load device, transport vehicle or rail car containing any quantity of a hazardous material must be placarded on each side and each end with the type of placards specified in tables 1 and 2 of this section and in accordance with other placarding requirements of this subpart, including the specifications for the placards named in the tables and described in detail in §§172.519 through 172.560.*

(b) DANGEROUS placard. A freight container, unit load device, transport vehicle, or rail car which contains non-bulk packages with two or more categories of hazardous materials that require different placards specified in table 2 of paragraph (e) of this section may be placarded with a DANGEROUS placard instead of the separate placarding specified for each of the materials in table 2 of paragraph (e) of this section. However, when 1,000 kg (2,205 pounds) aggregate gross weight or more of one category of material is loaded therein at one loading facility on a freight container, unit load device, transport vehicle, or rail car, the placard specified in table 2 of paragraph (e) of this section for that category must be applied.

(c) Exception for less than 454 kg (1,001 pounds). Except for bulk packagings and hazardous materials subject to §172.505, when hazardous materials covered by table 2 of this section are transported by highway or rail, placards are not required on-

(1) A transport vehicle or freight container which contains less than 454 kg (1001 pounds) aggregate gross weight of hazardous materials covered by table 2 of paragraph (e) of this section; or

(2) A rail car loaded with transport vehicles or freight containers, none of which is required to be placarded.

The exceptions provided in paragraph (c) of this section do not prohibit the display of placards in the manner prescribed in this subpart, if not otherwise prohibited (see §172.502), on transport vehicles or freight containers which are not required to be placarded.

(d) *Exception for empty non-bulk packages. A non-bulk packaging that contains only the residue of a hazardous material covered by table 2 of paragraph (e) of this section need not be included in determining placarding requirements.*

(e) Placarding tables. Placards are specified for hazardous materials in accordance with the following tables:

Table 1

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard design section reference ()
1.1	EXPLOSIVES 1.1	172.522
1.2	EXPLOSIVES 1.2	172.522
1.3	EXPLOSIVES 1.3	172.522
2.3	POISON GAS	172.540
4.3	DANGEROUS WHEN WET	172.548
5.2 (Organic peroxide, Type B, liquid *or* solid, temperature controlled)	ORGANIC PEROXIDE	172.552
6.1 (inhalation hazard, Zone A or B)	POISON INHALATION HAZARD	172.555
7 (Radioactive Yellow III label only)	RADIOACTIVE[1]	172.556

[1]RADIOACTIVE placard also required for exclusive use shipments of low specific activity material and surface contaminated objects transported in accordance with §173.427(a) of this subchapter.

Table 2

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard design section reference ()
1.4	EXPLOSIVES 1.4	172.523
1.5	EXPLOSIVES 1.5	172.524
1.6	EXPLOSIVES 1.6	172.525
2.1	FLAMMABLE GAS	172.532
2.2	NON-FLAMMABLE GAS	172.528
3	FLAMMABLE	172.542
Combustible liquid	COMBUSTIBLE	172.544
4.1	FLAMMABLE SOLID	172.546
4.2	SPONTANEOUSLY COMBUSTIBLE	172.547
5.1	OXIDIZER	172.550
5.2 (Other than organic peroxide, Type B, liquid or solid, temperature controlled)	ORGANIC PEROXIDE	172.552
6.1 (other than inhalation hazard, Zone A or B)	POISON	172.554
6.2	(None)	-
8	CORROSIVE	172.558
9	CLASS 9	172.560
ORM-D	(None)	-

(f) *Additional placarding exceptions. (1) When more than one division placard is required for Class 1 materials on a transport vehicle, rail car, freight container or unit load device, only the placard representing the lowest division number must be displayed.*

(2) A FLAMMABLE placard may be used in place of a COMBUSTIBLE placard on-

(i) A cargo tank or portable tank.

(ii) A compartmented tank car which contains both flammable and combustible liquids.

(3) A NON-FLAMMABLE GAS placard is not required on a transport vehicle which contains non-flammable gas if the transport vehicle also contains flammable gas or oxygen and it is placarded with FLAMMABLE GAS or OXYGEN placards, as required.

(4) OXIDIZER placards are not required for Division 5.1 materials on freight containers, unit load devices, transport vehicles or rail cars which also contain Division 1.1 or 1.2 materials and which are placarded with EXPLOSIVES 1.1 or 1.2 placards, as required.

(5) For transportation by transport vehicle or rail car only, an OXIDIZER placard is not required for Division 5.1 materials on a transport vehicle, rail car or freight container which also contains Division 1.5 explosives and is placarded with EXPLOSIVES 1.5 placards, as required.

(6) The EXPLOSIVE 1.4 placard is not required for those Division 1.4 Compatibility Group S (1.4S) materials that are not required to be labeled 1.4S.

(7) For domestic transportation of oxygen, compressed or oxygen, refrigerated liquid, the OXYGEN placard in §172.530 of this subpart may be used in place of a NON-FLAMMABLE GAS placard.

(8) Except for a material classed as a combustible liquid that also meets the definition of a Class 9 material, a COMBUSTIBLE placard is not required for a material classed as a combustible liquid when transported in a non-bulk packaging.

(9) For domestic transportation, a Class 9 placard is not required. A bulk packaging containing a Class 9 material must be marked with the appropriate identification number displayed on a Class 9 placard, an orange panel or a white-square-on-point display configuration as required by subpart D of this part.

(10) For Division 6.1, PG III materials, a POISON placard may be modified to display the text "PG III" below the mid line of the placard.

(11) For domestic transportation, a POISON placard is not required on a transport vehicle or freight container required to display a POISON INHALATION HAZARD or POISON GAS placard.

(g) For shipments of Class 1 (explosive) materials by aircraft or vessel, the applicable compatibility group letter must be displayed on the placards required by this section.

[Amdt. 172-123, 55 FR 52600, Dec. 21, 1990, as amended at 56 FR 66260, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; Amdt. 172-123, 57 FR 59310, Dec. 15, 1992; Amdt. 172-143, 60 FR 50305, Sept. 28, 1995; Amdt. 172-150, 61 FR 50624, Sept. 26, 1996; Amdt. 172-151, 62 FR 1230, Jan. 8, 1997; 62 FR 39398 and 39407, July 22, 1997; 63 FR 16076, Apr. 1, 1998; 63 FR 52849, Oct. 1, 1998; 64 FR 10776, Mar. 5, 1999]

§172.505 Placarding for subsidiary hazards.

(a) Each transport vehicle, freight container, portable tank, unit load device, or rail car that contains a poisonous material subject to the "Poison Inhalation Hazard" shipping description of §172.203(m)(3) must be placarded with a POISON INHALATION HAZARD or POISON GAS placard, as appropriate, on each side and each end, in addition to any other placard required for that material in §172.504. Duplication of the POISON INHALATION HAZARD or POISON GAS placard is not required.

(b) In addition to the RADIOACTIVE placard which may be required by §172.504(e) of this subpart, each transport vehicle, portable tank or freight container that contains 454 kg (1001 pounds) or more gross weight of fissile or low specific activity uranium hexafluoride shall be placarded with a CORROSIVE placard on each side and each end.

(c) Each transport vehicle, portable tank, freight container or unit load device that contains a material which has a subsidiary hazard of being dangerous when wet, as defined in §173.124 of this subchapter, shall be placarded with DANGEROUS WHEN WET placards, on each side and each end, in addition to the placards required by §172.504.

(d) Hazardous materials that possess secondary hazards may exhibit subsidiary placards that correspond to the placards described in this part, even when not required by this part (see also §172.519(b) (4) of this subpart).

[Amdt. 172-123, 55 FR 52601, Dec. 21, 1990, as amended at 56 FR 66260, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; Amdt. 172-127, 59 FR 49133, Sept. 26, 1994; Amdt. 172-151, 62 FR 1231, Jan. 8, 1997; 62 FR 39398, July 22, 1997]

§172.506 Providing and affixing placards: Highway.

(a) Each person offering a motor carrier a hazardous material for transportation by highway shall provide to the motor carrier the required placards for the material being offered prior to or at the same time the material is offered for transportation, unless the carrier's motor vehicle is already placarded for the material as required by this subpart.

(1) No motor carrier may transport a hazardous material in a motor vehicle, unless the placards required for the hazardous material are affixed thereto as required by this subpart.

(2) [Reserved]

(b) [Reserved]

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-29A, 41 FR 40679, Sept. 20, 1976]

§172.507 Special placarding provisions: Highway.

(a) Each motor vehicle used to transport a package of highway route controlled quantity Class 7 (radioactive) materials (see §173.403 of this subchapter) must have the required RADIOACTIVE warning placard placed on a square background as described in §172.527.

(b) A nurse tank, meeting the provisions of §173.315(m) of this subchapter, is not required to be placarded on an end containing valves, fittings, regulators or gauges when those appurtenances prevent the markings and placard from being properly placed and visible.

[Amdt. 172-103, 51 FR 5971, Feb. 18, 1986, as amended by Amdt. 172-143, 60 FR 50305, Sept. 28, 1995]

§172.508 Placarding and affixing placards: Rail.

(a) Each person offering a hazardous material for transportation by rail shall affix to the rail car containing the material, the placards specified by this subpart. Placards displayed on motor vehicles, transport containers, or portable tanks may be used to satisfy this requirement, if the placards otherwise conform to the provisions of this subpart.

(b) No rail carrier may accept a rail car containing a hazardous material for transportation unless the placards for the hazardous material are affixed thereto as required by this subpart.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-123, 55 FR 52601, Dec. 21, 1990]

§172.510 Special placarding provisions: Rail.

(a) *White square background. The following must have the specified placards placed on a white square background, as described in §172.527:*

(1) Division 1.1 and 1.2 (explosive) materials which require EXPLOSIVES 1.1 or EXPLOSIVES 1.2 placards affixed to the rail car;

(2) Materials classed in Division 2.3 Hazard Zone A or 6.1 Packing Group I Hazard Zone A which require POISON GAS or POISON placards affixed to the rail car, including tank cars containing only a residue of the material; and

(3) Class DOT 113 tank cars used to transport a Division 2.1 (flammable gas) material, including tank cars containing only a residue of the material.

(b) *Chemical ammunition. Each rail car containing Division 1.1 or 1.2 (explosive) ammunition which also meets the definition of a material poisonous by inhalation (see*

§171.8 of this subchapter) must be placarded EXPLOSIVES 1.1 or EXPLOSIVES 1.2 and POISON GAS or POISON INHALATION HAZARD.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-103, 51 FR 5971, Feb. 18, 1986; Amdt. 172-110, 52 FR 29528, Aug. 10, 1987; Amdt. 172-111, 52 FR 36671, Sept. 30, 1987; Amdt. 172-123, 55 FR 52601, Dec. 21, 1990; 56 FR 66260, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; Amdt. 172-248, 61 FR 28676, June 5, 1996; Amdt. 172-151, 62 FR 1231, Jan. 8, 1997; 62 FR 39398, July 22, 1997]

§172.512 Freight containers and aircraft unit load devices.

(a) *Capacity of 640 cubic feet or more. Each person who offers for transportation, and each person who loads and transports, a hazardous material in a freight container or aircraft unit load device having a capacity of 640 cubic feet or more shall affix to the freight container or aircraft unit load device the placards specified for the material in accordance with §172.504. However:*

(1) The placarding exception provided in §172.504(c) applies to motor vehicles transporting freight containers and aircraft unit load devices,

(2) The placarding exception provided in §172.504(c) applies to each freight container and aircraft unit load device being transported for delivery to a consignee immediately following an air or water shipment, and,

(3) Placarding is not required on a freight container or aircraft unit load device if it is only transported by air and is identified as containing a hazardous material in the manner provided in part 5, chapter 2, section 2.7, of the ICAO Technical Instructions.

(b) *Capacity less than 18 m^3 (640 cubic feet). Each person who offers for transportation by air, and each person who loads and transports by air, a hazardous material in a freight container or aircraft unit load device having a capacity of less than 18 m^3 (640 cubic feet) shall affix one placard of the type specified by paragraph (a) of this section unless the freight container or aircraft unit load device:*

(1) Is labeled in accordance with subpart E of this part, including §172.406(e);

(2) Contains radioactive materials requiring the Radioactive Yellow III label and is placarded with one Radioactive placard and is labeled in accordance with subpart E of this part, including §172.406(e); or,

(3) Is identified as containing a hazardous material in the manner provided in part 5, chapter 2, section 2.7, of the ICAO Technical Instructions.

When hazardous materials are offered for transportation, not involving air transportation, in a freight container having a capacity of less than 640 cubic feet the freight container need not be placarded. However, if not placarded it must be labeled in accordance with subpart E of this part.

(c) Notwithstanding paragraphs (a) and (b) of this section, packages containing hazardous materials, other than ORM-D, offered for transportation by air in freight containers are subject to the inspection requirements of §175.30 of this chapter.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-29A, 41 FR 40680, Sept. 20, 1976; Amdt. 172-87, 48 FR 53712, Nov. 29, 1983; 48 FR 55469, Dec. 13, 1983; Amdt. 172-103, 51 FR 5971, Feb. 18, 1986; Amdt. 172-111, 52 FR 36671, Sept. 30, 1987; Amdt. 172-123, 55 FR 52601, Dec. 21, 1990]

§172.514 Bulk packagings.

(a) Except as provided in paragraph (c) of this section, each person who offers for transportation a bulk packaging which contains a hazardous material, shall affix the placards specified for the material in §§172.504 and 172.505.

(b) Each bulk packaging that is required to be placarded when it contains a hazardous material, must remain placarded when it is emptied, unless it is-

(1) Sufficiently cleaned of residue and purged of vapors to remove any potential hazard; or

(2) Refilled, with a material requiring different placards or no placards, to such an extent that any residue remaining in the packaging is no longer hazardous.

(c) Exceptions. The following packagings may be placarded on only two opposite sides or, alternatively, may be labeled instead of placarded in accordance with subpart E of this part:

(1) A portable tank having a capacity of less than 3,785 L (1000 gallons);

(2) A DOT 106 or 110 multi-unit tank car tank;

(3) A bulk packaging other than a portable tank, cargo tank, or tank car (e.g., a bulk bag or box) with a volumetric capacity of less than 18 m^3 (640 cubic feet); and

(4) An intermediate bulk container.

[Amdt. 172-136, 59 FR 38064, July 26, 1994; Amdt. 172-148, 61 FR 50255, Sept. 25, 1996]

§172.516 Visibility and display of placards.

(a) Each placard on a motor vehicle and each placard on a rail car must be readily visible from the direction it faces except from the direction of another motor vehicle or rail car to which the motor vehicle or rail car is coupled. This requirement may be met by the placards displayed on the freight containers or portable tanks loaded on a motor vehicle or rail car.

(b) The required placarding of the front of a motor vehicle may be on the front of a truck-tractor instead of or in addition to the placarding on the front of the cargo body to which a truck-tractor is attached.

(c) Each placard on a transport vehicle, bulk packaging, freight container or aircraft unit load device must-

(1) Be securely attached or affixed thereto or placed in a holder thereon. (See

appendix C to this part.);

(2) Be located clear of appurtenances and devices such as ladders, pipes, doors, and tarpaulins;

(3) So far as practicable, be located so that dirt or water is not directed to it from the wheels of the transport vehicle;

(4) Be located away from any marking (such as advertising) that could substantially reduce its effectiveness, and in any case at least 3 inches (76.0 mm.) away from such marking;

(5) Have the words or identification number (when authorized) printed on it displayed horizontally, reading from left to right.

(6) Be maintained by the carrier in a condition so that the format, legibility, color, and visibility of the placard will not be substantially reduced due to damage, deterioration, or obscurement by dirt or other matter.

(7) Be affixed to a background of contrasting color, or must have a dotted or solid line outer border which contrasts with the background color.

(d) Recommended specifications for a placard holder are set forth in appendix C of this part. Except for a placard holder similar to that contained in appendix C to this part, the means used to attach a placard may not obscure any part of its surface other than the borders.

(e) A placard or placard holder may be hinged provided the required format, color, and legibility of the placard are maintained.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-101, 45 FR 74668, Nov. 10, 1980; Amdt. 172-123, 55 FR 52601, Dec. 21, 1990]

§172.519 General specifications for placards.

(a) *Strength and durability. Placards must conform to the following:*

(1) A placard may be made of any plastic, metal or other material capable of withstanding, without deterioration or a substantial reduction in effectiveness, a 30-day exposure to open weather conditions.

(2) A placard made of tagboard must be at least equal to that designated commercially as white tagboard. Tagboard must have a weight of at least 80 kg (176 pounds) per ream of 610 by 910 mm (24 by 36-inch) sheets, waterproofing materials included. In addition, each placard made of tagboard must be able to pass a 414 kPa (60 p.s.i.) Mullen test.

(3) Reflective or retroreflective materials may be used on a placard if the prescribed colors, strength and durability are maintained.

(b) *Design. (1) Except as provided in §172.332 of this part, each placard must be as described in this subpart, and except for size and color, the printing, inner border and symbol must be as shown in §§172.521 through 172.560 of this subpart, as appropriate.*

(2) The dotted line border shown on each placard is not part of the placard specification. However, a dotted or solid line outer border may be used when needed to

indicate the full size of a placard that is part of a larger format or is on a background of a non-contrasting color.

(3) For other than Class 7 or the OXYGEN placard, text indicating a hazard (for example, "FLAMMABLE") is not required.

(4) For a placard corresponding to the primary hazard class of a material, the hazard class or division number must be displayed in the lower corner of the placard. However, no hazard class or division number may be displayed on a placard corresponding to a subsidiary hazard of the material.

(c) *Size. (1) Each placard prescribed in this subpart must measure at least 273 mm (10.8 inches) on each side and must have a solid line inner border approximately 12.7 mm (0.5 inches) from each edge.*

(2) Except as otherwise provided in this subpart, the hazard class or division number, as appropriate, must be shown in numerals measuring at least 41 mm (1.6 inches) in height.

(3) Except as otherwise provided in this subpart, when text indicating a hazard is displayed on a placard, the printing must be in letters measuring at least 41 mm (1.6 inches) in height.

(d) *Color. (1) The background color, symbol, text, numerals and inner border on a placard must be as specified in §§172.521 through 172.560 of this subpart, as appropriate.*

(2) Black and any color on a placard must be able to withstand, without substantial change-

(i) A 72-hour fadeometer test (for a description of equipment designed for this purpose, see ASTM G 23-69 or ASTM G 26-70); and

(ii) A 30-day exposure to open weather.

(3) Upon visual examination, a color on a placard must fall within the color tolerances displayed on the appropriate Hazardous Materials Label and Placard Color Tolerance Chart (see §172.407(d) (4)).

(4) The placard color must extend to the inner border and may extend to the edge of the placard in the area designated on each placard except the color on the CORROSIVE and RADIOACTIVE placards (black and yellow, respectively) must extend only to the inner border.

(e) *Form identification. A placard may contain form identification information, including the name of its maker, provided that information is printed outside of the solid line inner border in no larger than 10-point type.*

(f) Exceptions. For a shipment under the provisions of §§171.11, 171.12 or §171.12a of this subchapter, a placard conforming to specifications in the ICAO Technical Instructions, the IMDG Code, or the TDG Regulations, respectively, may be used in place of a corresponding placard which conforms to the requirements of this subpart.

(g) Trefoil symbol. The trefoil symbol on the RADIOACTIVE placard must meet the appropriate specification in appendix B of this part.

[Amdt. 172-123, 55 FR 52601, Dec. 21, 1990, as amended at 56 FR 66260, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; Amdt. 172-143, 60 FR 50305, Sept. 28, 1995]

§172.521 DANGEROUS placard.

(a) Except for size and color, the DANGEROUS placard must be as follows:

(b) In addition to meeting the requirements of §172.519, and appendix B to this part, the DANGEROUS placard must have a red upper and lower triangle. The placard center area and $^{1/2}$-inch (12.7 mm.) border must be white. The inscription must be black with the $^{1/8}$-inch (3.2 mm.) border marker in the white area at each end of the inscription red.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 76, as amended by Amdt. 172-29A, 41 FR 40680, Sept. 20, 1976]

§172.522 EXPLOSIVES 1.1, EXPLOSIVES 1.2 and EXPLOSIVES 1.3 placards.

(a) Except for size and color, the EXPLOSIVES 1.1, EXPLOSIVES 1.2 and EXPLOSIVES 1.3 placards must be as follows:

(b) In addition to complying with §172.519 of this subpart, the background color on the EXPLOSIVES 1.1, EXPLOSIVES 1.2, and EXPLOSIVES 1.3 placards must be orange. The "*" shall be replaced with the appropriate division number and, when required, appropriate compatibility group letter. The symbol, text, numerals and inner border must be black.

[Amdt. 172-123, 55 FR 52602, Dec. 21, 1990, as amended at 56 FR 66260, Dec. 20, 1991]

§172.523 EXPLOSIVES 1.4 placard.

(a) Except for size and color, the EXPLOSIVES 1.4 placard must be as follows:

(b) In addition to complying with §172.519 of this subpart, the background color on the EXPLOSIVES 1.4 placard must be orange. The "*" shall be replaced, when required, with the appropriate compatibility group letter. The division numeral, 1.4, must measure at least 64 mm (2.5 inches) in height. The text, numerals and inner border must be black.

[Amdt. 172-123, 55 FR 52602, Dec. 21, 1990, as amended at 56 FR 66261, Dec. 20, 1991]

§172.524 EXPLOSIVES 1.5 placard.

(a) Except for size and color, the EXPLOSIVES 1.5 placard must be as follows:

(b) In addition to complying with the §172.519 of this subpart, the background color on EXPLOSIVES 1.5 placard must be orange. The "*" shall be replaced, when required, with the appropriate compatibility group letter. The division numeral, 1.5, must measure at least 64 mm (2.5 inches) in height. The text, numerals and inner border must be black.

[Amdt. 172-123, 55 FR 52602, Dec. 21, 1990, as amended at 56 FR 66261, Dec. 20, 1991]

§172.525 EXPLOSIVES 1.6 placard.

(a) Except for size and color the EXPLOSIVES 1.6 placard must be as follows:

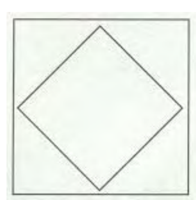
(b) In addition to complying with §172.519 of this subpart, the background color on the EXPLOSIVES 1.6 placard must be orange. The "*" shall be replaced, when required, with the appropriate compatibility group letter. The division numeral, 1.6, must measure at least 64 mm (2.5 inches) in height. The text, numerals and inner border must be black.

[Amdt. 172-123, 55 FR 52603, Dec. 21, 1990, as amended at 56 FR 66261, Dec. 20, 1991; Amdt. 172-130, 58 FR 51531, Oct. 1, 1993]

§172.526 [Reserved]

§172.527 Background requirements for certain placards.

(a) Except for size and color, the square background required by §172.510(a) for certain placards on rail cars, and §172.507 for placards on motor vehicles containing a package of highway route controlled quantity radioactive materials, must be as follows:



(b) In addition to meeting the requirements of §172.519 for minimum durability and strength, the square background must consist of a white square measuring $14^{1/4}$ inches (362.0 mm.) on each side surrounded by a black border extending to $15^{1/4}$ inches (387.0 mm.) on each side.

[Amdt. 172-29, 41 FR 15996, Apr. 15, 1976, as amended by Amdt. 172-64, 46 FR 5316, Jan. 19, 1981; Amdt. 172-78, 48 FR 10226, Mar. 10, 1983]

§172.528 NON-FLAMMABLE GAS placard.

(a) Except for size and color, the NON-FLAMMABLE GAS placard must be as follows:

(b) In addition to complying with §172.519, the background color on the NON-FLAMMABLE GAS placard must be green. The letters in both words must be at least 38 mm (1.5 inches) high. The symbol, text, class number and inner border must be white.

[Amdt. 172-123, 56 FR 66261, Dec. 20, 1991]

§172.530 OXYGEN placard.

(a) Except for size and color, the OXYGEN placard must be as follows:

(b) In addition to complying with §172.519 of this subpart, the background color on the OXYGEN placard must be yellow. The symbol, text, class number and inner border must be black.

[Amdt. 172-123, 56 FR 66262, Dec. 20, 1991]

§172.532 FLAMMABLE GAS placard.

(a) Except for size and color, the FLAMMABLE GAS placard must be as follows:

(b) In addition to complying with §172.519, the background color on the FLAMMABLE GAS placard must be red. The symbol, text, class number and inner border must be white.

[Amdt. 172-123, 56 FR 66262, Dec. 20, 1991]

§172.536 [Reserved]

§172.540 POISON GAS placard.

(a) Except for size and color, the POISON GAS placard must be as follows:

(b) In addition to complying with §172.519, the background on the POISON GAS placard and the symbol must be white. The background of the upper diamond must be black and the lower point of the upper diamond must be 65 mm ($2^{5/8}$ inches) above the horizontal center line. The text, class number, and inner border must be black.

[62 FR 39408, July 22, 1997]

§172.542 FLAMMABLE placard.

(a) Except for size and color, the FLAMMABLE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the FLAMMABLE placard must be red. The symbol, text, class number and inner border must be white.

(c) The word "GASOLINE" may be used in place of the word "FLAMMABLE" on a placard that is displayed on a cargo tank or a portable tank being used to transport gasoline by highway. The word "GASOLINE" must be shown in white.

[Amdt. 172-123, 56 FR 66262, Dec. 20, 1991]

§172.544 COMBUSTIBLE placard.

(a) Except for size and color, the COMBUSTIBLE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the COMBUSTIBLE placard must be red. The symbol, text, class number and inner border must be white. On a COMBUSTIBLE placard with a white bottom as prescribed by §172.332(c)(4), the class number must be red or black.

(c) The words "FUEL OIL" may be used in place of the word "COMBUSTIBLE" on a placard that is displayed on a cargo tank or portable tank being used to transport by highway fuel oil that is not classed as a flammable liquid. The words "FUEL OIL" must be white.

[Amdt. 172-123, 56 FR 66262, Dec. 20, 1991]

§172.546 FLAMMABLE SOLID placard.

(a) Except for size and color, the FLAMMABLE SOLID placard must be as follows:

(b) In addition to complying with §172.519, the background on the FLAMMABLE SOLID placard must be white with seven vertical red stripes. The stripes must be equally spaced, with one red stripe placed in the center of the label. Each red stripe and each white space between two red stripes must be 25 mm (1.0 inches) wide. The letters in the word "SOLID" must be at least 38.1 mm (1.5 inches) high. The symbol, text, class number and inner border must be black.

[Amdt. 172-123, 56 FR 66263, Dec. 20, 1991]

§172.547 SPONTANEOUSLY COMBUSTIBLE placard.

(a) Except for size and color, the SPONTANEOUSLY COMBUSTIBLE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the SPONTANEOUSLY COMBUSTIBLE placard must be red in the lower half and white in upper half. The letters in the word "SPONTANEOUSLY" must be at least 12 mm (0.5 inch) high. The symbol, text, class number and inner border must be black.

[Amdt. 172-123, 56 FR 66263, Dec. 20, 1991, as amended by Amdt. 172-139, 59 FR 67490, Dec. 29, 1994]

§172.548 DANGEROUS WHEN WET placard.

(a) Except for size and color, the DANGEROUS WHEN WET placard must be as follows:

(b) In addition to complying with §172.519, the background color on the DANGEROUS WHEN WET placard must be blue. The letters in the words "WHEN

WET" must be at least 25 mm (1.0 inches) high. The symbol, text, class number and inner border must be white.

[Amdt. 172-123, 56 FR 66263, Dec. 20, 1991]

§172.550 OXIDIZER placard.
(a) Except for size and color, the OXIDIZER placard must be as follows:

(b) In addition to complying with §172.519, the background color on the OXIDIZER placard must be yellow. The symbol, text, division number and inner border must be black.

[Amdt. 172-123, 56 FR 66263, Dec. 20, 1991]

§172.552 ORGANIC PEROXIDE placard.
(a) Except for size and color, the ORGANIC PEROXIDE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the ORGANIC PEROXIDE placard must be yellow. The symbol, text, division number and inner border must be black.

[Amdt. 172-123, 56 FR 66263, Dec. 20, 1991]

§172.553 [Reserved]

§172.554 POISON placard.

(a) Except for size and color, the POISON placard must be as follows:

(b) In addition to complying with §172.519, the background on the POISON placard must be white. The symbol, text, class number and inner border must be black. The word "TOXIC" may be used in lieu of the word "POISON".

[Amdt. 172-123, 56 FR 66264, Dec. 20, 1991, as amended by Amdt. 172-139, 59 FR 67490, Dec. 29, 1994]

§172.555 POISON INHALATION HAZARD placard.

(a) Except for size and color, the POISON INHALATION HAZARD placard must be as follows:

(b) In addition to complying with §172.519, the background on the POISON INHALATION HAZARD placard and the symbol must be white. The background of the upper diamond must be black and the lower point of the upper diamond must be 65 mm ($2^{5/8}$ inches) above the horizontal center line. The text, class number, and inner border must be black.

[62 FR 39409, July 22, 1997]

§172.556 RADIOACTIVE placard.

(a) Except for size and color, the RADIOACTIVE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the RADIOACTIVE placard must be white in the lower portion with a yellow triangle in the upper portion. The base of the yellow triangle must be 29 mm + 5 mm (1.1 inches +0.2 inches) above the placard horizontal center line. The symbol, text, class number and inner border must be black.

[Amdt. 172-123, 56 FR 66264, Dec. 20, 1991; Amdt. 172-130, 58 FR 51531, Oct. 1, 1993]

§172.558 CORROSIVE placard.

(a) Except for size and color, the CORROSIVE placard must be as follows:

(b) In addition to complying with §172.519, the background color on the CORROSIVE placard must be black in the lower portion with a white triangle in the upper portion. The base of the white triangle must be 38 mm + 5 mm (1.5 inches + 0.2 inches) above the placard horizontal center line. The text and class number must be white. The symbol and inner border must be black.

[Amdt. 172-123, 56 FR 66264, Dec. 20, 1991]

§172.560 CLASS 9 placard.

(a) Except for size and color the CLASS 9 (miscellaneous hazardous materials) placard must be as follows:

(b) In addition to conformance with §172.519, the background on the CLASS 9 placard must be white with seven black vertical stripes on the top half extending from the top of the placard to one inch above the horizontal centerline. The black vertical stripes must be spaced so that, visually, they appear equal in width to the six white spaces between them. The space below the vertical lines must be white with the class number 9 underlined and centered at the bottom.

[Amdt. 172-123, 56 FR 66264, Dec. 20, 1991, as amended at 57 FR 45460, Oct. 1, 1992]

[CFR] PART 172 SUBPART G - Emergency Response Information

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART G]

Subpart G - Emergency Response Information

§172.600 Applicability and general requirements.

(a) *Scope. Except as provided in paragraph (d) of this section, this subpart prescribes requirements for providing and maintaining emergency response information during transportation and at facilities where hazardous materials are loaded for transportation, stored incidental to transportation or otherwise handled during any phase of transportation.*

(b) Applicability. This subpart applies to persons who offer for transportation, accept for transportation, transfer or otherwise handle hazardous materials during transportation.

(c) General requirements. No person to whom this subpart applies may offer for transportation, accept for transportation, transfer, store or otherwise handle during transportation a hazardous material unless:

(1) Emergency response information conforming to this subpart is immediately available for use at all times the hazardous material is present; and

(2) Emergency response information, including the emergency response telephone number, required by this subpart is immediately available to any person who, as a

representative of a Federal, State or local government agency, responds to an incident involving a hazardous material, or is conducting an investigation which involves a hazardous material.

(d) *Exceptions. The requirements of this subpart do not apply to hazardous material which is excepted from the shipping paper requirements of this subchapter or a material properly classified as an ORM-D.*

[Amdt. 172-116, 54 FR 27145, June 27, 1989; 54 FR 28750, July 5, 1989, as amended at 55 FR 33712, Aug. 17, 1990; 172-127, 59 FR 49133, Sept. 26, 1994; Amdt. 172-149, 61 FR 27173, May 30, 1996]

§172.602 Emergency response information.

(a) *Information required. For purposes of this subpart, the term "emergency response information" means information that can be used in the mitigation of an incident involving hazardous materials and, as a minimum, must contain the following information:*

(1) The basic description and technical name of the hazardous material as required by §§172.202 and 172.203(k), the ICAO Technical Instructions, the IMDG Code, or the TDG Regulations, as appropriate;

(2) Immediate hazards to health;

(3) Risks of fire or explosion;

(4) Immediate precautions to be taken in the event of an accident or incident;

(5) Immediate methods for handling fires;

(6) Initial methods for handling spills or leaks in the absence of fire; and

(7) Preliminary first aid measures.

(b) *Form of information. The information required for a hazardous material by paragraph (a) of this section must be:*

(1) Printed legibly in English;

(2) Available for use away from the package containing the hazardous material; and

(3) Presented-

(i) On a shipping paper;

(ii) In a document, other than a shipping paper, that includes both the basic description and technical name of the hazardous material as required by §§172.202 and 172.203(k), the ICAO Technical Instructions, the IMDG Code, or the TDG Regulations, as appropriate, and the emergency response information required by this subpart (e.g., a material safety data sheet); or

(iii) Related to the information on a shipping paper, a written notification to pilot-in-command, or a dangerous cargo manifest, in a separate document (e.g., an emergency response guidance document), in a manner that cross-references the description of the hazardous material on the shipping paper with the emergency response information contained in the document. Aboard aircraft, the ICAO "Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods" and, aboard vessels, the IMO

"Emergency Procedures for Ships Carrying Dangerous Goods", or equivalent documents, may be used to satisfy the requirements of this section for a separate document.

(c) *Maintenance of information. Emergency response information shall be maintained as follows:*

(1) Carriers. Each carrier who transports a hazardous material shall maintain the information specified in paragraph (a) of this section and §172.606 of this part in the same manner as prescribed for shipping papers, except that the information must be maintained in the same manner aboard aircraft as the notification of pilot-in-command, and aboard vessels in the same manner as the dangerous cargo manifest. This information must be immediately accessible to train crew personnel, drivers of motor vehicles, flight crew members, and bridge personnel on vessels for use in the event of incidents involving hazardous materials.

(2) Facility operators. Each operator of a facility where a hazardous material is received, stored or handled during transportation, shall maintain the information required by paragraph (a) of this section whenever the hazardous material is present. This information must be in a location that is immediately accessible to facility personnel in the event of an incident involving the hazardous material.

[Amdt. 172-116, 54 FR 27146, June 27, 1989; 54 FR 28750, July 5, 1989, as amended by Amdt. 172-116, 55 FR 875, Jan. 10, 1990; Amdt. 172-151, 62 FR 1234, Jan. 8, 1997]

§172.604 Emergency response telephone number.

(a) A person who offers a hazardous material for transportation must provide a 24-hour emergency response telephone number (including the area code or international access code) for use in the event of an emergency involving the hazardous material. The telephone number must be-

(1) Monitored at all times the hazardous material is in transportation, including storage incidental to transportation;

(2) The number of a person who is either knowledgeable of the hazardous material being shipped and has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information; and

(3) Entered on a shipping paper, as follows:

(i) Immediately following the description of the hazardous material required by subpart C of this part; or

(ii) Entered once on the shipping paper in a clearly visible location. This provision may be used only if the telephone number applies to each hazardous material entered on the shipping paper, and if it is indicated that the telephone number is for emergency response information (for example: "EMERGENCY CONTACT: * * *).

(b) The telephone number required by paragraph (a) of this section must be the number of the person offering the hazardous material for transportation or the number of an agency or organization capable of, and accepting responsibility for, providing the detailed information concerning the hazardous material. A person offering a hazardous material for transportation who lists the telephone number of an agency or organization shall ensure that agency or organization has received current information on the material, as required by paragraph (a)(2) of this section before it is offered for transportation.

(c) The requirements of this section do not apply to-

(1) Hazardous materials that are offered for transportation under the provisions applicable to limited quantities; and

(2) Materials properly described under the shipping names "Engines, internal combustion", "Battery powered equipment", "Battery powered vehicle", Wheelchair, electric", "Carbon dioxide, solid", "Dry ice", "Fish meal, stabilized", "Fish scrap, stabilized", "Castor bean", "Castor meal", "Castor flake", "Castor pomace", or "Refrigerating machine".

[Amdt. 172-116, 54 FR 27145, June 27, 1989, as amended at 55 FR 33713, Aug. 17, 1990; Amdt. 172-127, 59 FR 49133, Sept. 26, 1994; Amdt. 172-149, 61 FR 27173, May 30, 1996]

§172.606 Carrier information contact.

(a) Each carrier who transports or accepts for transportation a hazardous material for which a shipping paper is required shall instruct the operator of a motor vehicle, train, aircraft, or vessel to contact the carrier (e.g., by telephone or mobile radio) in the event of an incident involving the hazardous material.

(b) For transportation by highway, if a transport vehicle, (e.g., a semi-trailer or freight container-on-chassis) contains hazardous material for which a shipping paper is required and the vehicle is separated from its motive power and parked at a location other than a facility operated by the consignor or consignee or a facility (e.g., a carrier's terminal or a marine terminal) subject to the provisions of §172.602(c)(2), the carrier shall-

(1) Mark the transport vehicle with the telephone number of the motor carrier on the front exterior near the brake hose and electrical connections or on a label, tag, or sign attached to the vehicle at the brake hose or electrical connection; or

(2) Have the shipping paper and emergency response information readily available on the transport vehicle.

(c) The requirements specified in paragraph (b) of this section do not apply to an unattended motor vehicle separated from its motive power when the motor vehicle is marked on an orange panel, a placard, or a plain white square-on-point configuration with the identification number of each hazardous material loaded therein, and the marking or placard is visible on the outside of the motor vehicle.

[Amdt. 172-151, 62 FR 1234, Jan. 8, 1997, as amended at 62 FR 39398 and 39409, July 22, 1997; 63 FR 16076, Apr. 1, 1998]

[CFR] PART 172 SUBPART H - Training

[TITLE 49] [SUBTITLE B] [PART 172] [SUBPART H]

Subpart H - Training

Source: Amdt. 172-126, 57 FR 20952, May 15, 1992, unless otherwise noted.

§172.700 Purpose and scope.

(a) *Purpose. This subpart prescribes requirements for training hazmat employees.*
(b) Scope. Training as used in this subpart means a systematic program that ensures a hazmat employee has familiarity with the general provisions of this subchapter, is able to recognize and identify hazardous materials, has knowledge of specific requirements of this subchapter applicable to functions performed by the employee, and has knowledge of emergency response information, self-protection measures and accident prevention methods and procedures (see §172.704).
(c) Modal-specific training requirements. Additional training requirements for the individual modes of transportation are prescribed in parts 174, 175, 176, and 177 of this subchapter.

§172.701 Federal-State relationship.

This subpart and the parts referenced in §172.700(c) prescribe minimum training requirements for the transportation of hazardous materials. For motor vehicle drivers, however, a State may impose more stringent training requirements only if those requirements-
(a) Do not conflict with the training requirements in this subpart and in part 177 of this subchapter; and
(b) Apply only to drivers domiciled in that State.

§172.702 Applicability and responsibility for training and testing.

(a) A hazmat employer shall ensure that each of its hazmat employees is trained in accordance with the requirements prescribed in this subpart.
(b) Except as provided in §172.704(c)(1), a hazmat employee who performs any function subject to the requirements of this subchapter may not perform that function unless instructed in the requirements of this subchapter that apply to that function. It is the duty of each hazmat employer to comply with the applicable requirements of this subchapter and to thoroughly instruct each hazmat employee in relation thereto.
(c) Training may be provided by the hazmat employer or other public or private sources.
(d) A hazmat employer shall ensure that each of its hazmat employees is tested by appropriate means on the training subjects covered in §72.704.

[Amdt. 172-126, 57 FR 20952, May 15, 1992; 57 FR 22182, May 27, 1992, as amended by Amdt. 172-149, 61 FR 27173, May 30, 1996]

§172.704 Training requirements.

(a) Hazmat employee training shall include the following:

(1) *General awareness/familiarization training. Each hazmat employee shall be provided general awareness/familiarization training designed to provide familiarity with the requirements of this subchapter, and to enable the employee to recognize and identify hazardous materials consistent with the hazard communication standards of this subchapter.*

(2) Function-specific training. (i) Each hazmat employee shall be provided function-specific training concerning requirements of this subchapter, or exemptions issued under subchapter A of this chapter, which are specifically applicable to the functions the employee performs.

(ii) As an alternative to function-specific training on the requirements of this subchapter, training relating to the requirements of the ICAO Technical Instructions and the IMDG Code may be provided to the extent such training addresses functions authorized by §§171.11 and 171.12 of this subchapter.

(3) *Safety training. Each hazmat employee shall receive safety training concerning-*

(i) Emergency response information required by subpart G of part 172;

(ii) Measures to protect the employee from the hazards associated with hazardous materials to which they may be exposed in the work place, including specific measures the hazmat employer has implemented to protect employees from exposure; and

(iii) Methods and procedures for avoiding accidents, such as the proper procedures for handling packages containing hazardous materials.

(b) *OSHA or EPA Training. Training conducted by employers to comply with the hazard communication programs required by the Occupational Safety and Health Administration (OSHA) of the Department of Labor (29 CFR 1910.120) or the Environmental Protection Agency (EPA) (40 CFR 311.1), to the extent that training addresses the training specified in paragraph (a) of this section, may be used to satisfy the training requirements in paragraph (a) of this section, in order to avoid unnecessary* *duplication of training.*

(c) Initial and recurrent training-(1) Initial training. A new hazmat employee, or a hazmat employee who changes job functions may perform those functions prior to the completion of training provided-

(i) The employee performs those functions under the direct supervision of a properly trained and knowledgeable hazmat employee; and

(ii) The training is completed within 90 days after employment or a change in job function.

(2) *Recurrent training. A hazmat employee shall receive the training required by this subpart at least once every three years.*

(3) Relevant Training. Relevant training received from a previous employer or other source may be used to satisfy the requirements of this subpart provided a current record of training is obtained from hazmat employees' previous employer.

(4) Compliance. Each hazmat employer is responsible for compliance with the requirements of this subchapter regardless of whether the training required by this subpart has been completed.

(d) Recordkeeping. A record of current training, inclusive of the preceding three years, in accordance with this section shall be created and retained by each hazmat employer for as long as that employee is employed by that employer as a hazmat employee and for 90 days thereafter. The record shall include:

(1) The hazmat employee's name;

(2) The most recent training completion date of the hazmat employee's training;

(3) A description, copy, or the location of the training materials used to meet the requirements in paragraph (a) of this section;

(4) The name and address of the person providing the training; and

(5) Certification that the hazmat employee has been trained and tested, as required by this subpart.

(e) *Limitation. A hazmat employee who repairs, modifies, reconditions, or tests packagings as qualified for use in the transportation of hazardous materials, and who does not perform any other function subject to the requirements of this subchapter, is not subject to the safety training requirement of paragraph (a)(3) of this section.*

[Amdt. 172-126, 57 FR 20952, May 15, 1992, as amended by Amdt. 172-126, 58 FR 5851, Jan. 22, 1993; Amdt. 172-145, 60 FR 49110, Sept. 21, 1995; Amdt. 172-149, 61 FR 27173, May 30, 1996]

Pt. 172, App. A

to Part 172-Office of Hazardous Materials Transportation Color Tolerance Charts and Tables

The following are Munsell notations and Commission Internationale de L'Eclairage (CIE) coordinates which describe the Office of Hazardous Materials Transportation Label and Placard Color Tolerance Charts in tables 1 and 2, and the CIE coordinates for the color tolerances specified in table 3. Central colors and tolerances described in table 2 approximate those described in table 1 while allowing for differences in production methods and materials used to manufacture labels and placards surfaced with printing inks. Primarily, the color charts based on table 1 are for label or placard colors applied as opaque coatings such as paint, enamel or plastic, whereas color charts based on table 2 are intended for use with labels and placards surfaced only with inks.

For labels printed directly on packaging surfaces, table 3 may be used, although compliance with either table 1 or table 2 is sufficient. However, if visual reference indicates that the colors of labels printed directly on package surfaces are outside the table 1 or 2 tolerances, a spectrophotometer or other instrumentation may be required to insure compliance with table 3.

Table 1-Specifications for Color Tolerance Charts for Use With Labels and Placards Surfaced With Paint, Lacquer, Enamel, Plastic, Other Opaque Coatings, or Ink[1]

Color	Munsell notations	CIE data for source C		
-	-	Y	x	y
Red:	-	-	-	-
Central color	7.5R 4.0/14	12.00	.5959	3269
Orange	8.5R 4.0/14	12.00	.6037	3389
Purple and vivid	6.5R 4.0/14	12.00	.5869	.3184
Grayish	7.5R 4.0/12	12.00	.5603	.3321
Vivid	7.5R 4.0/16	12.00	.6260	.3192
Light	7.5R 4.5/14	15.57	.5775	.3320
Dark	7. 5R 3.5/14	09.00	.6226	.3141
Orange:	-	-	-	-
Central color	5.OYR 6.0/15	30.05	.5510	.4214
Yellow and Grayish	6.25YR 6.0/15	30.05	.5452	.4329
Red and vivid	3.75YR 6.0/15	30.05	.5552	.4091
Grayish	5.OYR 6.0/13	30.05	.5311	.4154
Vivid	5.OYR 6.0/16	30.05	.5597	.4239
Light	5.OYR 6.5/15	36.20	.5427	.4206
Dark	5.OYR 5.5/15	24.58	.5606	.4218
Yellow:	-	-	-	-
Central color	5.OY 8.0/12	59.10	.4562	.4788
Green	6.5Y 8.0/12	59.10	.4498	.4865
Orange and vivid	3.5Y 8.0/12	59.10	.4632	.4669
Grayish	5.OY 8.0/10	59.10	.4376	.4601
Vivid	5.OY 8.0/14	59.10	.4699	.4920
Light	5.OY 8.5/12	68.40	.4508	.4754
Dark	5.OY 7.5/12	50.68	.4620	.4823
Green:	-	-	-	-
Central color	7.5G 4.0/9	12.00	.2111	.4121
Bluish	0.5BG 4.0/9	12.00	.1974	.3809
Green-yellow	5.0G 4.0/9	12.00	2237	.4399
Grayish A	7.5G 4.0/7	12.00	.2350	.3922
Grayish B[2]	7.5G 4.0/6	12.00	.2467	.3822
Vivid	7.5G 4.0/11	12.00	.1848	.4319
Light	7.5G 4.5/9	15.57	.2204	.4060
Dark	7.5G 3.5/9	09.00	.2027	.4163
Blue:	-	-	-	-
Central color	2.5PB 3.5/10	09.00	.1691	.1744

Purple	4.5PB 3.5/10	09.00	.1796	.1711
Green and vivid	10.0B 3.5/10	09.00	.1557	.1815
Grayish	2.5PB 3.5/8	09.00	.1888	.1964
Vivid	2.5PB 3.5/12	09.00	.1516	.1547
Light	2.5PB 4.0/10	12.00	.1805	.1888
Dark	2.5PB 3.0/10	06.55	.1576	.1600
Purple:	-	-	-	-
Central color	10.0P 4.5/10	15.57	.3307	.2245
Reddish purple	2.5RP 4.5/10	15.57	.3584	.2377
Blue purple	7.5P 4.5/10	15.57	.3068	.2145
Reddish gray	10.0P 4.5/8	15.57	.3280	.2391
Gray[2]	10.0P 4.5/6.5	15.57	.3254	.2519
Vivid	10.0P 4.5/12	15.57	.3333	.2101
Light	10.0P 5.0/10	19.77	.3308	.2328
Dark	10.0P 4.0/10	12.00	.3306	.2162

[1]Maximum chroma is not limited.

[2]For the colors green and purple, the minimum saturation (chroma) limits for porcelain enamel on metal are lower than for most other surface coatings. Therefore, the minimum chroma limits of these two colors as displayed on the Charts for comparison to porcelain enamel on metal is low, as shown for green (grayish B) and purple (gray).

NOTE: CIE=Commission Internationale de L'Eclairage.

Table 2-Specifications for Color Tolerance Charts for Use With Labels and Placards Surfaced With Ink

Color/series	Munsell notation	CIE data for source C		
-	-	Y	x	y
Red:	-	-	-	-
Central series:	-	-	-	-
Central color	6.8R 4.47/12.8	15.34	.5510	.3286
Grayish	7.2R 4.72/12.2	17.37	.5368	.3348
Purple	6.4R 4.49/12.7	15.52	.5442	.3258
Purple and vivid	6.1R 4.33/13.1	14.25	.5529	.3209
Vivid	6.7R 4.29/13.2	13.99	.5617	.3253
Orange	7.3R 4.47/12.8	15.34	.5572	.3331
Orange and grayish	7.65R 4.70/12.4	17.20	.5438	.3382
Light series:	-	-	-	-
Light	7.0R 4.72/13.2	17.32	.5511	.3322
Light and orange	7.4R 4.96/12.6	19.38	.5365	.3382
Light and purple	6.6R 4.79/12.9	17.94	.5397	.3289
Dark series:	-	-	-	-
Dark A	6.7R 4.19/12.5	13.30	.5566	.3265
Dark B	7.0R 4.25/12.35	13.72	.5522	.3294
Dark and purple	7.5R 4.23/12.4	13.58	.5577	.3329
Orange:	-	-	-	-
Central series:	-	-	-	-
Central color	5.0YR 6.10/12.15	31.27	.5193	.4117

Yellow and grayish A	5.8YR 6.22/11.7	32.69	.5114	.4155
Yellow and grayish B	6.1YR 6.26/11.85	33.20	.5109	.4190
Vivid	5.1YR 6.07/12.3	30.86	.5226	.4134
Red and vivid A	3.9YR 5.87/12.75	28.53	.5318	.4038
Red and vivid B	3.6YR 5.91/12.6	29.05	.5291	.4021
Grayish	4.9YR 6.10/11.9	31.22	.5170	.4089
Light series:	-	-	-	-
Light and vivid A	5.8YR 6.78/12.7	39.94	.5120	.4177
Light and yellow	6.0YR 6.80/12.8	40.20	.5135	.4198
Light and vivid B	4.9YR 6.60/12.9	37.47	.5216	.4126
Dark series:	-	-	-	-
Dark and yellow	5.8YR 5.98/11.0	29.87	.5052	.4132
Dark A	5.1YR 5.80/11.1	27.80	.5127	.4094
Dark B	5.0YR 5.80/11.0	27.67	.5109	.4068
Yellow:	-	-	-	-
Central series:	-	-	-	-
Central color	4.3Y 7.87/10.3	56.81	.4445	.4589
Vivid A	4.5Y 7.82/10.8	55.92	.4503	.4658
Vivid B	3.3Y 7.72/11.35	54.24	.4612	.4624
Vivid and orange	3.2Y 7.72/10.8	54.25	.4576	.4572
Grayish A	4.1Y 7.95/9.7	58.18	.4380	.4516
Grayish B	5.1Y 8.06/9.05	60.12	.4272	.4508
Green-yellow	5.2Y 7.97/9.9	58.53	.4356	.4605
Light series:	-	-	-	-
Light	5.4Y 8.59/10.5	70.19	.4351	.4628
Light and green-yellow	5.4Y 8.56/11.2	69.59	.4414	.4692
Light and vivid	4.4Y 8.45/11.4	67.42	.4490	.4662
Dark series:	-	-	-	-
Dark and green-yellow	4.4Y 7.57/9.7	51.82	.4423	.4562
Dark and orange A	3.4Y 7.39/10.4	48.86	.4584	.4590
Dark and orange B	3.5Y 7.41/10.0	49.20	.4517	.4544
Green:	-	-	-	-
Central series:	-	-	-	-
Central color	9.75G 4.26/7.75	13.80	.2214	.3791
Grayish	10G 4.46/7.5	15.25	.2263	.3742
Blue A	1.4BG 4.20/7.4	13.36	.2151	.3625
Blue B	1.0BG 4.09/7.75	12.60	.2109	.3685
Vivid	8.4G 4.09/8.05	12.59	.2183	.3954
Vivid green-yellow	7.0G 4.23/8.0	13.54	.2292	.4045
Green-yellow	7.85G 4.46/7.7	15.23	.2313	.3914
Light series:	-	-	-	-
Light and vivid	9.5G 4.45/8.8	15.21	.2141	.3863
Light and blue	0.2BG 4.31/8.8	14.12	.2069	.3814
Light and green-yellow	8.3G 4.29/9.05	14.01	.2119	.4006
Dark series:	-	-	-	-
Dark and green-yellow	7.1G 4.08/7.1	12.55	.2354	.3972
Dark and grayish	9.5G 4.11/6.9	12.70	.2282	.3764
Dark	8.5G 3.97/7.2	11.78	.2269	.3874
Blue:	-	-	-	-
Central series:	-	-	-	-
Central color	3.5PB 3.94/9.7	11.58	.1885	.1911
Green and grayish A	2.0PB 4.35/8.7	14.41	.1962	.2099
Green and grayish B	1.7PB 4.22/9.0	13.50	.1898	.2053
Vivid	2.9PB 3.81/9.7	10.78	.1814	.1852

Purple and vivid A	4.7PB 3.53/10.0	9.15	.1817	.1727
Purple and vivid B	5.0PB 3.71/9.9	10.20	.1888	.1788
Grayish	3.75PB 4.03/9.1	12.17	.1943	.1961
Light series:	-	-	-	-
Light and green A	1.7PB 4.32/9.2	14.22	.1904	.2056
Light and green B	1.5PB 4.11/9.6	12.72	.1815	.1971
Light and vivid	3.2PB 3.95/10.05	11.70	.1831	.1868
Dark series:	-	-	-	-
Dark and grayish	3.9PB 4.01/8.7	12.04	.1982	.1992
Dark and purple A	4.8PB 3.67/9.3	9.95	.1918	.1831
Dark and purple B	5.2PB 3.80/9.05	10.76	.1985	.1885
Purple:	-	-	-	-
Central series:	-	-	-	-
Central color	9.5P 4.71/11.3	17.25	.3274	.2165
Red	1.0RP 5.31/10.8	22.70	.3404	.2354
Red and vivid A	1.4RP 5.00/11.9	19.78	.3500	.2274
Red and vivid B	0.2RP 4.39/12.5	14.70	.3365	.2059
Vivid	8.0P 4.04/12.0	12.23	.3098	.1916
Blue	7.0P 4.39/10.8	14.71	.3007	.2037
Grayish	8.8P 5.00/10.3	19.73	.3191	.2251
Light series:	-	-	-	-
Light and red A	0.85RP 5.56/11.1	25.18	.3387	.2356
Light and red B	1.1RP 5.27/12.3	22.27	.3460	.2276
Light and vivid	9.2P 4.94/11.95	19.24	.3247	.2163
Dark series:	-	-	-	-
Dark and grayish	9.6P 4.70/10.9	17.19	.3283	.2204
Dark and vivid	8.4P 4.05/11.6	12.35	.3144	.1970
Dark and blue	7.5P 4.32/10.5	14.19	.3059	.2078

Table 3-Specification for Colors for Use With Labels Printed on Packagings Surfaces

CIE data for source C	Red	Orange	Yellow	Green	Blue	Purple
x	.424	.460	.417	.228	.200	.377
y	.306	.370	.392	.354	.175	.205
x	.571	.543	.490	.310	.255	.377
y	.306	.400	.442	.354	.250	.284
x	.424	.445	.390	.228	.177	.342
y	.350	.395	.430	.403	.194	.205
x	.571	.504	.440	.310	.230	.342
y	.350	.430	.492	.403	.267	.284
-	-	-	-	-	-	-
Y (high)	23.0	41.6	72.6	20.6	15.9	21.2
Y (low)	7.7	19.5	29.1	7.4	6.5	8.2

[Amdt. 172-50, 44 FR 9757, Feb. 15, 1979; Amdt. 172-50, 44 FR 10984, Feb. 26, 1979, as amended by Amdt. 172-50, 44 FR 22467, Apr. 16, 1979; 50 FR 45731, Nov. 1, 1985;

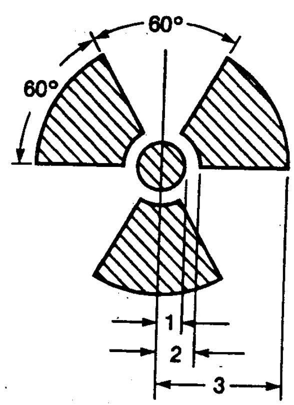
Amdt. 172-127, 59 FR 49133, Sept. 26, 1994]

to Part 172-Trefoil Symbol

SOURCE: 60 FR 50306, SEPT. 28, 1995, UNLESS OTHERWISE NOTED.

1. Except as provided in paragraph 2 of this appendix, the trefoil symbol required for RADIOACTIVE labels and placards and required to be marked on certain packages of Class 7 materials must conform to the design and size requirements of this appendix.

2. RADIOACTIVE labels and placards that were printed prior to April 1, 1996, in conformance with the requirements of this subchapter in effect on March 30, 1996, may continue to be used.



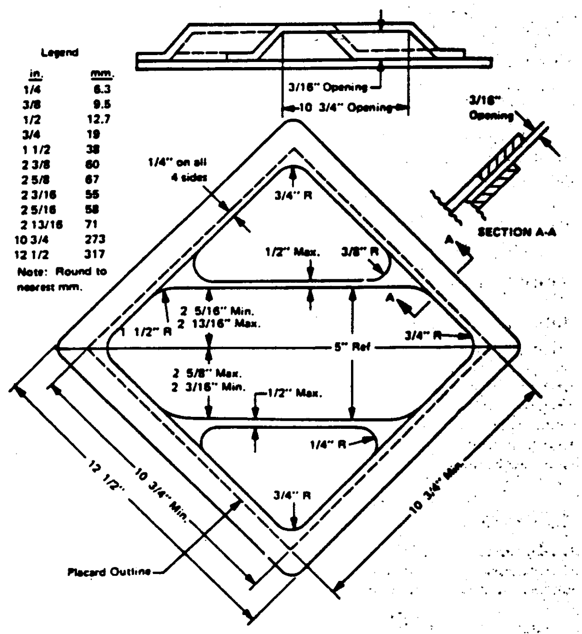
1=Radius of Circle-
Minimum dimensions
4 mm (0.16 inch) for markings and labels
12.5 mm (0.5 inch) for placards

2=$1^{1/2}$ Radii

3=5 radii for markings and labels
$4^{1/2}$ radii for placards.

[60 FR 50306, Sept. 28, 1995, as amended by 172-143, 61 FR 20750, May 8, 1996]

Appendix C to Part 172-Dimensional Specifications for Recommended Placard Holder



[CFR] PART 173 - SHIPPERS-GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS

TABLE OF CONTENTS

[TITLE 49] [SUBTITLE B] [PART 173]

Subpart A-General

Sec.

Subpart B-Preparation of Hazardous Materials for Transportation

Subpart C-Definitions, Classification and Packaging for Class 1

Subpart D-Definitions, Classification, Packing Group Assignments and Exceptions for Hazardous Material Other Than Class 1 and Class 7

Subpart E-Non-bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

Subpart F-Bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

Subpart G-Gases; Preparation and Packaging

173.309 Fire extinguishers.
173.314 Compressed gases in tank cars and multi-unit tank cars.
173.315 Compressed gases in cargo tanks and portable tanks.
173.316 Cryogenic liquids in cylinders.
173.318 Cryogenic liquids in cargo tanks.
173.319 Cryogenic liquids in tank cars.
173.320 Cryogenic liquids; exceptions.
173.321 Ethylamine.
173.322 Ethyl chloride.
173.323 Ethylene oxide.
173.334 Organic phosphates mixed with compressed gas.
173.335 Gas generator assemblies.
173.336 Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied.
173.337 Nitric oxide.
173.338 Tungsten hexafluoride.
173.340 Tear gas devices.

Subpart H [Reserved]

Subpart I-Class 7 (Radioactive) Materials

173.401 Scope.
173.403 Definitions.
173.410 General design requirements.
173.411 Industrial packagings.
173.412 Additional design requirements for Type A packages.
173.413 Requirements for Type B packages.
173.415 Authorized Type A packages.
173.416 Authorized Type B packages.
173.417 Authorized fissile materials packages.
173.418 Authorized packages-pyrophoric Class 7 (radioactive) materials.
173.419 Authorized packages-oxidizing Class 7 (radioactive) materials.
173.420 Uranium hexafluoride (fissile, fissile excepted and non-fissile).
173.421 Excepted packages for limited quantities of Class 7 (radioactive) materials.
173.422 Additional requirements for excepted packages containing Class 7 (radioactive) materials.
173.423 Requirements for multiple hazard limited quantity Class 7 (radioactive) materials.
173.424 Excepted packages for radioactive instruments and articles.
173.425 Table of activity limits-excepted quantities and articles.
173.426 Excepted packages for articles containing natural uranium or thorium.
173.427 Transport requirements for low specific activity (LSA) Class 7 (radioactive) materials and surface contaminated objects (SCO).

Subparts J-O [Reserved]

Authority: 49 U.S.C. 5101-5127, 44701; 49 CFR 1.45, 1.53.

Subpart A - General

§173.1 Purpose and scope.

(a) This part includes:

(1) Definitions of hazardous materials for transportation purposes;

(2) Requirements to be observed in preparing hazardous materials for shipment by air, highway, rail, or water, or any combination thereof; and

(3) Inspection, testing, and retesting responsibilities for persons who retest, recondition, maintain, repair and rebuild containers used or intended for use in the transportation of hazardous materials.

(b) A shipment of hazardous materials that is not prepared in accordance with this subchapter may not be offered for transportation by air, highway, rail, or water. It is the responsibility of each hazmat employer subject to the requirements of this subchapter to ensure that each hazmat employee is trained in accordance with the requirements prescribed in this subchapter. It is the duty of each person who offers hazardous materials for transportation to instruct each of his officers, agents, and employees having any responsibility for preparing hazardous materials for shipment as to applicable regulations in this subchapter.

(c) When a person other than the person preparing a hazardous material for shipment performs a function required by this part, that person shall perform the function in accordance with this part.

(d) In general, the Hazardous Materials Regulations (HMR) contained in this subchapter are based on the UN Recommendations and are consistent with international regulations issued by the International Civil Aviation Organization (ICAO Technical Instructions) and the International Maritime Organization (IMDG Code). However, the HMR are not consistent in all respects with the UN Recommendations, the ICAO Technical Instructions or the IMDG Code, and compliance with the HMR will not guarantee acceptance by regulatory bodies outside of the United States.

[Amdt. 173-94, 41 FR 16062, Apr. 15, 1976, as amended by Amdt. 173-100, 41 FR 40476, Sept. 20, 1976; Amdt. 173-161, 48 FR 2655, Jan. 20, 1983; Amdt. 173-224, 55 FR 52606, Dec. 21, 1990; Amdt. 173-231, 57 FR 20953, May 15, 1992; 64 FR 10776, Mar. 5, 1999]

§173.2 Hazardous materials classes and index to hazard class definitions.

The hazard class of a hazardous material is indicated either by its class (or division) number, its class name, or by the letters "ORM-D". The following table lists class numbers, division numbers, class or division names and those sections of this subchapter which contain definitions for classifying hazardous materials, including forbidden materials.

Class No.	Division No. (if any)	Name of class or division	49 CFR reference for definitions
None	-	Forbidden materials	173.21
None	-	Forbidden explosives	173.54
1	1.1	Explosives (with a mass explosion hazard)	173.50
1	1.2	Explosives (with a projection hazard)	173.50
1	1.3	Explosives (with predominately a fire hazard)	173.50
1	1.4	Explosives (with no significant blast hazard)	173.50
1	1.5	Very insensitive explosives; blasting agents	173.50
1	1.6	Extremely insensitive detonating substances	173.50
2	2.1	Flammable gas	173.115
2	2.2	Non-flammable compressed gas	173.115
2	2.3	Poisonous gas	173.115
3	-	Flammable and combustible liquid	173.120
4	4.1	Flammable solid	173.124
4	4.2	Spontaneously combustible material	173.124
4	4.3	Dangerous when wet material	173.124
5	5.1	Oxidizer	173.127
5	5.2	Organic peroxide	173.128
6	6.1	Poisonous materials	173.132
6	6.2	Infectious substance (Etiologic agent)	173.134
7	-	Radioactive material	173.403
8	-	Corrosive material	173.136
9	-	Miscellaneous hazardous material	173.140
None	-	Other regulated material: ORM-D	173.144

[Amdt. 173-224, 55 FR 52606, Dec. 21, 1990, as amended at 57 FR 45460, Oct. 1, 1992; Amdt. 173-234, 58 FR 51531, Oct. 1, 1993]

§173.2a Classification of a material having more than one hazard.

(a) *Classification of a material having more than one hazard. Except as provided in paragraph (c) of this section, a material not specifically listed in the §172.101 table that meets the definition of more than one hazard class or division as defined in this part,* *shall be classed according to the highest applicable hazard class of the following hazard classes, which are listed in descending order of hazard:*

(1) Class 7 (radioactive materials, other than limited quantities).

(2) Division 2.3 (poisonous gases).

(3) Division 2.1 (flammable gases).

(4) Division 2.2 (nonflammable gases).

(5) Division 6.1 (poisonous liquids), Packing Group I, poisonous-by-inhalation only.

(6) A material that meets the definition of a pyrophoric material in §173.124(b)(1) of this subchapter (Division 4.2).

(7) A material that meets the definition of a self-reactive material in §173.124(a)(2) of this subchapter (Division 4.1).

(8) Class 3 (flammable liquids), Class 8 (corrosive materials), Division 4.1 (flammable solids), Division 4.2 (spontaneously combustible materials), Division 4.3 (dangerous when wet materials), Division 5.1 (oxidizers) or Division 6.1 (poisonous liquids or solids other than Packing Group I, poisonous-by-inhalation). The hazard class and packing group for a material meeting more than one of these hazards shall be determined using the precedence table in paragraph (b) of this section.

(9) Combustible liquids.

(10) Class 9 (miscellaneous hazardous materials).

(b) *Precedence of hazard table for Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1 and 6.1. The following table ranks those materials that meet the definition of Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1 and 6.1:*

Precedence of Hazard Table
[Hazard class and packing group]

	4.2	4.3	5.1 I	5.1 II	5.1 III	6.1, I dermal	6.1, I oral	6.1 II	6.1 III	8, I liquid	8, I solid	8, II liquid	8, II solid	8, III liquid	8, III solid
3 I	-	-	-	-	-	3	3	3	3	3	([3])	3	([3])	3	([3])
3 II	-	-	-	-	-	3	3	3	3	8	([3])	3	([3])	3	([3])
3 III	-	-	-	-	-	6.1	6.1	6.1	3[4]	8	([3])	8	([3])	3	([3])
4.1 II[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	([3])	8	([3])	4.1	([3])	4.1
4.1 III[2]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	([3])	8	([3])	8	([3])	4.1
4.2 II	-	4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	8	8	4.2	4.2	4.2	4.2
4.2 III	-	4.3	5.1	5.1	4.2	6.1	6.1	6.1	4.2	8	8	8	8	4.2	4.2
4.3 I	-	-	5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3 II	-	-	5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	4.3	4.3	4.3	4.3
4.3 III	-	-	5.	5.	4.	6.1	6.1	6.	4.3	8	8	8	8	4.3	4.3

			1	1	3			1							
5.1 I[1]	-	-	-	-	-	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1 II[1]	-	-	-	-	-	6.1	5.1	5.1	5.1	8	8	5.1	5.1	5.1	5.1
5.1 III[1]	-	-	-	-	-	6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1 I, Dermal	-	-	-	-	-	-	-	-	-	8	6.1	6.1	6.1	6.1	6.1
6.1 I, Oral	-	-	-	-	-	-	-	-	-	8	6.1	6.1	6.1	6.1	6.1
6.1 II, Inhalation	-	-	-	-	-	-	-	-	-	8	6.1	6.1	6.1	6.1	6.1
6.1 II, Dermal	-	-	-	-	-	-	-	-	-	8	6.1	8	6.1	6.1	6.1
6.1 II, Oral	-	-	-	-	-	-	-	-	-	8	8	8	6.1	6.1	6.1
6.1 III	-	-	-	-	-	-	-	-	-	8	8	8	8	8	8

[1]There are at present no established criteria for determining Packing Groups for liquids in Division 5.1. For the time being, the degree of hazard is to be assessed by analogy with listed substances, allocating the substances to Packing Group I, great; II, medium; or III, minor danger.

[2]Substances of Division 4.1 other than self-reactive substances.

[3]Denotes an impossible combination.

[4]For pesticides only, where a material has the hazards of Class 3, Packing Group III, and Division 6.1, Packing Group III, the primary hazard is Division 6.1, Packing Group III.

Note 1: The most stringent packing group assigned to a hazard of the material takes precedence over other packing groups; for example, a material meeting Class 3 PG II and Division 6.1 PG I (oral toxicity) is classified as Class 3 PG I.

Note 2: A material which meets the definition of Class 8 and has an inhalation toxicity by dusts and mists which meets criteria for Packing Group I specified in §173.133(a)(1) must be classed as Division 6.1 if the oral or dermal toxicity meets criteria for Packing Group I or II. If the oral or dermal toxicity meets criteria for Packing Group III or less, the material must be classed as Class 8.

(c) The following materials are not subject to the provisions of paragraph (a) of this section because of their unique properties:

(1) A Class 1 (explosive) material that meets any other hazard class or division as defined in this part shall be assigned a division in Class 1. Class 1 materials shall be classed and approved in accordance with §173.56 of this part;

(2) A Division 5.2 (organic peroxide) material that meets the definition of any other hazard class or division as defined in this part, shall be classed as Division 5.2;

(3) A Division 6.2 (infectious substance) material that also meets the definition of another hazard class or division, other than Class 7, or that also is a limited quantity Class 7 material, shall be classed as Division 6.2;

(4) A material that meets the definition of a wetted explosive in §173.124(a)(1) of this subchapter (Division 4.1). Wetted explosives are either specifically listed in the §172.101 table or are approved by the Associate Administrator for Hazardous Materials

Safety (see §173.124(a)(1) of this subchapter); and

(5) A limited quantity of a Class 7 (radioactive) material that meets the definition for more than one hazard class or division shall be classed in accordance with §173.423.

[Amdt. 173-224, 55 FR 52606, Dec. 21, 1990, as amended at 56 FR 66264, Dec. 20, 1991; Amdt. 173-241, 59 FR 67490, Dec. 29, 1994; Amdt. 173-247, 60 FR 48787, Sept. 20, 1995; Amdt. 173-244, 60 FR 50307, Sept. 28, 1995; 64 FR 10776, Mar. 5, 1999]

§173.3 Packaging and exceptions.

(a) The packaging of hazardous materials for transportation by air, highway, rail, or water must be as specified in this part. Methods of manufacture, packing, and storage of hazardous materials, that affect safety in transportation, must be open to inspection by a duly authorized representative of the initial carrier or of the Department. Methods of manufacture and related functions necessary for completion of a DOT specification or U.N. standard packaging must be open to inspection by a representative of the Department.

(b) The regulations setting forth packaging requirements for a specific material apply to all modes of transportation unless otherwise stated, or unless exceptions from packaging requirements are authorized.

(c) Salvage drums. Packages of hazardous materials that are damaged, defective, or found leaking and hazardous materials that have spilled or leaked may be placed in a metal or plastic removable head salvage drum that is compatible with the lading and shipped for repackaging or disposal under the following conditions:

(1) Except as provided in paragraph (c)(7) of this section, the drum must be a UN 1A2, 1B2, 1N2 or 1H2 tested and marked for Packing Group III or higher performance standards for liquids or solids and a leakproofness test of 20 kPa (3 psi). Alternatively, a drum manufactured and marked prior to October 1, 1993 as a salvage drum, in accordance with the provisions of this section in effect on September 30, 1991, is authorized. Capacity of the drum may not exceed 450 L (119 gallons).

(2) Each drum shall be provided when necessary with sufficient cushioning and absorption material to prevent excessive movement of the damaged package and to eliminate the presence of any free liquid at the time the salvage drum is closed. All cushioning and absorbent material used in the drum must be compatible with the hazardous material.

(3) Each salvage packaging must be marked with the proper shipping name of the hazardous material inside the packaging and the name and address of the consignee. In addition, the packaging must be marked "SALVAGE" or "SALVAGE DRUM".

(4) Each drum shall be labeled as prescribed for the respective material.

(5) The shipper shall prepare shipping papers in accordance with subpart C of part 172 of this subchapter.

(6) The overpack requirements of §173.25 do not apply to drums used in accordance with this paragraph.

(7) A salvage packaging marked "T" in accordance with applicable provisions in the UN Recommendations may be used.

[Amdt. 173-224, 55 FR 52607, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-234, 58 FR 51531, Oct. 1, 1993; Amdt. 173-261, 62 FR 24719, May 6, 1997]

§173.4 Small quantity exceptions.

(a) Small quantities of Class 3, Division 4.1, Division 4.2 (PG II and III), Division 4.3 (PG II and III), Division 5.1, Division 5.2, Division 6.1, Class 7, Class 8, and Class 9 materials that also meet the definition of one or more of these hazard classes, are not subject to any other requirements of this subchapter when-

(1) The maximum quantity of material per inner receptacle is limited to:

(i) Thirty (30) ml (1 ounce) for authorized liquids, other than Division 6.1, Packing Group I, materials;

(ii) Thirty (30) g (1 ounce) for authorized solids, other than Division 6.1, Packing Group I, materials;

(iii) One (1) g (0.04 ounce) for authorized materials classed as Division 6.1, Packing Group I; and

(iv) An activity level not exceeding that specified in §§173.421, 173.424, 173.425 or 173.426, as appropriate, for a package containing a Class 7 (radioactive) material.

(2) With the exception of temperature sensing devices, each inner receptacle:

(i) Is not liquid-full at 55 ^{o}C (131 ^{o}F), and

(ii) Is constructed of plastic having a minimum thickness of no less than 0.2 mm (0.008 inch), or earthenware, glass, or metal;

(3) Each inner receptacle with a removable closure has its closure held securely in place with wire, tape, or other positive means;

(4) Unless equivalent cushioning and absorbent material surrounds the inside packaging, each inner receptacle is securely packed in an inside packaging with cushioning and absorbent material that:

(i) Will not react chemically with the material, and

(ii) Is capable of absorbing the entire contents (if a liquid) of the receptacle;

(5) The inside packaging is securely packed in a strong outside packaging;

(6) The completed package, as demonstrated by prototype testing, is capable of sustaining-

(i) Each of the following free drops made from a height of 1.8 m (5.9 feet) directly onto a solid unyielding surface without breakage or leakage from any inner receptacle and without a substantial reduction in the effectiveness of the package:

(A) One drop flat on bottom;

(B) One drop flat on top;

(C) One drop flat on the long side;

(D) One drop flat on the short side; and

(E) One drop on a corner at the junction of three intersecting edges; and
(ii) A compressive load as specified in §178.606(c) of this subchapter.
(7) Placement of the material in the package or packing different materials in the package does not result in a violation of §173.21;
(8) The gross mass of the completed package does not exceed 29 kg (64 pounds);
(9) The package is not opened or otherwise altered until it is no longer in commerce; and
(10) The shipper certifies conformance with this section by marking the outside of the package with the statement "This package conforms to 49 CFR 173.4" or, alternatively, until October 1, 2001, with the statement "This package conforms to the conditions and limitations specified in 49 CFR 173.4."
(b) A package containing a Class 7 (radioactive) material also must conform to the requirements of §173.421(a)(1) through (a)(5) or §173.424(a) through (g), as appropriate.
(c) Packages which contain a Class 2, Division 4.2 (PG I), or Division 4.3 (PG I) material conforming to paragraphs (a)(1) through (a)(10) of this section may be offered for transportation or transported if specifically approved by the Associate Administrator for Hazardous Materials Safety.

[Amdt. 173-224, 55 FR 52608, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-234, 58 FR 51531, Oct. 1, 1993; Amdt. 173-244, 60 FR 50307, Sept. 28, 1995; Amdt. 173-253, 61 FR 27173, May 30, 1996]

§173.5 Agricultural operations.
(a) The transportation of an agricultural product other than a Class 2 material, over local roads between fields of the same farm, is excepted from the requirements of this subchapter when:
(1) It is transported by a farmer who is an intrastate private motor carrier; and
(2) The movement of the agricultural product conforms to requirements of the State in which it is transported and is specifically authorized by a State statute or regulation in effect before October 1, 1998.
(b) The transportation of an agricultural product to or from a farm, within 150 miles of the farm, is excepted from the requirements in subparts G and H of part 172 of this subchapter and from the specific packaging requirements of this subchapter when:
(1) It is transported by a farmer who is an intrastate private motor carrier;
(2) The total amount of agricultural product being transported on a single vehicle does not exceed:
(i) 7,300 kg (16,094 lbs.) of ammonium nitrate fertilizer properly classed as Division 5.1, PG III, in a bulk packaging, or
(ii) 1900 L (502 gallons) for liquids or gases, or 2,300 kg (5,070 lbs.) for solids, of any other agricultural product;
(3) The movement and packaging of the agricultural product conform to the

requirements of the State in which it is transported and are specifically authorized by a State statute or regulation in effect before October 1, 1998; and

(4) Each person having any responsibility for transporting the agricultural product or preparing the agricultural product for shipment has been instructed in the applicable requirements of this subchapter.

(c) Formulated liquid agricultural products in specification packagings of 220 L (58 gallons) capacity, or less, with closures manifolded to a closed mixing system and equipped with positive dry disconnect devices may be transported by a private motor carrier between a final distribution point and an ultimate point of application or for loading aboard an airplane for aerial application.

(d) See §173.315(m) pertaining to nurse tanks of anhydrous ammonia.

(e) See §173.6 pertaining to materials of trade.

[Amdt. 173-259, 62 FR 1215, Jan. 8, 1997, as amended by Amdt. 173-262, 62 FR 49566, Sept. 22, 1997; Amdt. 173-259, 63 FR 8142, Feb. 18, 1998]

§173.5a Oilfield service vehicles.

Notwithstanding §173.29 of this subchapter, a cargo tank mounted on a transport vehicle used in oilfield servicing operations is not subject to the specification requirements of this subchapter if-

(a) The cargo tank and equipment contains only residual amounts (i.e., it is emptied so far as practicable) of a flammable liquid alone or in combination with water,

(b) No flame producing device is operated during transportation, and

(c) The proper shipping name is preceded by "Residual" on the shipping paper for each movement on a public highway.

[Amdt. 173-196, 51 FR 5971, Feb. 18, 1986]

§173.6 Materials of trade exceptions.

When transported by motor vehicle in conformance with this section, a material of trade (see §171.8 of this subchapter) is not subject to any other requirements of this subchapter besides those set forth or referenced in this section.

(a) *Materials and amounts. A material of trade is limited to the following:*

(1) A Class 3, 8, 9, Division 4.1, 5.1, 5.2, 6.1, or ORM-D material contained in a packaging having a gross mass or capacity not over-

(i) 0.5 kg (1 pound) or 0.5 L (1 pint) for a Packing Group I material;

(ii) 30 kg (66 pounds) or 30 L (8 gallons) for a Packing Group II, Packing Group III, or ORM-D material;

(iii) 1500 L (400 gallons) for a diluted mixture, not to exceed 2 percent concentration, of a Class 9 material.

(2) A Division 2.1 or 2.2 material in a cylinder with a gross weight not over 100 kg (220 pounds), or a permanently mounted tank manufactured to ASME standards of not more than 70 gallon water capacity for a non-liquefied Division 2.2 material with no subsidiary hazard.

(3) A Division 4.3 material in Packing Group II or III contained in a packaging having a gross capacity not exceeding 30 ml (1 ounce).

(4) This section does not apply to a hazardous material that is self-reactive (see §173.124), poisonous by inhalation (see §173.133), or a hazardous waste.

(b) *Packaging. (1) Packagings must be leak tight for liquids and gases, sift proof for solids, and be securely closed, secured against movement, and protected against damage.*

(2) Each material must be packaged in the manufacturer's original packaging, or a packaging of equal or greater strength and integrity.

(3) Outer packagings are not required for receptacles (e.g., cans and bottles) that are secured against movement in cages, carts, bins, boxes or compartments.

(4) For gasoline, a packaging must be made of metal or plastic and conform to the requirements of this subchapter or to the requirements of the Occupational Safety and Health Administration of the Department of Labor contained in 29 CFR 1910.106(d)(2) or 1926.152(a)(1).

(5) A cylinder or other pressure vessel containing a Division 2.1 or 2.2 material must conform to packaging, qualification, maintenance, and use requirements of this subchapter, except that outer packagings are not required. Manifolding of cylinders is authorized provided all valves are tightly closed.

(c) *Hazard communication. (1) A non-bulk packaging other than a cylinder (including a receptacle transported without an outer packaging) must be marked with a common name or proper shipping name to identify the material it contains, including the letters "RQ" if it contains a reportable quantity of a hazardous substance.*

(2) A bulk packaging containing a diluted mixture of a Class 9 material must be marked on two opposing sides with the four-digit identification number of the material. The identification number must be displayed on placards, orange panels or, alternatively, a white square-on-point configuration having the same outside dimensions as a placard (at least 273 mm (10.8 inches) on a side), in the manner specified in §172.332 (b) and (c) of this subchapter.

(3) A DOT specification cylinder (except DOT specification 39) must be marked and labeled as prescribed in this subchapter. Each DOT-39 cylinder must display the markings specified in 178.65(i).

(4) The operator of a motor vehicle that contains a material of trade must be informed of the presence of the hazardous material (including whether the package contains a reportable quantity) and must be informed of the requirements of this section.

(d) *Aggregate gross weight. Except for a material of trade authorized by paragraph (a)(1)(iii) of this section, the aggregate gross weight of all materials of trade on a motor vehicle may not exceed 200 kg (440 pounds).*

(e) Other exceptions. A material of trade may be transported on a motor vehicle under the provisions of this section with other hazardous materials without affecting its eligibility for exceptions provided by this section.

[Amdt. 173-259, 62 FR 1216, Jan. 8, 1997, as amended by Amdt. 173-262, 62 FR 49566, Sept. 22, 1997; 62 FR 51560, Oct. 1, 1997; Amdt. 173-259, 63 FR 8142, Feb. 18, 1998; 63 FR 52849, Oct. 1, 1998]

§173.7 U.S. Government material.

(a) Hazardous materials offered for transportation by, for, or to the Department of Defense (DOD) of the U.S. Government, including commercial shipments pursuant to a DOD contract, must be packaged in accordance with the regulations in this subchapter or in packagings of equal or greater strength and efficiency as certified by DOD in accordance with the procedures prescribed by "Performance Oriented Packaging of Hazardous Material, DLAR 4145.41/AR 700-143/AFR 71-5/NAVSUPINST 4030.55/MCO 4030.40." Hazardous materials offered for transportation by DOD under this provision may be reshipped by any shipper to any consignee provided the original packaging has not been damaged or altered in any manner.

(1) Hazardous materials sold by the DOD in packagings that are not marked in accordance with the requirements of this subchapter may be shipped from DOD installations if the DOD certifies in writing that the packagings are equal to or greater in strength and efficiency than the packaging prescribed in this subchapter. The shipper shall obtain such a certification in duplicate for each shipment. He shall give one copy to the originating carrier and retain the other for no less than 1 year.

(2) [Reserved]

(b) Shipments of hazardous materials, made by or under the direction or supervision of the U.S. Department of Energy (DOE) or the Department of Defense (DOD), for the purpose of national security, and which are escorted by personnel specifically designated by or under the authority of those agencies, are not subject to the requirements of this subchapter. For transportation by a motor vehicle or a rail car, the escorts must be in a separate transport vehicle from the transport vehicle carrying the hazardous materials that are excepted by this paragraph. A document certifying that the shipment is for the purpose of national security must be in the possession of the person in charge of providing security during transportation.

(c) Shipments of explosive samples, not exceeding one gram net weight, offered by and consigned to the Bureau of Alcohol, Tobacco and Firearms (ATF) of the Department of the Treasury are not otherwise subject to the regulations in parts 110-189 of this subchapter when placed in a specifically designed multi-unit assembly packed in a strong outside packaging. The packaging must be of a type accepted by ATF as capable of precluding a propagation of any explosion outside the packaging. The second component from the outside of the packaging must be marked or tagged to indicate the presence of an explosive.

(d) Notwithstanding the requirements of §§173.416 and 173.417 of this subchapter, packagings made by or under the direction of the U.S. Department of Energy may be used for the transportation of Class 7 materials when evaluated, approved, and certified by the Department of Energy against packaging standards equivalent to those specified in 10 CFR part 71. Packages shipped in accordance with this paragraph shall be marked and otherwise prepared for shipment in a manner equivalent to that required by this subchapter for packagings approved by the Nuclear Regulatory Commission.

[29 FR 18671, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.7, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.8 Exceptions for non-specification packagings used in intrastate transportation.

(a) *Non-specification bulk packagings. Notwithstanding requirements for specification packagings in subpart F of this part and parts 178 and 180 of this subchapter, a non-specification bulk packaging may be used for transportation of a hazardous material by an intrastate motor carrier until July 1, 2000, in accordance with the provisions of paragraph (d) of this section.*

(b) Non-specification cargo tanks for petroleum products. Notwithstanding requirements for specification packagings in subpart F of this part and parts 178 and 180 of this subchapter, a non-specification cargo tank motor vehicle having a capacity of less than 13,250 liters (3,500 gallons) may be used by an intrastate motor carrier for transportation of a flammable liquid petroleum product in accordance with the provisions of paragraph (d) of this section.

(c) Permanently secured non-bulk tanks for petroleum products. Notwithstanding requirements for specification packagings in subpart F of this part 173 and parts 178 and 180 of this subchapter, a non-specification metal tank permanently secured to a transport vehicle and protected against leakage or damage in the event of a turnover, having a capacity of less than 450 liters (119 gallons), may be used by an intrastate motor carrier for transportation of a flammable liquid petroleum product in accordance with the provisions of paragraph (d) of this section.

(d) Additional requirements. A packaging used under the provisions of paragraphs (a), (b) or (c) of this section must-

(1) Be operated by an intrastate motor carrier and in use as a packaging for hazardous material before October 1, 1998;

(2) Be operated in conformance with the requirements of the State in which it is authorized;

(3) Be specifically authorized by a State statute or regulation in effect before October 1, 1998, for use as a packaging for the hazardous material being transported;

(4) Be offered for transportation and transported in conformance with all other applicable requirements of this subchapter;

(5) Not be used to transport a flammable cryogenic liquid, hazardous substance, hazardous waste, or a marine pollutant (except for gasoline); and
(6) On and after July 1, 2000, for a tank authorized under paragraph (b) or (c) of this section, conform to all requirements in part 180 (except for §180.405(g)) of this subchapter in the same manner as required for a DOT specification MC 306 cargo tank motor vehicle.

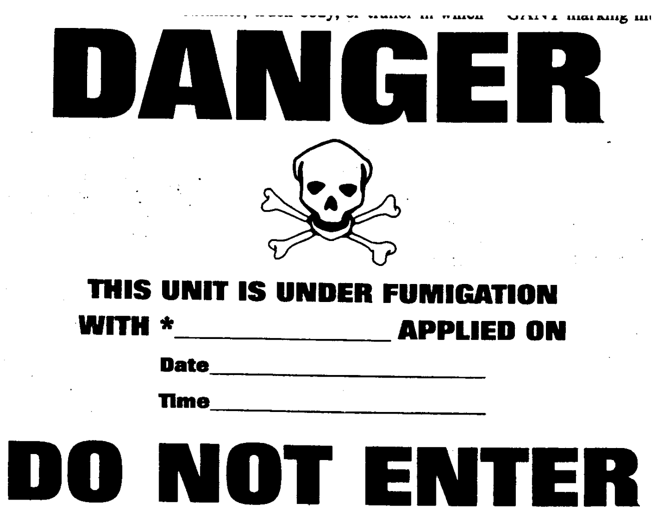
[Amdt. 173-259, 62 FR 1216, Jan. 8, 1997, as amended by Amdt. 172-262, 62 FR 49567, Sept. 22, 1997; Amdt. 173-259, 63 FR 8142, Feb. 18, 1998]

§173.9 Transport vehicles or freight containers containing lading which has been fumigated.

(a) For the purpose of this section, not including 49 CFR part 387, a rail car, freight container, truck body, or trailer in which the lading has been fumigated with any material, or is undergoing fumigation, is a package containing a hazardous material, unless the transport vehicle or freight container has been sufficiently aerated so that it does not pose an unreasonable risk to health and safety.

(b) No person may offer for transportation or transport a rail car, freight container, truck body, or trailer in which the lading has been fumigated or treated with any material, or is undergoing fumigation, unless the FUMIGANT marking specified in paragraph (c) of this section is prominently displayed so that it can be seen by any person attempting to enter the interior of the transport vehicle or freight container. For domestic transportation, a hazard warning label authorized by EPA under 40 CFR part 156 may be used as an alternative to the FUMIGANT marking.

(c) *FUMIGANT marking. (1) The FUMIGANT marking must consist of red letters on a white background that is at least 30 cm (11.8 inches) wide and at least 25 cm (9.8 inches) high. Except for size and color, the FUMIGANT marking must be as follows:*



(2) The "" shall be replaced with the technical name of the fumigant.*
(d) No person may affix or display on a rail car, freight container, truck body, or trailer (a package) the FUMIGANT marking specified in paragraph (c) of this section, unless the lading has been fumigated or is undergoing fumigation.
(e) The FUMIGANT marking required by paragraph (b) of this section must remain on the rail car, freight container, truck body, or trailer until:
(1) The fumigated lading is unloaded; and
(2) The transport vehicle or freight container has undergone sufficient aeration to assure that it does not pose an unreasonable risk to health and safety.
(f) For international shipments, transport documents must indicate the date of fumigation, type and amount of fumigant used, and instructions for disposal of any residual fumigant, including fumigation devices.
(g) Any person subject to the requirements of this section, solely due to the fumigated lading, must be informed of the requirements of this section and the safety precautions necessary to protect themselves and others in the event of an incident or accident involving the fumigated lading.
(h) Any person who offers for transportation or transports a rail car, freight container, truck body or trailer that is subject to this subchapter solely because of the hazardous materials designation specified in paragraph (a) of this section is not subject to any other requirements of this subchapter.

[Amdt. 173-260, 62 FR 1234, Jan. 8, 1997]

§173.10 Tank car shipments.
(a) Tank cars containing any 2.1 material (including a cryogenic liquid) or Class 3 material with a flash point below 38 °C (100 °F), except liquid road asphalt or tar, may not be offered for transportation unless originally consigned or subsequently reconsigned to parties having private-siding (see Note 1 of this section) or to parties using railroad siding facilities which have been equipped for piping the liquid from tank cars to permanent storage tanks of sufficient capacity to receive contents of car.
(b) A tank car containing any Class 2 material must not be offered for transportation unless the car is consigned for delivery (see paragraph (c) of this section) and unloading on a private track (see Note 1 of this section) except that where no private track is available, delivery and unloading on carrier tracks is permitted provided the following conditions are complied with:
(1) Any tank car of DOT-106A or 110A type (see §§179.300 and 179.301 of this subchapter) may be offered for transportation and the loaded unit tanks may be removed from car frame on carrier tracks, provided the shipper has obtained from the

delivering carrier and filed with originating carrier, written permission (see Note 2 of this section) for such removal. The consignee must furnish adequately safe mechanical hoist, obtained from the carrier if desirable, by which the tanks shall be lifted from the car and deposited directly upon vehicles furnished by the consignee for immediate removal from carrier property or tanks must be lifted by adequately safe mechanical hoist from car directly to vessels for further transportation

(c) Any tank car of other than DOT-106A or 110A type (see §§179.300 and 179.301 of this subchapter), containing anhydrous ammonia, liquefied hydrocarbon or liquefied petroleum gas, and having interior pipes of liquid and gas discharge valves equipped with check valves, may be consigned for delivery and unloading on carrier tracks, if the lading is piped directly from the car to permanent storage tanks of sufficient capacity to receive the entire contents of the car. Such cars may also be consigned for storage on a private track or on a carrier track when designated by the carrier for such storage.

(d) For cars of the DOT-106A or 110A type (see §§179.300 and 179.301 of this subchapter), the tanks must be placed in position and attached to the car structure by the shipper.

(e) Class 3 materials with a flash point below 38 ^{o}C (100 ^{o}F) and Division 2.1 materials (including a cryogenic liquid) may not be loaded into tank cars on carrier property from tank trucks or drums.

Note 1: For this purpose, a private track is a track outside of carrier's right-of-way, yard, and terminals, and of which the carrier does not own either the rails, ties, roadbed or right-of-way; or a track or portion of a track which is devoted to the purpose of its user, either by lease or written agreement; in which case the lease or written agreement will be considered as equivalent to ownership.

Note 2: Carriers should give permission for the unloading of these containers on carrier tracks only where no private siding is available within reasonable trucking distance of final destination. The danger involved is the release of compressed gases due to accidental injury to container in handling. The exposure to this danger decreases directly with the isolation of the unloading point.

[29 FR 18773, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and by Amdt. 173-162, 48 FR 10226, Mar. 10, 1983, and amended by Amdt. 173-180, 49 FR 42735, Oct. 24, 1984; Amdt. 173-207, 53 FR 38274, Sept. 29, 1988; Amdt. 173-224, 55 FR 52608, Dec. 21, 1990; 56 FR 66265, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993]

§173.12 Exceptions for shipment of waste materials.

(a) Open head drums. If a hazardous material that is a hazardous waste is required by this subchapter to be shipped in a closed head drum (i.e., a drum with a 7.0 cm (3 inches) or less bung opening) and the hazardous waste contains solids or semisolids that make its placement in a closed head drum impracticable, an equivalent (except for

closure) open head drum may be used for the hazardous waste.

(b) Lab packs. (1) Waste materials classed as Class or Division 3, 4.1, 4.2, 4.3, 5.1, 6.1, 8, or 9 are excepted from the specification packaging requirements of this subchapter for combination packagings if packaged in accordance with this paragraph and transported for disposal or recovery by highway only. In addition, a generic description from the §172.101 table may be used in place of specific chemical names, when two or more chemically compatible waste materials in the same hazard class are packaged in the same outside packaging.

(2) Additional packaging requirements are as follows:

(i) The outer packaging must be a UN 1A2 or UN 1B2 metal drum, a UN 1D plywood drum, a UN 1G fiber drum or a UN 1H2 plastic drum tested and marked at least for the Packing Group III performance level for liquids or solids;

(ii) The inner packagings must be either glass, not exceeding 4 L (1 gallon) rated capacity, or metal or plastic, not exceeding 20 L (5.3 gallons) rated capacity;

(iii) Each outer packaging may contain only one class of hazardous material;

(iv) Inner packagings containing liquid must be surrounded by a chemically compatible absorbent material in sufficient quantity to absorb the total liquid contents; and

(v) Gross weight of the complete package may not exceed 205 kg (452 lbs).

(3) *Prohibited materials. Materials meeting the definition of Division 6.1, Packing Group I, or Division 4.2, Packing Group I, and bromine pentafluoride; bromine trifluoride; chloric acid; and oleum (fuming sulfuric acid) may not be packaged or described under the provisions of this paragraph.*

(c) Reuse of packagings. A previously used packaging may be reused for the shipment of hazardous waste to designated facilities, not subject to the reconditioning and reuse provisions contained in §173.28 and part 178 of this subchapter, under the following conditions:

(1) Except as authorized by this paragraph, the waste must be packaged in accordance with this part and offered for transportation in accordance with the requirements of this subchapter.

(2) Transportation is performed by highway only.

(3) A package is not offered for transportation less than 24 hours after it is finally closed for transportation, and each package is inspected for leakage and is found to be free from leaks immediately prior to being offered for transportation.

(4) Each package is loaded by the shipper and unloaded by the consignee, unless the motor carrier is a private or contract carrier.

(5) The packaging may be used only once under this paragraph and may not be used again for shipment of hazardous materials except in accordance with §173.28.

(d) *Technical names for n.o.s. descriptions. The requirements for the inclusion of technical names for n.o.s. descriptions on shipping papers and package markings, §§172.203 and 172.301 of this subchapter, respectively, do not apply to packagings prepared in accordance with paragraph (b) of this section, except as follows:*

(1) Packages containing materials meeting the definition of a hazardous substance must be described as required in §172.203(c) of this subchapter and marked as

required in §172.324 of this subchapter; and

(2) Packages containing hazardous materials subject to the provisions of §172.203(m) of this subchapter must be described in accordance with §172.203(m) of this subchapter.

[Amdt. 173-224, 55 FR 52609, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-231, 57 FR 52939, Nov. 5, 1992; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994]

§173.13 Exceptions for Class 3, Divisions 4.1, 4.2, 4.3, 5.1, 6.1, and Classes 8 and 9 materials.

(a) A Class 3, 8 or 9, or Division 4.1, 4.2, 4.3, 5.1, or 6.1 material is excepted from the labeling and placarding requirements of this subchapter if prepared for transportation in accordance with the requirements of this section. A material that meets the definition of a material poisonous by inhalation may not be offered for transportation or transported under provisions of this section.

(b) A hazardous material conforming to requirements of this section may be transported by motor vehicle, rail car, or cargo-only aircraft. Only hazardous materials permitted to be transported aboard a cargo-only aircraft by column (9B) of the Hazardous Materials Table in §172.101 of this subchapter are authorized for transport aboard cargo-only aircraft pursuant to the provisions of this section.

(c) A hazardous material permitted by paragraph (a) of this section must be packaged as follows:

(1) For liquids:

(i) The hazardous material must be placed in a tightly closed glass, plastic or metal inner packaging with a maximum capacity not exceeding 1.2 liters. Sufficient outage must be provided such that the inner packaging will not become liquid full at 55 ^{o}C (130 ^{o}F). The net quantity (measured at 20 ^{o}C (68 ^{o}F)) of liquid in any inner packaging may not exceed one liter.

(ii) The inner packaging must be placed in a hermetically-sealed barrier bag which is impervious to the lading, and then wrapped in a non-reactive absorbent material in sufficient quantity to completely absorb the contents of the inner packaging, and placed in a snugly fitting, metal can.

(iii) The metal can must be securely closed. For liquids that are in Division 4.2 or 4.3, the metal can must be hermetically sealed. For Division 4.2 materials in Packing Group I, the metal can must be tested in accordance with part 178 of this subchapter at the Packing Group I performance level.

(iv) The metal can must be placed in a fiberboard box that is placed in a hermetically-sealed barrier bag which is impervious to the lading.

(v) The intermediate packaging must be placed inside a securely closed, outer packaging conforming to §173.201.

(vi) Not more than four intermediate packagings are permitted in an outer packaging.

(2) For solids:

(i) The hazardous material must be placed in a tightly closed glass, plastic or metal inner packaging. The net quantity of material in any inner packaging may not exceed 2.85 kg (6.25 pounds).

(ii) The inner packaging must be placed in a hermetically-sealed barrier bag which is impervious to the lading.

(iii) The barrier bag and its contents must be placed in a fiberboard box that is placed in a hermetically-sealed barrier bag which is impervious to the lading.

(iv) The intermediate packaging must be placed inside an outer packaging conforming to §173.211.

(v) Not more than four intermediate packagings are permitted in an outer packaging.

(d) The outside of the package must be marked, in association with the proper shipping name, with the statement: "This package conforms to 49 CFR 173.13."

[Amdt. 173-253, 61 FR 27173, May 30, 1996]

[CFR] PART 173 SUBPART B - Preparation of Hazardous Materials for Transportation

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART B]

Subpart B - Preparation of Hazardous Materials for Transportation

§173.21 Forbidden materials and packages.

Unless otherwise provided in this subchapter, the offering for transportation or transportation of the following is forbidden:

(a) Materials that are designated "Forbidden" in Column 3 of the §172.101 table.

(b) Forbidden explosives as defined in §173.54 of this part.

(c) Electrical devices which are likely to create sparks or generate a dangerous quantity of heat, unless packaged in a manner which precludes such an occurrence.

(d) For carriage by aircraft, any package which has a magnetic field of more than 0.00525 gauss measured at 4.5 m (15 feet) from any surface of the package.

(e) A material in the same packaging, freight container, or overpack with another material, the mixing of which is likely to cause a dangerous evolution of heat, or flammable or poisonous gases or vapors, or to produce corrosive materials.

(f) A package containing a material which is likely to decompose with a self-accelerated decomposition temperature (SADT) of 50 ^{o}C (122 ^{o}F) or less, or polymerize at a temperature of 54 ^{o}C (130 ^{o}F) or less with an evolution of a dangerous quantity of heat or gas when decomposing or polymerizing, unless the material is stabilized or inhibited in a manner to preclude such evolution. The SADT may be determined by any of the test methods described in Part II of the UN Manual of Tests and Criteria.

(1) A package meeting the criteria of paragraph (f) of this section may be required to be shipped under controlled temperature conditions. The control temperature and emergency temperature for a package shall be as specified in the table in this paragraph based upon the SADT of the material. The control temperature is the temperature above which a package of the material may not be offered for transportation or transported. The emergency temperature is the temperature at which, due to imminent danger, emergency measures must be initiated.

§173.21 Table: Method of Determining Control and Emergency Temperature.

SADT	Control temperatures	Emergency temperature
SADT > 20 ^{o}C (68 ^{o}F)	20 ^{o}C (36 ^{o}F) below SADT	10 ^{o}C (18 ^{o}F) below SADT.
20 ^{o}C (68 ^{o}F) < SADT > 35 ^{o}C (95 ^{o}F)	15 ^{o}C (27 ^{o}F) below SADT	10 ^{o}C (18 ^{o}F) below SADT.
35 ^{o}C (95 ^{o}F) < SADT > 50 ^{o}C (122 ^{o}F)	10 ^{o}C (18 ^{o}F) below SADT	5 ^{o}C (9 ^{o}F) below SADT.
50 ^{o}C (122 ^{o}F) < SADT	([2])	([2])

[1]Self-accelerating decomposition temperature.
[2]Temperature control not required.

(2) For self-reactive materials listed in §173.224(b) table control and emergency temperatures, where required are shown in Columns 5 and 6, respectively. For organic peroxides listed in The Organic Peroxides Table in §173.225 control and emergency temperatures, where required, are shown in Columns 7a and 7b, respectively.

(3) Refrigeration may be used as a means of stabilization only when approved by the Associate Administrator for Hazardous Materials Safety. For status of approvals previously issued by the Bureau of Explosives, see §171.19 of this subchapter. Methods of stabilization approved by the Associate Administrator for Hazardous Materials Safety are as follows:

(i) For highway transportation:

(A) A material meeting the criteria of this paragraph (f) may be transported only in a transport vehicle, freight container, or motor vehicle equipped with a mechanical refrigeration unit, or loaded with a consumable refrigerant, capable of maintaining the inside temperature of the hazardous material at or below the control temperature required for the material during transportation.

(B) Each package containing a material meeting the criteria of this paragraph (f) must be loaded and maintained at or below the control temperature required for the material. The temperature of the material must be determined by appropriate means and entered on a written record at the time the packaging is loaded.

(C) The vehicle operator shall monitor the inside temperature of the transport vehicle, freight container, or motor vehicle and enter that temperature on a written record at the time the package is loaded and thereafter at intervals not exceeding two hours. Alternatively, a transport vehicle, freight container, or motor vehicle may be equipped with a visible or audible warning device that activates when the inside temperature of the transport vehicle, freight container, or motor vehicle exceeds the control temperature required for the material. The warning device must be readily visible or audible, as appropriate, from the vehicle operator's seat in the vehicle.

(D) The carrier shall advise the vehicle operator of the emergency temperature for the material, and provide the vehicle operator with written procedures that must be followed to assure maintenance of the control temperature inside the transport vehicle, freight container, or motor vehicle. The written procedures must include instructions for the vehicle operator on actions to take if the inside temperature exceeds the control temperature and approaches or reaches the emergency temperature for the material. In addition, the written temperature-control procedures must identify enroute points where the consumable refrigerant may be procured, or where repairs to, or replacement of, the mechanical refrigeration unit may be accomplished.

(E) The vehicle operator shall maintain the written temperature-control procedures, and the written record of temperature measurements specified in paragraph (f)(3)(i)(C) of this section, if applicable, in the same manner as specified in §177.817 of this subchapter for shipping papers.

(F) If the control temperature is maintained by use of a consumable refrigerant (e.g., dry ice or liquid nitrogen), the quantity of consumable refrigerant must be sufficient to maintain the control temperature for twice the average transit time under normal conditions of transportation.

(G) A material that has a control temperature of 40 ^{o}C (104 ^{o}F) or higher may be transported by common carrier. A material that has a control temperature below 40 ^{o}C (104 ^{o}F) must be transported by a private or contract carrier.

(ii) For transportation by vessel, shipments are authorized in accordance with the control-temperature requirements of Section 21 of the General Introduction of the International Maritime Dangerous Goods Code (IMDG Code).

(g) Packages which give off a flammable gas or vapor, released from a material not otherwise subject to this subchapter, likely to create a flammable mixture with air in a transport vehicle.

(h) Packages containing materials (other than those classed as explosive) which will detonate in a fire.

(1) For purposes of this paragraph, "detonate" means an explosion in which the shock wave travels through the material at a speed greater than the speed of sound.

(2) When tests are required to evaluate the performance of a package under the provisions of this paragraph, the testing must be done or approved by one of the agencies specified in §173.56.

(i) A package containing a cigarette lighter, or other similar device, equipped with an ignition element and containing fuel; except that a cigarette lighter or similar device subject to this paragraph may be shipped if the design of the device and its inner packaging has been examined by the Bureau of Explosives and specifically approved by the Associate Administrator for Hazardous Materials Safety. The examination of cigarette lighters and similar devices containing gaseous fuel will include scrutiny for compliance with §173.308 of this part. For the status of approvals previously issued by the Bureau of Explosives, see §171.19 of this subchapter.

(j) An organic peroxide of the "ketone peroxide" category which contains more than 9 percent available oxygen as calculated using the equation in §173.128(a)(4)(ii). The category, ketone peroxide, includes, but is not limited to:

Acetyl acetone peroxide
Cyclohexanone peroxide(s)
Diacetone alcohol peroxides
Methylcyclohexanone peroxide(s)
Methyl ethyl ketone peroxide(s)
Methyl isobutyl ketone peroxide(s)

(k) Notwithstanding any other provision of this subchapter, including §§171.11 and 175.10(a)(2) of this subchapter, an oxygen generator (chemical) as cargo on a passenger-carrying aircraft. This prohibition does not apply to an oxygen generator for medical or personal use of a passenger that meets the requirements of §175.10(a)(7) or §175.10(a)(24) of this subchapter.

[Amdt. 173-224, 55 FR 52609, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-241, 59 FR 67490, Dec. 29, 1994; Amdt. 173-254, 61 FR 26419, May 24, 1996; Amdt. 173-253, 61 FR 27174, May 30, 1996; Amdt. 173-254, 61 FR 68954, Dec. 30, 1996; Amdt. 173-261, 62 FR 24719, May 6, 1997]

§173.22 Shipper's responsibility.

(a) Except as otherwise provided in this part, a person may offer a hazardous material for transportation in a packaging or container required by this part only in accordance with the following:

(1) The person shall class and describe the hazardous material in accordance with parts 172 and 173 of this subchapter, and

(2) The person shall determine that the packaging or container is an authorized packaging, including part 173 requirements, and that it has been manufactured, assembled, and marked in accordance with:

(i) Section 173.7(a) and parts 173, 178, or 179 of this subchapter;

(ii) A specification of the Department in effect at the date of manufacture of the packaging or container;

(iii) National or international regulations based on the UN Recommendations on the

Transport of Dangerous Goods, as authorized in §173.24(d)(2);
(iv) An approval issued under this subchapter; or
(v) An exemption issued under subchapter A of this chapter.
(3) In making the determination under paragraph (a)(2) of this section, the person may accept:
(i) Except for the marking on the bottom of a metal or plastic drum with a capacity over 100 liters which has been reconditioned, remanufactured or otherwise converted, the manufacturer's certification, specification, approval, or exemption marking (see §§178.2 and 179.1 of this subchapter); or
(ii) With respect to cargo tanks provided by a carrier, the manufacturer's identification plate or a written certification of specification or exemption provided by the carrier.
(4) For a DOT specification or UN standard packaging subject to the requirements of part 178 of this subchapter, a person shall perform all functions necessary to bring that package into compliance with part 178 of this subchapter, as identified by the packaging manufacturer or subsequent distributor, in accordance with §178.2 of this subchapter.
(b) [Reserved]
(c) Prior to each shipment of fissile radioactive materials, and Type B or highway route controlled quantity packages of radioactive materials (see §173.403), the shipper shall notify the consignee of the dates of shipment and expected arrival. The shipper shall also notify each consignee of any special loading/unloading instructions prior to his first shipment. For any shipment of irradiated reactor fuel, the shipper shall provide physical protection in compliance with a plan established under:
(1) Requirements prescribed by the U.S. Nuclear Regulatory Commission, or
(2) Equivalent requirements approved by the Associate Administrator for Hazardous Materials Safety, RSPA.

[Amdt. 173-100, 42 FR 2689, Jan. 13, 1977]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.22, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.22a Use of packagings authorized under exemptions.

(a) Except as provided in paragraph (b) of this section, no person may offer a hazardous material for transportation in a packaging the use of which is dependent upon an exemption issued under subpart B of part 107 of this title, unless that person is the holder of or a party to the exemption.
(b) If an exemption authorizes the use of a packaging for the shipment or transportation of a hazardous material by any person or class of persons other than or in addition to the holder of the exemption, that person or a member of that class of persons may use the packaging for the purposes authorized in the exemption subject to the terms specified therein. However, no person may use a packaging under the authority of this

paragraph unless he maintains a copy of the exemption at each facility where the packaging is being used in connection with the shipment or transportation of the hazardous material concerned. Copies of exemptions may be obtained from the Associate Administrator for Hazardous Materials Safety, U.S. Department of Transportation, Washington, DC 20590-0001, Attention: Docket Section.
(c) When an exemption issued to a person who offers a hazardous material contains requirements that apply to a carrier of the hazardous material, the offeror shall furnish a copy of the exemption to the carrier before or at the time a shipment is tendered.

[Amdt. 173-93, 41 FR 3478, Jan. 23, 1976, as amended by Amdt. 173-121, 43 FR 48643, Oct. 19, 1978; Amdt. 173-223, 55 FR 39981, Oct. 1, 1990; Amdt. 173-224, 56 FR 66279, Dec. 20, 1991; Amdt. 173-233, 58 FR 33305, June 16, 1993; Amdt. 173.249, 61 FR 21102, May 9, 1996; Amdt.173-249, 61 FR 51242, Oct. 1, 1996]

§173.23 Previously authorized packaging.

(a) When the regulations specify a packaging with a specification marking prefix of "DOT," a packaging marked prior to January 1, 1970, with the prefix of "ICC" may be used in its place if the packaging otherwise conforms to applicable specification requirements.

(b) [Reserved]

(c) After July 2, 1982, a seamless aluminum cylinder manufactured in conformance with and for use under DOT special permit (SP) or exemption (E) 6498, 7042, 8107, 8364 or 8422 may be continued in use if marked before or at the time of the next retest with either the specification identification "3AL" immediately above the special permit or exemption number, or the DOT mark (e.g., DOT 3AL 1800) in proximity to the special permit or exemption marking.

(d) Cylinders (spheres) manufactured and marked under DOT special permit (SP) or exemption (E) 6616 prior to January 1, 1983, may be continued in use if marked before or at the time of the next retest with the specification identification "4BA" near the special permit or exemption marking.

(e) After October 1, 1984, cylinders manufactured for use under special permit (SP) or exemption (E) 6668 or 8404 may be continued in use, and must be marked "DOT-4LXXXYY" (XXX to be replaced by the service pressure, YY to be replaced by the letters "AL", if applicable) in compliance with Specification 4L (§178.57 of this subchapter) on or before January 1, 1986. The "DOT-4LXXXYY" must appear in proximity to other required special permit or exemption markings.

(f) An MC 331 cargo tank motor vehicle must conform to structural integrity requirements in §178.337-3 or to corresponding requirements in effect at the time of manufacture.

(g) A non-bulk packaging manufactured, tested, marked, and certified on or before September 30, 1996, in accordance with the applicable provisions of subparts L and M of part 178 of this subchapter in effect on September 30, 1995, may be used as authorized by this subchapter if the packaging conforms to all requirements applicable at the time of manufacture. In addition, such a packaging may be reused as authorized by §173.28 without a nominal thickness marking, if it conforms to the minimum thickness criteria prescribed in §173.28(b)(4).

[Amdt. 173-3, 33 FR 14921, Oct. 4, 1968]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.23, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.24 General requirements for packagings and packages.
(a) Applicability. Except as otherwise provided in this subchapter, the provisions of this section apply to-
(1) Bulk and non-bulk packagings;
(2) New packagings and packagings which are reused; and
(3) Specification and non-specification packagings.
(b) Each package used for the shipment of hazardous materials under this subchapter shall be designed, constructed, maintained, filled, its contents so limited, and closed, so that under conditions normally incident to transportation-
(1) Except as otherwise provided in this subchapter, there will be no identifiable (without the use of instruments) release of hazardous materials to the environment;
(2) The effectiveness of the package will not be substantially reduced; for example, impact resistance, strength, packaging compatibility, etc. must be maintained for the minimum and maximum temperatures encountered during transportation;
(3) There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging.
(c) Authorized packagings. A packaging is authorized for a hazardous material only if-
(1) The packaging is prescribed or permitted for the hazardous material in a packaging section specified for that material in Column 8 of the §172.101 table and conforms to applicable requirements in the special provisions of Column 7 of the §172.101 table and, for specification packagings (but not including UN standard packagings manufactured outside the United States), the specification requirements in parts 178 and 179 of this subchapter; or
(2) The packaging is permitted under, and conforms to, provisions contained in §§171.11, 171.12, 171.12a, 173.3, 173.4, 173.5, 173.7, 173.27, or 176.11 of this subchapter.
(d) *Specification packagings and UN standard packagings manufactured outside the U.S.-(1) Specification packagings. A specification packaging, including a UN standard packaging manufactured in the United States, must conform in all details to the applicable specification or standard in part 178 or part 179 of this subchapter.*

(2) UN standard packagings manufactured outside the United States. A UN standard packaging manufactured outside the United States, in accordance with national or international regulations based on the UN Recommendations on the Transport of Dangerous Goods, may be imported and used and is considered to be an authorized packaging under the provisions of paragraph (c)(1) of this section, subject to the following conditions and limitations:
(i) The packaging fully conforms to applicable provisions in the UN Recommendations on the Transport of Dangerous Goods and the requirements of this subpart, including reuse provisions;
(ii) The packaging is capable of passing the prescribed tests in part 178 of this subchapter applicable to that standard; and
(iii) The competent authority of the country of manufacture provides reciprocal treatment for UN standard packagings manufactured in the U.S.
(e) Compatibility. (1) Even though certain packagings are specified in this part, it is, nevertheless, the responsibility of the person offering a hazardous material for transportation to ensure that such packagings are compatible with their lading. This particularly applies to corrosivity, permeability, softening, premature aging and embrittlement.
(2) Packaging materials and contents must be such that there will be no significant chemical or galvanic reaction between the materials and contents of the package.
(3) Plastic packagings and receptacles. (i) Plastic used in packagings and receptacles must be of a type compatible with the lading and may not be permeable to an extent that a hazardous condition is likely to occur during transportation, handling or refilling.
(ii) Each plastic packaging or receptacle which is used for liquid hazardous materials must be capable of withstanding without failure the procedure specified in appendix B of this part ("Procedure for Testing Chemical Compatibility and Rate of Permeation in Plastic Packagings and Receptacles"). The procedure specified in appendix B of this part must be performed on each plastic packaging or receptacle used for Packing Group I materials. The maximum rate of permeation of hazardous lading through or into the plastic packaging or receptacles may not exceed 0.5 percent for materials meeting the definition of a Division 6.1 material according to §173.132 and 2.0 percent for other hazardous materials, when subjected to a temperature no lower than-
(A) 18 ^{o}C (64 ^{o}F) for 180 days in accordance with Test Method 1 in appendix B of this part;
(B) 50 ^{o}C (122 ^{o}F) for 28 days in accordance with Test Method 2 in appendix B of this part; or
(C) 60 ^{o}C (140 ^{o}F) for 14 days in accordance with Test Method 3 in appendix B of this part.
(iii) Alternative procedures or rates of permeation are permitted if they yield a level of safety equivalent to or greater than that provided by paragraph (e)(3)(ii) of this section and are specifically approved by the Associate Administrator for Hazardous Materials Safety.
(4) Mixed contents. Hazardous materials may not be packed or mixed together in the same outer packaging with other hazardous or nonhazardous materials if such

materials are capable of reacting dangerously with each other and causing-
(i) Combustion or dangerous evolution of heat;
(ii) Evolution of flammable, poisonous, or asphyxiant gases; or
(iii) Formation of unstable or corrosive materials.
(5) Packagings used for solids, which may become liquid at temperatures likely to be encountered during transportation, must be capable of containing the hazardous material in the liquid state.
(f) Closures. (1) Closures on packagings shall be so designed and closed that under conditions (including the effects of temperature and vibration) normally incident to transportation-
(i) Except as provided in paragraph (g) of this section, there is no identifiable release of hazardous materials to the environment from the opening to which the closure is applied; and
(ii) The closure is secure and leakproof.
(2) Except as otherwise provided in this subchapter, a closure (including gaskets or other closure components, if any) used on a specification packaging must conform to all applicable requirements of the specification.
(g) Venting. Venting of packagings, to reduce internal pressure which may develop by the evolution of gas from the contents, is permitted only when-
(1) Transportation by aircraft is not involved;
(2) Except as otherwise provided in this subchapter, the evolved gases are not poisonous, likely to create a flammable mixture with air or be an asphyxiant under normal conditions of transportation;
(3) The packaging is designed so as to preclude an unintentional release of hazardous materials from the receptacle; and
(4) For shipments in bulk packagings, venting is authorized for the specific hazardous material by a special provision in the §172.101 table or by the applicable bulk packaging specification in part 178 of this subchapter.
(h) Outage and filling limits-(1) *General. When filling packagings and receptacles for liquids, sufficient ullage (outage) must be left to ensure that neither leakage nor permanent distortion of the packaging or receptacle will occur as a result of an expansion of the liquid caused by temperatures likely to be encountered during transportation. Requirements for outage and filling limits for non-bulk and bulk packagings are specified in §§173.24a(d) and 173.24b(a), respectively.*
(2) Compressed gases and cryogenic liquids. Filling limits for compressed gases and cryogenic liquids are specified in §§173.301 through 173.306 for cylinders and §§173.314 through 173.319 for bulk packagings.
(i) Air transportation. Packages offered or intended for transportation by aircraft must conform to the general requirements for transportation by aircraft in §173.27, except as provided in §171.11 of this subchapter.

[Amdt. 173-224, 55 FR 52610, Dec. 21, 1990, as amended by Amdt. 173-227, 56 FR 49989, Oct. 2, 1991; 56 FR 66265, Dec. 20, 1991; Amdt. 173-238, 59 FR 38064, July 26, 1994; Amdt. 173-241, 59 FR 67491, Dec. 29, 1994; Amdt. 173-242, 60 FR 26805, May 18, 1995]

§173.24a Additional general requirements for non-bulk packagings and packages.

(a) *Packaging design. Except as provided in §172.312 of this subchapter:*

(1) Inner packaging closures. A combination packaging containing liquid hazardous materials must be packed so that closures on inner packagings are upright.

(2) Friction. The nature and thickness of the outer packaging must be such that friction during transportation is not likely to generate an amount of heat sufficient to alter dangerously the chemical stability of the contents.

(3) Securing and cushioning. Inner packagings of combination packagings must be so packed, secured and cushioned to prevent their breakage or leakage and to control their movement within the outer packaging under conditions normally incident to transportation. Cushioning material must not be capable of reacting dangerously with the contents of the inner packagings or having its protective properties significantly weakened in the event of leakage.

(4) Metallic devices. Nails, staples and other metallic devices shall not protrude into the interior of the outer packaging in such a manner as to be likely to damage inner packagings or receptacles.

(5) Vibration. Each non-bulk package must be capable of withstanding, without rupture or leakage, the vibration test procedure specified in §178.608 of this subchapter.

(b) Non-bulk packaging filling limits. (1) A single or composite non-bulk packaging may be filled with a liquid hazardous material only when the specific gravity of the material does not exceed that marked on the packaging, or a specific gravity of 1.2 if not marked, except as follows:

(i) A Packing Group I packaging may be used for a Packing Group II material with a specific gravity not exceeding the greater of 1.8, or 1.5 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material;

(ii) A Packing Group I packaging may be used for a Packing Group III material with a specific gravity not exceeding the greater of 2.7, or 2.25 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material; and

(iii) A Packing Group II packaging may be used for a Packing Group III material with a specific gravity not exceeding the greater of 1.8, or 1.5 times the specific gravity marked on the packaging, provided all the performance criteria can still be met with the higher specific gravity material.

(2) Except as otherwise provided in this section, a non-bulk packaging may not be filled with a hazardous material to a gross mass greater than the maximum gross mass marked on the packaging.

(3) A single or composite non-bulk packaging which is tested and marked for liquid hazardous materials may be filled with a solid hazardous material to a gross mass, in

kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked. In addition:

(i) A single or composite non-bulk packaging which is tested and marked for Packing Group I liquid hazardous materials may be filled with a solid Packing Group II hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 1.5, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked.

(ii) A single or composite non-bulk packaging which is tested and marked for Packing Group I liquid hazardous materials may be filled with a solid Packing Group III hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 2.25, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked.

(iii) A single or composite non-bulk packaging which is tested and marked for Packing Group II liquid hazardous materials may be filled with a solid Packing Group III hazardous material to a gross mass, in kilograms, not exceeding the rated capacity of the packaging in liters, multiplied by 1.5, multiplied by the specific gravity marked on the packaging, or 1.2 if not marked.

(4) Packagings tested as prescribed in §178.605 of this subchapter and marked with the hydrostatic test pressure as prescribed in §178.503(a)(5) of this subchapter may be used for liquids only when the vapor pressure of the liquid conforms to one of the following:

(i) The vapor pressure must be such that the total pressure in the packaging (i.e., the vapor pressure of the liquid plus the partial pressure of air or other inert gases, less 100 kPa (15 psi)) at 55 ^{o}C (131 ^{o}F), determined on the basis of a maximum degree of filling in accordance with paragraph (d) of this section and a filling temperature of 15 ^{o}C (59 ^{o}F)), will not exceed two-thirds of the marked test pressure;

(ii) The vapor pressure at 50 ^{o}C (122 ^{o}F) must be less than four-sevenths of the sum of the marked test pressure plus 100 kPa (15 psi); or

(iii) The vapor pressure at 55 ^{o}C (131 ^{o}F) must be less than two-thirds of the sum of the marked test pressure plus 100 kPa (15 psi).

(5) No hazardous material may remain on the outside of a package after filling.

(c) *Mixed contents. (1) An outer non-bulk packaging may contain more than one hazardous material only when-*

(i) The inner and outer packagings used for each hazardous material conform to the relevant packaging sections of this part applicable to that hazardous material;

(ii) The package as prepared for shipment meets the performance tests prescribed in part 178 of this subchapter for the packing group indicating the highest order of hazard for the hazardous materials contained in the package;

(iii) Corrosive materials (except ORM-D) in bottles are further packed in securely closed inner receptacles before packing in outer packagings; and

(iv) For transportation by aircraft, the total net quantity does not exceed the lowest permitted maximum net quantity per package as shown in Column 9a or 9b, as appropriate, of the §172.101 table. The permitted maximum net quantity must be calculated in kilograms if a package contains both a liquid and a solid.

(2) A packaging containing inner packagings of Division 6.2 materials may not contain other hazardous materials, except dry ice.

(d) Liquids must not completely fill a receptacle at a temperature of 55 ^{o}C (131 ^{o}F) or less.

[Amdt. 173-224, 55 FR 52611, Dec. 21, 1990, as amended at 56 FR 66265, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; 58 FR 51532, Oct. 1, 1993; Amdt. 173-255, 61 FR 50624, Sept. 26, 1996]

§173.24b Additional general requirements for bulk packagings.

(a) *Outage and filling limits. (1) Except as otherwise provided in this subchapter, liquids and liquefied gases must be so loaded that the outage is at least five percent for materials poisonous by inhalation, or at least one percent for all other materials, of the total capacity of a cargo tank, portable tank, tank car (including dome capacity), multi-unit tank car tank, or any compartment thereof, at the following reference temperatures-*

(i) 46 ^{o}C (115 ^{o}F) for a noninsulated tank;

(ii) 43 ^{o}C (110 ^{o}F) for a tank car having a thermal protection system, incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/ per degree F) temperature differential; or

(iii) 41 ^{o}C (105 ^{o}F) for an insulated tank.

(2) Hazardous materials may not be loaded into the dome of a tank car. If the dome of the tank car does not provide sufficient outage, vacant space must be left in the shell to provide the required outage.

(b) *Equivalent steel. For the purposes of this section, the reference stainless steel is stainless steel with a guaranteed minimum tensile strength of 51.7 deka newtons per square millimeter (75,000 psi) and a guaranteed elongation of 40 percent or greater. Where the regulations permit steel other than stainless steel to be used in place of a specified stainless steel (for example, as in §172.102 of this subchapter, special provision B30), the minimum thickness for the steel must be obtained from one of the following formulas, as appropriate:*

Formula for metric units

$e_1 = (12.74e_0) / (Rm_1 \ A_1)^{1/3}$

Formula for non-metric units

$e_1 = (144.2e_0) / (Rm_1 \ A_1)^{1/3}$

where:

e_0 = Required thickness of the reference stainless steel in millimeters or inches respectively;

e_1 = Equivalent thickness of the steel used in millimeters or inches respectively;

Rm_1 = Specified minimum tensile strength of the steel used in deka-newtons per square millimeter or pounds per square inch respectively; and

A_1 = Specified minimum percentage elongation of the steel used multiplied by 100 (for example, 20 percent times 100 equals 20). Elongation values used must be determined from a 50 mm or 2 inch test specimen.

(c) Air pressure in excess of ambient atmospheric pressure may not be used to load or unload any lading which may create an air-enriched mixture within the flammability range of the lading in the vapor space of the tank.

(d) A bulk packaging may not be loaded with a hazardous material that:

(1) Is at a temperature outside of the packaging's design temperature range; or

(2) Except as otherwise provided in this subchapter, exceeds the maximum weight of lading marked on the specification plate.

[Amdt. 173-224, 55 FR 52612, Dec. 21, 1990, as amended at 56 FR 66266, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-243, 60 FR 40038, Aug. 4, 1995; Amdt. 173-252, 61 FR 28676, June 5, 1996; Amdt. 173-255, 61 FR 50624, Sept. 26, 1996]

§173.25 Authorized packagings and overpacks.

(a) Authorized packages containing hazardous materials may be offered for transportation in an overpack as defined in §171.8 of this subchapter, if all of the following conditions are met:

(1) The package meets the requirements of §§173.21 and 173.24 of this subchapter.

(2) The overpack is marked with the proper shipping name and identification number, and labeled as required by this subchapter for each hazardous material contained therein unless markings and labels representative of each hazardous material in the overpack are visible.

(3) Each package subject to the orientation marking requirements of §172.312 of this subchapter is packed in the overpack with its filling holes up and the overpack is marked with package orientation marking arrows on two opposite vertical sides of the overpack with the arrows pointing in the correct direction of orientation.

(4) The overpack is marked with a statement indicating that the inside (inner) packages comply with prescribed specifications when specification packagings are required, unless specification markings on the inside packages are visible.

(5) Packages containing Class 8 (corrosive) materials in Packing Group I or Division 5.1 (oxidizing) materials in Packing Group I may not be overpacked with any other materials.

(b) Shrink-wrapped or stretch-wrapped trays may be used as outer packagings for inner packagings prepared in accordance with the limited quantity provisions or consumer commodity provisions of this subchapter, provided that-

(1) Inner packagings are not fragile, liable to break or be easily punctured, such as

those made of glass, porcelain, stoneware or certain plastics; and

(2) Each complete package does not exceed 20 kg (44 lbs) gross weight.

(c) Hazardous materials which are required to be labeled POISON may be transported in the same motor vehicle with material that is marked or known to be foodstuffs, feed or any edible material intended for consumption by humans or animals provided the hazardous material is marked, labeled, and packaged in accordance with this subchapter, conforms to the requirements of paragraph (a) of this section and is overpacked as specified in §177.841(e) of this subchapter or in an overpack which is a UN 1A2, 1B2, or 1N2 drum tested and marked for a Packing Group II or higher performance level.

[Amdt. 173-165, 48 FR 28099, June 20, 1983, as amended by Amdt. 173-224, 55 FR 52612 Dec. 21, 1990; 56 FR 66266, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-214, 59 FR 67491, Dec. 29, 1994; 64 FR 10776, Mar. 5, 1999]

§173.26 Quantity limitations.

When quantity limitations do not appear in the packaging requirements of this subchapter, the permitted gross weight or capacity authorized for a packaging is as shown in the packaging specification or standard in part 178 or 179, as applicable, of this subchapter.

[Amdt. 173-224, 55 FR 52612, Dec. 21, 1990]

§173.27 General requirements for transportation by aircraft.

(a) The requirements of this section are in addition to the requirements in §173.24 and apply to packages offered or intended for transportation aboard aircraft. Notwithstanding any Packing Group III performance level specified in Column 5 of the §172.101 table, the required performance level for packages containing Class 4, 5, or 8 materials, when offered or intended for transportation aboard aircraft, is at the Packing Group II performance level, unless otherwise excepted from performance requirements in subpart E of this part.

(b) Packages authorized on board aircraft. (1) When Column 9a of the §172.101 table indicates that a material is "Forbidden", that material may not be offered for transportation or transported aboard passenger-carrying aircraft.

(2) When Column 9b of the §172.101 table indicates that a material is "Forbidden", that material may not be offered for transportation or transported aboard aircraft.

(3) The maximum quantity of hazardous material in a package that may be offered for transportation or transported aboard a passenger-carrying aircraft or cargo aircraft may not exceed that quantity prescribed for the material in Column 9a or 9b, respectively, of the §172.101 table.

(4) A package containing a hazardous material which is authorized aboard cargo aircraft but not aboard passenger aircraft must be labeled with the CARGO AIRCRAFT ONLY label required by §172.402(b) of this subchapter and may not be offered for transportation or transported aboard passenger-carrying aircraft.

(c) Pressure requirements. (1) Packagings must be designed and constructed to prevent leakage that may be caused by changes in altitude and temperature during transportation aboard aircraft.

(2) Packagings for which retention of liquid is a basic function must be capable of withstanding without leakage the greater of-

(i) An internal pressure which produces a gauge pressure of not less than 75 kPa (11 psi) for liquids in Packing Group III of Class 3 or Division 6.1. or 95 kPa (14 psi) for other liquids; or

(ii) A pressure related to the vapor pressure of the liquid to be conveyed, determined by one of the following:

(A) The total gauge pressure measured in the receptacle (i.e., the vapor pressure of the material and the partial pressure of air or other inert gases, less 100 kPa (15 psi)) at 55 ^{o}C (131 ^{o}F), multiplied by a safety factor of 1.5; determined on the basis of a filling temperature of 15 ^{o}C (59 ^{o}F) and a degree of filling such that the receptacle is not completely liquid full at a temperature of 55 ^{o}C (131 ^{o}F) or less;

(B) 1.75 times the vapor pressure at 50 ^{o}C (122 ^{o}F) less 100 kPa (15 psi); or

(C) 1.5 times the vapor pressure at 55 ^{o}C (131 ^{o}) less 100 kPa (15 psi).

(3) Notwithstanding the provisions of paragraph (c)(2) of this section-

(i) Hazardous materials may be contained in an inner packaging which does not itself meet the pressure requirement provided that the inner packaging is packed within a supplementary packaging which does meet the pressure requirement and other applicable packaging requirements of this subchapter.

(ii) Packagings which are subject to the hydrostatic pressure test and marking requirements of §§178.605 and 178.503(a)(5), respectively, of this subchapter must have a marked test pressure of not less than 250 kPa (36 psi) for liquids in Packing Group I, 80 kPa (12 psi) for liquids in Packing Group III of Class 3 or Division 6.1, and 100 kPa (15 psi) for other liquids.

(d) Closures. Stoppers, corks or other such friction-type closures must be held securely, tightly and effectively in place by positive means. Each screw-type closure on any packaging must be secured to prevent closure from loosening due to vibration or substantial change in temperature.

(e) Absorbent materials. Except as otherwise provided in this subchapter, liquids in Packing Group I or II of Class 3, 4, 5, 6, or 8, when in glass or earthenware inner packagings, must be packaged using material capable of absorbing and not likely to react dangerously with the liquid. Absorbent material is not required if the inner packagings are so protected that breakage of them and leakage of their contents from the outer packaging is not likely to occur under normal conditions of transportation and is not required for packagings containing liquids in Packing Group II for transport aboard cargo aircraft only. Where absorbent material is required and an outer packaging is not liquid-tight, a means of containing the liquid in the event of leakage must be used in the form of a leakproof liner, plastic bag or other equally efficient means of containment. Where absorbent material is required, the quantity and disposition of it in each outer packaging must be as follows:

(1) For packagings containing liquids in Packing Group I offered for transportation or transported aboard passenger-carrying aircraft, each packaging must contain sufficient absorbent material to absorb the contents of all inner packagings containing such liquids;

(2) For packagings containing liquids in Packing Group I offered for transportation or transported aboard cargo aircraft only and packagings containing liquids in Packing Group II offered for transportation or transported aboard passenger aircraft, each package must contain sufficient absorbent material to absorb the contents of any one of the inner packagings containing such liquids and, where they are of different sizes and quantities, sufficient absorbent material to absorb the contents of the inner packaging containing the greatest quantity of liquid.

(f) Combination packagings. Unless otherwise specified in this part, or in §171.11 of this subchapter, when combination packagings are offered for transportation aboard aircraft, inner packagings must conform to the quantity limitations set forth in table 1 of this paragraph for transport aboard passenger-carrying aircraft and table 2 of this paragraph for transport aboard cargo aircraft only, as follows:

Table 1-Maximum Net Capacity of Inner Packaging for Transportation on Passenger-Carrying Aircraft

Maximum net quantity per package from Column 9a of the 172.101 table	Maximum authorized net capacity of each inner packaging	
-	Glass, earthenware or fiber inner packagings	Metal or plastic inner packagings
Liquids:	-	-
Not greater than 0.5L	0.5L	0.5L.
Greater than 0.5L. not greater than lL	0.5L	lL.
Greater than 1L, not greater than 5L	1L	5L.
Greater than 5L, not greater than 60L	2.5L	10L.
Greater than 60L, not greater than 220L	5L	25L.
Greater than 220L	No limit	No limit.
Solids:	-	-
Not greater than 5 kg	0.5 kg	1 kg.
Greater than 5 kg, not greater than 25 kg	1 kg	2.5 kg.
Greater than 25 kg, not greater than 200 kg	5 kg	10 kg.
Greater than 200 kg	No limit	No limit.

Table 2-Maximum Net Capacity of Inner Packaging for Transportation on Cargo Aircraft

Maximum net quantity per package from	Maximum authorized net capacity of each inner packaging

Column 9b of the 172.101 table -		
	Glass, earthenware or fiber inner packagings	Metal or plastic inner packagings
Liquids:	-	-
Not greater than 2.5L	1L	1L.
Greater than 2.5L, not greater than 30L	2.5L	2.5L.
Greater than 30L, not greater than 60L	5L	10L.
Greater than 60L, not greater than 220L	5L	25L.
Greater than 220L	No limit	No limit.
Solids:	-	-
Not greater than 15 kg	1 kg	2.5 kg.
Greater than 15 kg, not greater than 50 kg	2.5 kg	5 kg.
Greater than 50 kg, not greater than 200 kg	5 kg	10 kg.
Greater than 200 kg	No limit	No limit.

(g) Cylinders. For any cylinder containing hazardous materials and incorporating valves, sufficient protection must be provided to prevent operation of, and damage to, the valves during transportation, by one of the following methods:

(1) By equipping each cylinder with securely attached valve caps or protective headrings; or

(2) By boxing or crating the cylinder.

(h) Tank cars and cargo tanks. Any tank car or cargo tank containing a hazardous material may not be transported aboard aircraft.

[Amdt. 173-224, 55 FR 52612, Dec. 21, 1990, as amended at 56 FR 66266, Dec. 20, 1991; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994]

§173.28 Reuse, reconditioning and remanufacture of packagings.

(a) *General. Packagings and receptacles used more than once must be in such condition, including closure devices and cushioning materials, that they conform in all respects to the prescribed requirements of this subchapter. Before reuse, each packaging must be inspected and may not be reused unless free from incompatible residue, rupture, or other damage which reduces its structural integrity.*

(b) Reuse of non-bulk packaging. A non-bulk packaging used more than once must conform to the following provisions and limitations:

(1) A non-bulk packaging which, upon inspection, shows evidence of a reduction in integrity may not be reused unless it is reconditioned in accordance with paragraph (c) of this section.

(2) Before reuse, packagings subject to the leakproofness test with air prescribed in §178.604 of this subchapter shall be-

(i) Retested without failure in accordance with §178.604 of this subchapter using an internal air pressure (gauge) of at least 48 kPa (7.0 psi) for Packing Group I and 20 kPa (3.0 psi) for Packing Group II and Packing Group III; and

(ii) Marked with the letter "L", with the name and address or symbol of the person conducting the test, and the last two digits of the year the test was conducted. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(3) Packagings made of paper, plastic film, or textile are not authorized for reuse;

(4) Metal and plastic drums and jerricans used as single packagings or the outer packagings of composite packagings are authorized for reuse only when they are marked in a permanent manner (e.g., embossed) in millimeters with the nominal (for metal packagings) or minimum (for plastic packagings) thickness of the packaging material, as required by §178.503(a)(9) of this subchapter, and-

(i) Except as provided in paragraph (b)(4)(ii) of this section, conform to the following minimum thickness criteria:

Maximum capacity not over -	Minimum thickness of packaging material	
	Metal drum or jerrican	Plastic drum or jerrican
20 L	0.63 mm (0.025 inch)	1.1 mm (0.043 inch).
30 L	0.73 mm (0.029 inch)	1.1 mm (0.043 inch).
40 L	0.73 mm (0.029 inch)	1.8 mm (0.071 inch).
60 L	0.92 mm (0.036 inch)	1.8 mm (0.071 inch).
120 L	0.92 mm (0.036 inch)	2.2 mm (0.087 inch).
220 L	0.92 mm (0.036 inch)[1]	2.2 mm (0.087 inch).
450 L	1.77 mm (0.070 inch)	5.0 mm (0.197 inch).

[1]Metal drums or jerricans with a minimum thickness of 0.82 mm body and 1.09 mm heads which are manufactured and marked prior to January 1, 1997 may be reused. Metal drums or jerricans manufactured and marked on or after January 1, 1997, and intended for reuse, must be constructed with a minimum thickness of 0.82 mm body and 1.11 mm heads.

(ii) For stainless steel drums and jerricans, conform to a minimum wall thickness as determined by the following equivalence formula:

Formula for Metric Units

[ILLUSTRATION GOES HERE]

EP26JN96.000

Formula for U.S. Standard Units

[ILLUSTRATION GOES HERE]

EP26JN96.001

where:

e_1 = required equivalent wall thickness of the metal to be used (in mm or, for U.S. Standard units, use inches).
e_0 = required minimum wall thickness for the reference steel (in mm or, for U.S. Standard units, use inches).
Rm_1 = guaranteed minimum tensile strength of the metal to be used (in N/mm^2 or for U.S. Standard units, use pounds per square inch).
A_1 = guaranteed minimum elongation (as a percentage) of the metal to be used on fracture under tensile stress (see paragraph (c)(1) of this section).

(5) Plastic inner receptacles of composite packagings must have a minimum thickness of 1.0 mm (0.039 inch).

(6) A previously used non-bulk packaging may be reused for the shipment of hazardous waste, not subject to the reconditioning and reuse provisions of this section, in accordance with §173.12(c).

(7) Notwithstanding the provisions of paragraph (b)(2) of this section, a packaging otherwise authorized for reuse may be reused without being leakproofness tested with air provided the packaging-

(i) Is refilled with a material which is compatible with the previous lading:

(ii) Is refilled and offered for transportation by the original filler;

(iii) Is transported in a transport vehicle or freight container under the exclusive use of the refiller of the packaging; and

(iv) Is constructed of-

(A) Stainless steel, monel or nickel with a thickness not less than one and one-half times the minimum thickness prescribed in paragraph (b)(4) of this section;

(B) Plastic, provided the packaging is not refilled for reuse on a date more than five years from the date of manufacture marked on the packaging in accordance with §178.503(a)(6) of this subchapter; or

(C) another material or thickness when approved under the conditions established by the Associate Administrator for Hazardous Materials Safety for reuse without retesting.

(c) Reconditioning of non-bulk packaging. (1) For the purpose of this subchapter, reconditioning of metal drums is:

(i) Cleaning to base material of construction, with all former contents, internal and external corrosion, and any external coatings and labels removed;

(ii) Restoring to original shape and contour, with chimes (if any) straightened and sealed, and all non-integral gaskets replaced: and

(iii) Inspecting after cleaning but before painting, Packagings that have visible pitting, significant reduction in material thickness, metal fatigue, damaged threads or closures, or other significant defects, must be rejected.

(2) For the purpose of this subchapter, reconditioning of a non-bulk packaging other

than a metal drum or a UN 1H1 plastic drum includes:

(i) Removal of all former contents, external coatings and labels, and cleaning to the original materials of construction;

(ii) Inspection after cleaning with rejection of packagings with visible damage such as tears, creases or cracks, or damaged threads or closures, or other significant defects;

(iii) Replacement of all non-integral gaskets and closure devices with new or refurbished parts, and cushioning and cushioning materials; and components including gaskets, closure devices and cushioning and cushioning material. (For a UN 1H1 plastic drum, replacing a removable gasket or closure device with another of the same design and material that provides equivalent performance does not constitute reconditioning); and

(iv) Ensuring that the packagings are restored to a condition that conforms in all respects with the prescribed requirements of this subchapter.

(3) A person who reconditions a packaging manufactured and marked under the provisions of subpart L of part 178 of this subchapter, shall mark that packaging as required by §178.503(c) and (d) of this subchapter. The marking is the certification of the reconditioner that the packaging conforms to the standard for which it is marked and that all functions performed by the reconditioner which are prescribed by this subchapter have been performed in compliance with this subchapter.

(4) The markings applied by the reconditioner may be different from those applied by the manufacturer at the time of original manufacture, but may not identify a greater performance capability than that for which the original design type had been tested (for example, the reconditioner may mark a drum which was originally marked as 1A1/Y1.8 as 1A1/Y1.2 or 1A1/Z2.0).

(5) Packagings which have significant defects which cannot be repaired may not be reused.

(d) *Remanufacture of non-bulk packagings. For the purpose of this subchapter, remanufacture is the conversion of a non-specification, non-bulk packaging to a DOT specification or U.N. standard, the conversion of a packaging meeting one specification or standard to another specification or standard (for example, conversion of 1A1 non-removable head drums to 1A2 removable head drums) or the replacement of integral structural packaging components (such as non-removable heads on drums). A person who remanufactures a non-bulk packaging to conform to a specification or standard in part 178 of this subchapter is subject to the requirements of part 178 of this subchapter as a manufacturer.*

(e) Non-reusable containers. A packaging marked as NRC according to the DOT specification or UN standard requirements of part 178 of this subchapter may be reused for the shipment of any material not required by this subchapter to be shipped in a DOT specification or UN standard packaging.

[Amdt. 173-224, 55 FR 52614, Dec. 21, 1990, as amended at 56 FR 66266, Dec. 20, 1991; 57 FR 45460, Oct. 1, 1992; Amdt. 173-241, 59 FR 67491, 67492, Dec. 29, 1994; 60 FR 7627, Feb. 8, 1995; Amdt. 173-241, 60 FR 26805, 26806, May 18, 1995 Amdt. 173-255, 61 FR 50624, 50265, Sept. 26, 1996; 61 FR 51495, Oct. 2, 1996; Amdt. 173-

254, 62 FR 14338, Mar. 26, 1997; 64 FR 10776, Mar. 5, 1999; 64 FR 44428, Aug. 16, 1999]

§173.29 Empty packagings.

(a) General. Except as otherwise provided in this section, an empty packaging containing only the residue of a hazardous material shall be offered for transportation and transported in the same manner as when it previously contained a greater quantity of that hazardous material.

(b) Notwithstanding the requirements of paragraph (a) of this section, an empty packaging is not subject to any other requirements of this subchapter if it conforms to the following provisions:

(1) Any hazardous material shipping name and identification number markings, any hazard warning labels or placards, and any other markings indicating that the material is hazardous (e.g., RQ, INHALATION HAZARD) are removed, obliterated, or securely covered in transportation. This provision does not apply to transportation in a transport vehicle or a freight container if the packaging is not visible in transportation and the packaging is loaded by the shipper and unloaded by the shipper or consignee;

(2) The packaging-

(i) Is unused;

(ii) Is sufficiently cleaned of residue and purged of vapors to remove any potential hazard;

(iii) Is refilled with a material which is not hazardous to such an extent that any residue remaining in the packaging no longer poses a hazard; or

(iv) Contains only the residue of-

(A) An ORM-D material; or

(B) A Division 2.2 non-flammable gas, other than ammonia, anhydrous, and with no subsidiary hazard, at an absolute pressure less than 280 kPa (40.6 psia); at 20 ^{o}C (68 ^{o}F); and

(3) Any material contained in the packaging does not meet the definitions in §171.8 of this subchapter for a hazardous substance, a hazardous waste, or a marine pollutant.

(c) A non-bulk packaging containing only the residue of a hazardous material covered by table 2 of §172.504 of this subchapter-

(1) Does not have to be included in determining the applicability of the placarding requirements of subpart F of part 172 of this subchapter; and

(2) Is not subject to the shipping paper requirements of this subchapter when collected and transported by a contract or private carrier for reconditioning, remanufacture or reuse.

(d) Notwithstanding the stowage requirements in Column 10a of the §172.101 table for transportation by vessel, an empty drum or cylinder may be stowed on deck or under deck.

(e) Specific provisions for describing an empty packaging on a shipping paper appear in §172.203(e) of this subchapter.

(f) [Reserved]

(g) A package which contains a residue of an elevated temperature material may remain marked in the same manner as when it contained a greater quantity of the material even though it no longer meets the definition in §171.8 of this subchapter for an elevated temperature material.

[Amdt. 173-224, 55 FR 52614, Dec. 21, 1990, as amended by Amdt. 173-227, 56 FR 49989, Oct. 2, 1991; Amdt. 173-231, 57 FR 52939, Nov. 5, 1992; Amdt. 173-251, 61 FR 28676, June 5, 1996; Amdt. 173-260, 62 FR 1236, Jan. 8, 1997; 64 FR 10776, Mar. 5, 1999]

§173.30 Loading and unloading of transport vehicles.

A person who loads or unloads hazardous materials into or from a transport vehicle or vessel shall comply with the applicable loading and unloading requirements of parts 174, 175, 176, and 177 of this subchapter.

[Amdt. 173-94, 41 FR 16064, Apr. 15, 1976]

§173.31 Use of tank cars.

(a) *General. (1) No person may offer a hazardous material for transportation in a tank car unless the tank car meets the applicable specification and packaging requirements of this subchapter or, when this subchapter authorizes the use of an non-DOT specification tank car, the applicable specification to which the tank was constructed.*

(2) Tank cars and appurtenances may be used for the transportation of any commodity for which they are authorized in this part and specified on the certificate of construction (AAR Form 4-2 or by addendum on Form R-1). See §179.5 of this subchapter. Transfer of a tank car from one specified service on its certificate of construction to another may be made only by the owner or with the owner's authorization. A tank car proposed for a commodity service other than specified on its certificate of construction must be approved for such service by the AAR's Tank Car Committee.

(3) No person may fill a tank car overdue for periodic inspection with a hazardous material and then offer it for transportation. Any tank car marked as meeting a DOT specification and any non-specification tank car transporting a hazardous material must have a periodic inspection and test conforming to subpart F of part 180 of this subchapter.

(4) No railroad tank car, regardless of its construction date, may be used for the transportation in commerce of any hazardous material unless the air brake equipment support attachments of such tank car conform to the standards for attachments set forth in §§179.100-16 and 179.200-19 of this subchapter.

(5) No railroad tank car, regardless of its construction date, may be used for the transportation in commerce of any hazardous material with a self-energized manway located below the liquid level of the lading.

(6) Unless otherwise specifically provided in this part:

(i) When the tank car delimiter is an "A," offerors may also use tank cars with a delimiter "S," "J" or "T".

(ii) When the tank car delimiter is an "S," offerors may also use tank cars with a delimiter "J" or "T".

(iii) When a tank car delimiter is a "T" offerors may also use tank cars with a delimiter of "J".

(iv) When a tank car delimiter is a "J", offerors may not use a tank car with any other delimiter.

(b) *Safety systems-(1) Coupler vertical restraint. Each tank car conforming to a DOT specification and any other tank car used for transportation of a hazardous material must be equipped with a coupler vertical restraint system that meets the requirements of §179.14 of this subchapter.*

(2) Pressure relief devices. (i) Pressure relief devices on tank cars must conform to part 179 of this subchapter.

(ii) Except for shipments of chloroprene, inhibited, in class DOT 115 tank cars, single-unit tank cars used for materials meeting the definition for Division 6.1 liquid, Packing Group I or II, Class 2 materials, or Class 3 or 4 liquids, must have self-closing pressure relief devices. However, a tank car built before January 1, 1991, and equipped with a non-closing pressure relief device may be used to transport a Division 6.1 or Class 4 liquid if the liquid is not poisonous by inhalation. Unless otherwise specifically provided in this subchapter, frangible discs may not have breather holes.

(3) *Tank-head puncture-resistance requirements. The following tank cars must have a tank-head puncture-resistance system that conforms to the requirements in §179.16 of this subchapter, or to the corresponding requirements in effect at the time of installation:*

(i) Tank cars transporting a Class 2 material.

(ii) Tank cars constructed from aluminum or nickel plate that are used to transport hazardous material.

(iii) Except as provided in paragraph (b)(3)(iv) of this section, those tank cars specified in paragraphs (b)(3)(i) and (ii) of this section not requiring a tank-head puncture resistance system prior to July 1, 1996, must have a tank-head puncture resistance system installed no later than July 1, 2006.

(iv) Class DOT 105A tank cars built prior to September 1, 1981, having a tank capacity less than 70 kl (18,500 gallons), and used to transport a Division 2.1 (flammable gas) material, must have a tank-head puncture-resistant system installed no later than July 1, 2001.

(4) *Thermal protection requirements. The following tank cars must have thermal protection that conforms to the requirements of §179.18 of this subchapter:*

(i) Tank cars transporting a Class 2 material, except for a class 106, 107A, 110, and 113 tank car. A tank car equipped with a thermal protection system conforming to

§179.18 of this subchapter, or that has an insulation system having an overall thermal conductance of no more than 0.613 kilojoules per hour, per square meter, per degree Celsius temperature differential (0.03 B.t.u. per square foot, per hour, per degree Fahrenheit temperature differential), conforms to this requirement.

(ii) A tank car transporting a Class 2 material that was not required to have thermal protection prior to July 1, 1996, must be equipped with thermal protection no later than July 1, 2006.

(5) *Bottom-discontinuity protection requirements. No person may offer for transportation a hazardous material in a tank car with bottom discontinuity protection unless the tank car has bottom-discontinuity protection that conforms to the requirements of E9.00 and E10.00 of the AAR Specifications for Tank Cars. Tank cars not requiring bottom-discontinuity protection under the terms of appendix Y of the AAR Specifications for Tank Cars as of July 1, 1996, must conform to these requirements no later than July 1, 2006. Tank cars modified before July 1, 1996, may conform to the bottom-discontinuity protection requirements of appendix Y of the 1992 edition of the AAR Specifications for Tank Cars.*

(6) Scheduling of modifications and progress reporting. The date of conformance for the continued use of tank cars subject to paragraphs (b)(3), (b)(4), (b)(5), (e)(2), and (f) of this section and §§173.314(j) and 173.323(c)(1) is subject to the following conditions and limitations.

(i) Each tank car owner shall modify, reassign, retire, or remove at least 50 percent of their in-service tank car fleet within the first half of the compliance period and the remainder of their in-service tank car fleet during the second half of the compliance period.

(ii) By October 1 of each year, each owner of a tank car subject to this paragraph (b)(6) shall submit to the Hazardous Materials Division (RRS-12), Office of Safety Assurance and Compliance, Federal Railroad Administration, 400 7th Street, SW., Washington, DC 20590-0001, a progress report that shows the total number of in-service tank cars that need head protection, thermal protection, or bottom-discontinuity protection; the number of new or different tank cars acquired to replace those tank cars required to be upgraded to a higher service pressure; and the total number of tank cars modified, reassigned, acquired, retired, or removed from service the previous year.

(c) *Tank car test pressure. A tank car used for the transportation of a hazardous material must have a tank test pressure equal to or greater than the greatest of the following:*

(1) Except for shipments of carbon dioxide, anhydrous hydrogen chloride, vinyl fluoride, ethylene, or hydrogen, 133 percent of the sum of lading vapor pressure at the reference temperature of 46 ^{o}C (115 ^{o}F) for non-insulated tank cars or 41 ^{o}C (105 ^{o}F) for insulated tank cars plus static head, plus gas padding pressure in the vacant space of a tank car;

(2) 133 percent of the maximum loading or unloading pressure, whichever is greater;

(3) 20.7 Bar (300 psi) for materials that are poisonous by inhalation (see §173.31(e)(2)(ii) for compliance dates);

(4) The minimum pressure prescribed by the specification in part 179 of this

subchapter; or

(5) The minimum test pressure prescribed for the specific hazardous material in the applicable packaging section in subpart F or G of this part.

(d) *Examination before shipping. (1) No person may offer for transportation a tank car containing a hazardous material or a residue of a hazardous material unless that person determines that the tank car is in proper condition and safe for transportation. As a minimum, each person offering a tank car for transportation must perform an external visual inspection that includes:*

(i) Except where insulation or a thermal protection system precludes an inspection, the tank shell and heads for abrasion, corrosion, cracks, dents, distortions, defects in welds, or any other condition that makes the tank car unsafe for transportation;

(ii) The piping, valves, fittings, and gaskets for corrosion, damage, or any other condition that makes the tank car unsafe for transportation;

(iii) For missing or loose bolts, nuts, or elements that make the tank car unsafe for transportation;

(iv) All closures on tank cars and determine that the closures and all fastenings securing them are properly tightened in place by the use of a bar, wrench, or other suitable tool;

(v) Protective housings for proper securement;

(vi) The pressure relief device, including a careful inspection of the frangible disc in non-closing pressure relief devices, for corrosion or damage that may alter the intended operation of the device;

(vii) Each tell-tale indicator after filling and prior to transportation to ensure the integrity of the rupture disc;

(viii) The external thermal protection system, tank-head puncture resistance system, coupler vertical restraint system, and bottom discontinuity protection for conditions that make the tank car unsafe for transportation.

(ix) The required markings on the tank car for legibility; and

(x) The periodic inspection date markings to ensure that the inspection and test intervals are within the prescribed intervals.

(2) Closures on tank cars are required, in accordance with this subchapter, to be designed and closed so that under conditions normally incident to transportation, including the effects of temperature and vibration, there will be no identifiable release of a hazardous material to the environment. In any action brought to enforce this section, the lack of securement of any closure to a tool-tight condition, detected at any point, will establish a rebuttable presumption that a proper inspection was not performed by the offeror of the car. That presumption may be rebutted by any evidence indicating that the lack of securement resulted from a specific cause not within the control of the offeror.

(e) *Special requirements for materials poisonous by inhalation-(1) Interior heater coils. Tank cars used for materials poisonous by inhalation may not have interior heater coils.*

(2) Tank car specifications. A tank car used for a material poisonous by inhalation must have a tank test pressure of 20.7 Bar (300 psi) or greater, head protection, and a metal jacket (e.g., DOT 105S300W), except that-

(i) A higher test pressure is required if otherwise specified in this subchapter; and

(ii) Other than as provided in paragraph (b)(6) of this section, a tank car which does not conform to the requirements of this paragraph (e)(2), and was authorized for the material poisonous by inhalation under the regulations in effect on June 30, 1996, may continue in use until July 1, 2006.

(f) *Special requirements for hazardous substances. (1) A tank car used for a hazardous substance listed in paragraph (f)(2) of this section must have a tank test pressure of at least 13.8 Bar (200 psi), head protection and a metal jacket, except that-*

(i) No metal jacket is required if-

(A) The tank test pressure is 23.4 Bar (340 psi) or higher; or

(B) The tank shell and heads are manufactured from AAR steel specification TC-128, normalized;

(ii) A higher test pressure is required if otherwise specified in this subchapter; and

(iii) Other than as provided in paragraph (b)(6) of this section, a tank car which does not conform to the requirements of this paragraph (f)(1), and was authorized for a hazardous substance under the regulations in effect on June 30, 1996, may continue in use until July 1, 2006.

(2) *List of hazardous substances. Hazardous substances for which the provisions of this paragraph (f) apply are as follows:*

Aldrin
Allyl chloride
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC
Bis(2-chloroethyl) ether
Bromoform
Carbon tetrachloride
Chlordane
p-Chloroaniline
Chlorobenzene
Chlorobenzilate
p-Chloro-m-cresol
2-Chloroethyl vinyl ether
Chloroform
2-Chloronapthalene
o-Chlorophenol
3-Chloropropionitrile
DDE
DDT
1,2-Dibromo-3-chloropropane
m-Dichlorobenzene
o-Dichlorobenzene

p-Dichlorobenzene
3,3'-Dichlorobenzidine
1,4-Dichloro-2-butene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
Dichloroisopropyl ether
Dichloromethane @
2,4-Dichlorophenol
2,6-Dichlorophenol
1,2-Dichloropropane
1,3-Dichloropropene
Dieldrin
alpha-Endosulfan
beta-Endosulfan
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachloroethane
Hexachlorophene
Hexachloropropene
Isodrin
Kepone
Methoxychlor
4,4'-Methylenebis(2-chloroaniline)
Methylene bromide
Pentachlorobenzene
Pentachloroethane
Pentachloronitrobenzene (PCNB)
Pentachlorophenol
Polychlorinated biphenyls (PCBs)
Pronamide
Silvex (2,4,5-TP)
2,4,5-T
TDE
1,2,4,5-Tetrachlorobenzene
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Tetrachloroethane
Tetrachloroethylene
2,3,4,6-Tetrachlorophenol
Toxaphene

1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Tris(2,3-dibromopropyl) phosphate

[Amdt. 173-245, 60 FR 49072, Sept. 21, 1995, as amended by Amdt. 173-245, 61 FR 33254, June 26, 1996; Amdt. 173-256, 61 FR 51338, Oct. 1, 1996]

§173.32 Qualification, maintenance and use of portable tanks other than Specification IM portable tanks.

(a) Except as otherwise provided in this section, each portable tank used for the transportation of hazardous materials must conform to the requirements of the specification and regulations for the transportation of the particular commodity. Except for Specification 56 and 57 portable tanks, a manufacturer's data report of the portable tank must be procured and retained in the files of the owner during the time that such portable tank is used for such service.

(1) When a portable tank container is used as a cargo tank container, it shall conform to all the requirements prescribed for cargo tank containers. (See §173.33)

(2) [Reserved]

(3) Each uninsulated portable tank used for the transportation of compressed gases, as defined in §173.115, must have an exterior surface finish conforming to §178.245-1(c) of this subchapter.

(4) No portable tank or specification 106A or 110A tank containing a hazardous material may be offered for transportation aboard a passenger vessel unless:

(i) The vessel is operating under a change to its character of vessel certification as defined in §171.8 of this subchapter; and

(ii) The material is permitted to be transported aboard a passenger vessel in §172.101 of this subchapter.

(5) Where IM-101 and IM-102 portable tanks are prescribed, Specification 51 portable tanks otherwise conforming to the special commodity requirements of §172.102(c)(7) of this subchapter may be used.

(6) A DOT 51 portable tank may be used where DOT 56 or DOT 57 type portable tanks or DOT 60 portable tanks are authorized. A DOT 60 portable tank may be used where DOT 56 or DOT 57 type portable tanks are authorized. A higher integrity tank used instead of a specified portable tank must meet the same design profile; e.g., a DOT 51 portable tank must be lined if used instead of a lined DOT 60 portable tank.

(b) Any portable tank container constructed prior to May 15, 1950, complying with the requirements of either the A. S. M. E. Code for Unfired Pressure Vessels, 1946 Edition, or the A. P. I.-A. S. M. E. Code for Unfired Pressure Vessels, 1943 Edition, may be used for the transportation of liquefied compressed gas, provided it fulfills all the requirements of this part and specifications for the particular gas or gases to be transported therein and shall be marked "ICC Specification 51X" on the plate required by the specification, except as modified by any or all of the following:

(1) Tanks designed and constructed in accordance with Pars. U-68, U-69, or U-201 of the A. S. M. E. Code may be used. Tanks designed and constructed in accordance with Par. U-68 or U-69 may be re-rated at a working pressure 25 percent in excess of the design pressure for which the tank was originally constructed. If advantage is taken of the increased rating, the re-rated pressure shall be marked on the plate as follows:

Re-rated working pressure-psig

Note 1: For purposes of setting safety relief valves, pressure control valves and establishing retest pressure, and for purposes of establishing maximum and minimum design pressures, the re-rated working pressure shall be considered as the equivalent of the design pressure as defined in the specification.

(2) Loading and unloading accessories, valves, piping, fittings, safety and gauging devices, do not have to comply with the requirements for the particular location on the tank.

(3) Specification requirements as to stress-relieving and radiographing are waived.

(c) Any portable tank container of ICC Specification 50[1] fulfilling the requirements of that specification may be continued in service for transportation of a liquefied petroleum gas if it is retested every five years in accordance with the requirements of paragraphs (e)(3) and (4) of this section: *Provided, That it is in and can be maintained in safe operating condition for the transportation of that gas. In this case the container may retain its original markings.*

[1]Use of existing portable tanks authorized, but new construction not authorized.

(d) *Use of Specification 52, 53, 56 and 57 portable tanks. Continued use of an existing portable tank constructed to DOT Specification 52 or 53 is authorized only for a tank constructed before June 1, 1972. Continued use of an existing portable tank constructed to DOT Specification 56 or 57 is authorized only for a tank constructed before October 1, 1996. A stainless steel portable tank internally lined with polyethylene, which was constructed on or before October 1, 1996, and complies with all requirements of Specification 57 except that it is equipped with a polypropylene discharge ball valve and polypropylene secondary discharge opening closure, may be marked as a Specification 57 portable tank and used in accordance with the provisions of this section.*

(e) Retest. Each portable tank used for the transportation of a hazardous material must be successfully retested before further use in accordance with the following:

(1) Schedule. Each tank must be retested as prescribed in paragraph (e)(2) of this section, in accordance with the following schedule:

(i) Specification 51 (§178.245 of this subchapter): At least once every 5 years.

(ii) Specifications 52, 53, 56 and 57 portable tanks (§§178.251, 178.252, 178.253 of this subchapter): At least once every 2.5 years.

(iii) Specification 60 (§178.255 of this subchapter): At the end of the first 4-year period after the original test; at least once every 2 years thereafter up to a total of 12 years of service; and at least once annually thereafter. Retesting is not required on a rubber-lined tank except before each relining.

(iv) Any other portable tank authorized by this part for transportation of compressed gases (including liquefied compressed gases): At least once every 5 years.

(2) *Test procedures. Unless otherwise specified, each tank must be retested in accordance with the following test procedures:*

(i) Pressure. Each Specification 60 tank must be retested in accordance with §178.255-12 of this subchapter. Each Specification 57 tank must be leak tested by a minimum sustained air pressure of at least three pounds per square inch gage applied to the entire tank. Any other tank must be tested by a minimum pressure (air or hydrostatic) of at least 2 pounds per square inch gage or at least one and one-half times the design pressure (maximum allowable working pressure, or re-rated pressure) of the tank, whichever is greater. During each air pressure test, the entire surface of all joints under pressure must be coated with or immersed in a solution of soap and water, heavy oil, or other material suitable for the purpose of detecting leaks. The pressure must be held for a period of time sufficiently long to assure detection of leaks. During the air or hydrostatic test, relief devices may be removed, but all the closure fittings must be in place and the relief device openings plugged. Lagging need not be removed from a lagged tank if it is possible to maintain the required test pressure at constant temperature with the tank disconnected from the source of pressure.

(ii) Visual. While under the test pressure, the tank must be visually inspected for leakage, defective fittings and welds, defective closures, significant dents, and other defects or abnormalities which indicate a potential or actual weakness that could render the tank unsafe for the transportation of a hazardous material.

(iii) Rejection criteria. A tank fails to meet the requirements of the pressure test if, during the test, there is permanent distortion of the tank exceeding that permitted by the applicable specification, if there is any leakage, or if any deficiencies described in paragraph (e)(2)(ii) of this section are found. Any tank that fails must be rejected and may not be used again for the transportation of a hazardous material unless the tank is adequately repaired and thereafter a successful test is conducted in accordance with the requirements of this paragraph.

(3) Marking. The date of the most recent periodic retest must be marked on the tank, on or near the metal certification plate. Marking must be in accordance with §178.3 of this subchapter.

(4) Records. The owner of the tank or his authorized agent must retain a written record indicating the date and results of all required tests and the name and address of the tester, until the next retest has been satisfactorily completed and recorded.

(5) A portable tank for which the prescribed retest or reinspection under paragraph (e)(1) of this section has become due may not be filled and offered for transportation until the retest or reinspection has been successfully completed. This paragraph does not apply to any tank filled prior to the test due date.

(f) *Special tanks. Each portable tank authorized by this part including each exemption tank (other than a tank covered by paragraph (e)(1)(iv) of this section) which is not in* *compliance with one of the specifications listed in paragraph (e) of this section, must be tested in accordance with the procedures prescribed in paragraph (e) of this section for the type of portable tank most nearly equivalent in design and usage. A tank constructed in accordance with paragraph U-68 or U-69 of previous editions of the ASME Code, and which has not been re-rated, must be hydrostatically retested at twice the design pressure instead of the one and one-half times prescribed in paragraph (e)(2)(i) of this section.*

(g) Deteriorated tanks. Without regard to any other retest requirements, any tank that shows evidence at any time of significant dents, corroded areas, leakage, or other conditions that indicate weakness which could render the tank unsafe for the transportation of a hazardous material, must be retested as prescribed in paragraph (e)(2) of this section.

(h) Damaged tanks. Any tank that has been in an accident and that has been damaged to an extent that may adversely affect its product retention capability, must be retested as prescribed in paragraph (e)(2) of this section.

(i) Unused tanks. Any tank that has not been used to transport a hazardous material for a period of 1 year or more may not be returned to hazardous materials service until it has been tested successfully in accordance with the requirements of paragraph (e)(2) of this section.

(j) The Department may require the testing under prescribed conditions of any tank when probable cause appears for suspecting that such tank is in unsafe operating condition.

(k) The repair of tanks is authorized, provided such repairs are made under requirements prescribed in the "Code" for the original design and construction.

(1) In addition to any other provisions of the specification, no tank shall be repaired, or remodeled, as to cause leakage or cracks or likelihood of leakage or cracks, by areas of stress concentration due to shrinkage of cooling metal in welding operations, sharp fillets, reversal of stresses, or otherwise.

(2) No field welding shall be done except to non-pressure parts.

(l) The bursting strength of any piping and fittings shall be not less than four times the design pressure of the tank, and not less than four times that pressure to which, in any instance, it may be subjected in service, by the action of a pump or other device (not including safety relief valves) the action of which may be to subject certain portions of the tank piping to pressures greater than the design pressure of the tank.

(1) Pipe joints shall be threaded, welded or flanged. If threaded pipe is used, the pipe and pipe fittings must not be lighter than (Schedule 80) weight. Nonmalleable metals must not be used in the construction of valves or fittings. Where copper tubing is permitted, joints must be brazed or be of equally strong metal union type. The melting point of brazing material may not be lower than 1000 ^{o}F. The method of joining tubing must not decrease the strength of the tubing such as by the cutting of threads.

(2) Fittings shall be extra heavy. Non-malleable metals shall not be employed in the construction of valves or fittings.

(3) Suitable provision shall be made in every case to allow for expansion, contraction, jarring and vibration of all pipe. Slip joints shall not be used for this purpose.

(4) Piping and fittings shall be grouped in the smallest practicable space and shall be protected from damage as required by the specification.

(5) All piping, valves and fittings on every tank shall be leakage tested with gas or air after installation and proved tight at not less than the design pressure of the tank on which they are used. In the event of replacement, all such piping, valves, or fittings so replaced shall be tested in accordance with the requirements of this section before the tank is returned to transportation service. The requirements of this section shall apply with equal force to all hose used on such tanks, except that such hose may be so tested either before or after installation on the tank.

(m) All materials of construction used in portable tank containers and their appurtenances shall not be subject to destructive attack by the contents of the tank.

(1) All parts of tanks and appurtenances for anhydrous ammonia shall be steel. No copper, silver, zinc, nor their alloys shall be permitted. Brazed joints shall not be permitted.

(2) [Reserved]

(n) Each outlet of portable tanks used for the transportation of liquefied compressed gases, except carbon dioxide, shall be provided with a suitable automatic excess-flow valve. These valves shall be located inside the tank or at a point outside the tank where the line enters or leaves the tank. The valve seat shall be located inside the tank or shall be located within a welded flange or its companion flange, or within a nozzle or within a coupling. The installation shall be made in such a manner as reasonably to assure that any undue strain which causes failure requiring functioning of the valve shall cause failure in such a manner that it will not impair the operation of the valve.

Exception. Safety device connections and liquid level gauging devices which are so constructed that the outward flow of tank contents shall not exceed that passed by a No. 54 drill size opening are not required to be equipped with excess-flow valves.

(1) Excess-flow valves shall close automatically at the rated flows of gas or liquid as specified by the valve manufacturer. The connections or lines on each side of the excess-flow valve, including valves, fittings, etc., shall have a greater capacity than the rated flow of the excess-flow valve.

(2) Excess-flow valves may be designed with a by-pass, not to exceed a No. 60 drill size opening, to allow equalization of pressures.

(3) Filling and discharge lines shall be provided with manually operated shut-off valves located as close to the tank as is practicable. The use of so-called "Stop-Check" valves to satisfy with one valve the requirements of this paragraph and of paragraph (n) of this section, is forbidden.

(o) Each tank for carbon dioxide and nitrous oxide shall be lagged with a suitable insulation material of such thickness that the overall thermal conductance is not more than 0.08 Btu per square foot per degree F. differential in temperature per hour. The conductance shall be determined at 60 ^{o}F. Insulation material used on tanks for nitrous oxide shall be noncombustible.

(p) A refrigerating and/or heating coil or coils may be installed in tanks for carbon dioxide and nitrous oxide. Such coils must be tested externally to at least the same pressure as the test pressure of the tank. The coils must also be tested internally to at least twice the working pressure of the heating or refrigerating system to be used but in no case less than the test pressure of the tank. Such coils shall be securely anchored. The refrigerant or heating medium to be circulated through the coil or coils must be such as to cause no adverse chemical reaction with the tank or tank contents in case of leakage.

(q) *Maximum Lading Pressure. Prior to filling and offering a portable tank for transportation, the person must confirm that the portable tank conforms to the specification required for the lading and that the maximum allowable working pressure (MAWP) of the portable tank is greater than or equal to the largest pressure obtained under the following conditions:*

(1) For compressed gases and certain refrigerated liquids that are not cryogenic liquids, the pressure prescribed in §173.315 of this subchapter.

(2) For liquid hazardous materials not covered in paragraph (q)(1) of this section, the sum of the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F), plus the tank static head exerted by the lading, plus any pressure exerted by the gas padding, including air in the ullage space.

(3) The pressure prescribed in subpart B, D, E, F, G, or H of this part, as applicable.

(4) The maximum pressure used to load or unload the lading.

(r) Unless otherwise specified, where a portable tank is authorized, minimum tank design pressure is 172 kPa (25 psig) for any Packing Group I or Packing Group II liquid lading that meets more than one hazard class definition.

(s) Any DOT specification portable tank manufactured prior to January 1, 1992 that is equipped with a non-reclosable pressure relief device can continue in service for the commodities for which it is authorized. Except for DOT Specification 56 and 57 portable tanks, any DOT specification portable tank manufactured after January 1, 1992 used for materials meeting the definition for Division 6.1 liquids, Packing Group I or II, Class 2 gases, or Class 3 or 4 liquids, must be equipped with a reclosing pressure relief valve having adequately-sized venting capacity.

(t) *Exemption portable tanks based on DOT 51 portable tanks. (1) The owner of a portable tank constructed in accordance with and used under an exemption issued prior to August 31, 1996, that was in conformance with the requirements for Specification DOT 51 portable tanks with the exception of the location of fill and discharge outlets, shall examine the portable tank and its design to determine if it meets the new outlet requirements contained in §178.245-1(d) of this subchapter. If the owner determines that the portable tank is in compliance with all the requirements of §178.245 of this subchapter, the exemption number stenciled on the portable tank shall be removed and the specification plate (or a plate placed adjacent to the specification plate) shall be durably marked "DOT 51-E*****" (where ***** is to be replaced by the exemption number).*

(2) During the period the portable tank is in service, and for one year thereafter, the owner of the portable tank must retain on file at its principal place of business a copy of the last exemption in effect.

[29 FR 18671, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.32, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.32a Approval of Specification IM portable tanks.

(a) *Application for approval. (1) An owner or manufacturer of an IM portable tank (§§178.270 through 178.272 of this subchapter) shall apply for approval to any approval agency designated to approve that tank in accordance with the procedures in subpart E, part 107 of this chapter.*

(2) Each application for approval must contain the following information:

(i) Three complete copies of all engineering drawings, calculations, and test data necessary to insure that the design complies with the relevant specification.

(ii) The manufacturer's serial number that will be assigned to each portable tank.

(iii) A statement as to whether the design type has been examined by any approval agency previously and judged unacceptable. Affirmative statements must be documented with the name of the approving agency, reason for nonacceptance, and the nature of modifications made to the design type.

(b) *Action by approval agency. The approval agency shall:*

(1) Review the application for approval to determine whether it is complete and conforms with the requirements of paragraph (a) of this section. If an application is incomplete, it will be returned to the applicant and the applicant will be informed in what respects the application is incomplete.

(2) Review all drawings and calculations to ensure that the design is in compliance with all requirements of the relevant specification. If the application is approved, one set of the approved drawings, calculations, and test data shall be returned to the applicant. The second and third (inspector's copy) sets of approved drawings, calculations, and test data shall be retained by the approval agency.

(3) Witness all tests required in §178.270-13 of this subchapter.

(4) Ensure, through appropriate inspection that each IM portable tank is fabricated in all respects in conformance with the approved drawings, calculations, and test data; and

(5) Upon successful completion of all requirements of this subpart, the approval agency shall:

(i) Apply its name, identifying mark or identifying number, and the date upon which the approval was issued, to the metal identification plate required by §178.270-14 of this subchapter.

(ii) Issue an approval certificate for each IM portable tank or, in the case of a series of identical tanks manufactured to a single design, for the series of IM portable tanks. The approval certificate must include all the information required to be displayed on the required metal identification plate.

(c) *Disposition of approval certificates. A copy of each approval certificate must be retained by the approval agency and by the owner of each IM portable tank.*
(d) Denial of application for approval. If an approval agency finds that an IM portable tank cannot be approved for any reason, it shall so notify the applicant in writing and shall provide the applicant with the reasons for which the approval is denied. An applicant aggrieved by a decision of an approval agency may appeal the decision in writing within 90 days of receipt to the Associate Administrator for Hazardous Materials Safety.
(e) [Reserved]
(f) *Approval of other existing IM portable tanks. Portable tanks constructed on or before May 1, 1981, that have not operated under a DOT exemption must be approved in accordance with the provisions of paragraph (b) of this section.*
(g) Modifications to approved portable tanks. (1) Prior to modification of any approved portable tank which may affect conformance to §178.271 or §178.272 of this subchapter, the owner or manufacturer desiring to make such modification shall inform the approval agency that issued the initial approval of the portable tank (or if unavailable another approval agency) of the nature of the modification and request approval of the modification. The owner or manufacturer shall supply the approval agency with three sets of all revised drawings, calculations, and test data relative to the intended modification.
(2) A statement as to whether the intended modification has been examined by any approval agency previously and judged unacceptable. An affirmative statement must be documented with the name of the approving agency, the reason for nonacceptance, and the nature of changes made to the modification since its original rejection.
(3) The approval agency shall review the request for modification, and if it is determined that the proposed modification is in full compliance with the relevant DOT specification the request shall be approved and the approval agency shall:
(i) Return one set of the approved revised drawings, calculations, and test data to the applicant. The second and third sets of the approved revised drawings, calculations, and test data shall be retained by the approval agency as required in §107.404(a)(3) of this chapter.
(ii) Ensure through appropriate inspection, that all modifications conform to the revised drawings, calculations, and test data.
(iii) Determine the extent to which retesting of the modified tank is necessary based on the nature of the proposed modification, and ensure that all required retests are performed in accordance with §178.270-13 of this subchapter.
(iv) If modification to an approved tank alters any information on the approval certificate, issue a new approval certificate for the modified tank and ensure that any necessary changes are made to the metal identification plate. A copy of each newly issued approval certificate shall be retained by the approval agency and by the owner of each portable tank.
(4) If it determined that the proposed modification is not in compliance with the relevant DOT specification, the request shall be denied. The procedures of paragraph (d) of this section apply to such denial.

(h) *Termination of Approval Certificate. (1) The Associate Administrator for Hazardous Materials Safety may terminate an approval issued under this section if he determines that:*
(i) Information upon which the approval was based is fraudulent or substantially erroneous; or
(ii) Termination of the approval is necessary to adequately protect against risks to life and property.
(iii) The approval was not issued by the approval agency in good faith.
(2) Before an approval is withdrawn, the Associate Administrator for Hazardous Materials Safety gives the owner or manufacturer and the approval agency:
(i) Written notice of the facts or conduct believed to warrant the withdrawal;
(ii) Opportunity to submit oral and written evidence, and
(iii) Opportunity to demonstrate or achieve compliance with the application requirement.
(3) If the Associate Administrator for Hazardous Materials Safety determines that a certificate of approval must be withdrawn to preclude a significant and imminent adverse affect on public safety, he shall withdraw the certificate of approval issued by a designated approval agency. In such circumstances, the procedures of paragraphs (h)(2) (ii) and (iii) of this section need not be provided prior to withdrawal of the approval, but shall be provided as soon as practicable thereafter.

[Amdt. 173-144, 46 FR 9890, Jan. 29, 1981, as amended by Amdt. 173-185, 50 FR 11052, Mar. 19, 1985; Amdt. 173-224, 56 FR 66279, Dec. 20, 1991; Amdt. 173-253, 61 FR 27174, May 30, 1996]

§173.32b Periodic testing and inspection of Specification IM portable tanks.

(a) *Periodic testing-(1) Hydrostatic test. Each Specification IM portable tank (§§178.270, 178.271 and 178.272 of this subchapter) and all piping, valves and accessories, except pressure-relief devices, shall be hydrostatically tested with water, or other liquid of similar density and viscosity, to a pressure not less than 150 percent of its maximum allowable working pressure. Testing shall be at intervals of not more than five years. While under pressure the tank shall be inspected, for leakage, distortion, or any other condition which might render the tank unsafe for service. The hydrostatic test shall be witnessed by an approval agency. Any damage or deficiency which might render the portable tank unsafe for service shall be repaired to the satisfaction of the witnessing approval agency and the tank hydrostatically retested. Upon successful completion of the hydrostatic test, the witnessing approval agency shall apply its name, identifying mark or identifying number and the date of the test on the tank as described in paragraph (d) of this section.*

(2) Pressure relief valves. Spring loaded pressure relief valves must be removed from the tank and tested at intervals of not more than two and one-half years.

(b) Visual inspection. Each portable tank and all piping, valves and accessories shall be visually inspected at intervals not exceeding two and one-half years. The inspection shall be conducted by an owner or his agent or by an approval agency, except that it must be conducted by an approval agency coincident with each hydrostatic test required by paragraph (a) of this section. In the case of insulated tanks, insulation need not be removed if, in the opinion of the person performing the visual inspection, external corrosion is likely to be negligible. If evidence of any unsafe condition is discovered, the portable tank may not be returned to service until such condition has been corrected to the satisfaction of the person performing the inspection. The inspection shall include the following:

(1) The tank shall be carefully inspected internally for corroded areas, dents, distortions, defects in welds, and other conditions that might render the tank unsafe for service. The two and one-half year internal inspection may be waived for portable tanks dedicated to the transportation of a single hazardous material if it is leakproofness tested prior to each filling, or if approved by the Associate Administrator for Hazardous Materials Safety.

(2) The piping, valves, and gaskets shall be carefully inspected for corroded areas, defects in welds, and other conditions, including leakage, that might render the tank unsafe for service.

(3) Devices for tightening manhole covers must be operative and there must be no leakage at manhole covers or gaskets.

(4) Missing or loose bolts or nuts on any flanged connection or blank flange must be replaced or tightened.

(5) All emergency devices and valves must be free from corrosion, distortion and any damage or defect that could prevent their normal operation.

(6) Required markings on the tank must be legible.

(7) Upon successful completion of the visual reinspection, the inspector shall mark the date of the visual reinspection on the tank as described in paragraph (d) of this section.

(c) *International shipments. A portable tank that meets the definition of "container" in §450.3(a)(3) of this title may not be offered for international transport unless the frame work, tank supports and lifting attachments fully comply with all applicable requirements of parts 450-453 of this title.*

(d) Test date marking. The month and year of the last hydrostatic test, the identification markings of the approval agency witnessing the test, and the date of the last visual inspection must be durably and legibly marked on or near the metal identification plate in letters not less than 3 mm (0.118 inches) high when on the metal identification plate and 32 mm (1.25 inches) high when on the tank.

(e) Damaged or deteriorated portable tanks. Without regard to any other test requirement, any tank that shows evidence at any time of damaged or corroded areas, leakage, or other deterioration that indicates a weakness that could render the tank unsafe for service, must be inspected and tested in accordance with the requirements of paragraphs (a) and (b) of this section prior to reuse. Pressure relief devices need not be tested or replaced unless there is reason to believe the relief devices have been affected by the damage or deterioration.

(f) Record retention. The owner of each portable tank or his authorized agent shall retain a written record of the date and results of all required tests, (including visual inspections), and the name and address of the person performing the test, until the next retest has been satisfactorily completed and recorded.

[Amdt. 173-144, 46 FR 9891, Jan. 29, 1981, as amended at 64 FR 10776, Mar. 5, 1999]

§173.32c Use of Specification IM portable tanks.

(a) No person may offer a hazardous material for transportation in an IM portable tank except as authorized by this subchapter.

(b) Except as otherwise provided in this subpart, an IM portable tank may not be used for the transportation of a hazardous material unless it meets the requirements of this subchapter.

(c) An IM portable tank for which the prescribed periodic retest or reinspection under §173.32b of this subchapter has become due may not be filled and offered for shipment until the retest or reinspection has been successfully completed. This paragraph does not apply to any tank filled prior to the test due date.

(d) Prior to filling, each IM portable tank shall be given a complete external inspection. Any unsafe condition must be corrected prior to its use. The external inspection shall include:

(1) A visual inspection of:

(i) The shell, piping, valves and other appurtenances for corroded areas, dents, defects in welds and other defects such as missing, damaged, or leaking gaskets;

(ii) All flanged connections or blank flanges for missing or loose nuts and bolts;

(iii) All emergency devices for corrosion, distortion, or any damage or defect that could prevent their normal operation; and

(iv) All required markings on the tank for legibility.

(2) An inspection to determine that any device for tightening manhole covers is operative and adequate to prevent leakage at the manhole cover.

(e) A hazardous material may not be loaded in an IM portable tank if the part of the tank or any of its appurtenances having contact with the material during transportation would be subject to destructive attack by or a dangerous reaction with the material.

(f) A hazardous material may not be loaded in an IM portable tank unless it has pressure relief devices providing total relieving capacity meeting the requirements of §178.270-11(d) of this subchapter.

(g) A hazardous material may not be loaded in an IM portable tank with filling or discharge connections located below the normal liquid level of the tank unless:

(1) Each filling or discharge connection located below the normal liquid level of the tank has at least two serially-mounted closures consisting of an internal discharge valve and a bolted blank flange or other suitable, liquid-tight closure on each filling or discharge connection; or

(2) When this paragraph (g)(2) is specified for a hazardous material through §172.102(c)(7) of this subchapter, each filling or discharge connection located below the

normal liquid level of the tank, or compartment thereof, has three serially-mounted closures consisting of an internal discharge valve capable of being closed from a location remote from the valve itself, an external valve, and a bolted blank flange or other suitable, liquid-tight closure on the outlet side of the external valve.

(h) Except during a hydrostatic test, an IM portable tank may not be subjected to a pressure greater than its maximum allowable working pressure.

(i) An IM portable tank may not be loaded to a gross weight greater than the maximum allowable gross weight specified on its identification plate.

(j) Except for a non-flowable solid or a liquid with a viscosity of 2,680 centistokes (millimeters squared per second) or greater at 20°C, an IM portable tank or compartment thereof having a volume greater than 7,500 L (1,980 gallons) may not be loaded to a filling density of more than 20% and less than 80% by volume. If a portable tank is divided by partitions or surge plates into compartments of not more than 7,500 L capacity, this filling restriction does not apply.

(k) The outage for an IM portable tank may not be less than 2 percent at a temperature of 122 °F (50 °C).

(l) Each tell-tale indicator for the space between a frangible disc and a safety relief valve mounted in series must be checked after the tank is filled and prior to transportation to ensure that the frangible disc is leak free. Any leakage through the frangible disc must be corrected prior to offering the tank for transportation. The tell-tale device must be designed to prevent the loss of any hazardous material through the device itself while the tank is in transportation.

(m) An IM portable tank containing a hazardous material may not be loaded on a highway or rail transport vehicle unless loaded entirely within the horizontal outline thereof, without overhang or projection of any part of the tank assembly. In addition, for unloading an IM portable tank, see §177.834(h) of this subchapter.

(n) Specifications IM 101 and IM 102 portable tanks used for the transportation of flammable liquids via rail may not be fitted with nonreclosing pressure relief devices except in series with spring loaded pressure relief valves.

(o) An IM 101 tank may be used whenever an IM 102 tank is authorized provided it meets the requirements for pressure relief devices, bottom outlets and any other special provisions specified for the IM 102 tank in §172.102 of this subchapter.

(p) Any IM 101 or IM 102 portable tank certified by an approval agency prior to January 1, 1992, that is equipped with a non-reclosable pressure relief device may continue in service for the commodities for which it is authorized. Any IM 101 and IM 102 portable tank certified after January 1, 1992, used for materials meeting the definition for Division 6.1 liquids, Packing Group I or II, or Class 3 or 4 liquids, must be equipped with a reclosing pressure relief valve having adequately-sized venting capacity.

(q) If the hazardous material being transported is in a molten state, the tank must be thermally insulated by completely covering it with at least 100 mm (3.94 inches) of cork or other suitable insulation material of sufficient thickness that the overall thermal conductance is not more than 0.080 Btu per hour per square foot per degree Fahrenheit differential.

(r) Hazardous materials authorized for transport in a tank fitted with bottom outlets having two serially mounted closures are also authorized for transport in a tank fitted with three serially mounted closures and in tanks fitted with no bottom outlets. Similarly, hazardous materials authorized for transport in tanks fitted with bottom outlets having three serially mounted closures are also authorized for transport in tanks fitted with no bottom outlets.

[Amdt. 173-144, 46 FR 9892, Jan. 29, 1981, as amended by Amdt. 173-224, 55 FR 52616 Dec. 21, 1990; 56 FR 66266, Dec. 20, 1991; 57 FR 45460, 45461, Oct. 1, 1992; Amdt. 173-261, 62 FR 24719, May 6, 1997; 63 FR 37461, July 10, 1998; 64 FR 10777, Mar. 5, 1999; 64 FR 44428, Aug. 16, 1999]

§173.33 Hazardous materials in cargo tank motor vehicles.

(a) *General requirements. (1) No person may offer or accept a hazardous material for transportation in a cargo tank motor vehicle except as authorized by this subchapter.*

(2) Two or more materials may not be loaded or accepted for transportation in the same cargo tank motor vehicle if, as a result of any mixture of the materials, an unsafe condition would occur, such as an explosion, fire, excessive increase in pressure or heat, or the release of toxic vapors.

(3) No person may fill and offer for transportation a specification cargo tank motor vehicle for which the prescribed periodic retest or reinspection under subpart E of part 180 of this subchapter is past due until the retest or inspection has been successfully completed. This requirement does not apply to a cargo tank supplied by a motor carrier who is other than the person offering the hazardous material for transportation (see §180.407(a)(1) of this subchapter), or to any cargo tank filled prior to the retest or inspection due date.

(b) *Loading requirements. (1) A hazardous material may not be loaded in a cargo tank if during transportation any part of the tank in contact with the hazardous material lading would have a dangerous reaction with the hazardous material.*

(2) A cargo tank may not be loaded with a hazardous material that will have an adverse effect on the tank's integrity or-

(i) May combine chemically with any residue or contaminants in the tank to produce an explosion, fire, excessive increase in pressure, release of toxic vapors or other unsafe condition.

(ii)-(iii) [Reserved]

(iv) May severely corrode or react with the tank material at any concentration and temperature that will exist during transportation.

(v) Is prohibited by §173.21 or §173.24 of this subchapter.

(3) Air pressure in excess of ambient atmospheric pressure may not be used to load or unload any lading which may create an air-enriched mixture within the flammability range of the lading in the vapor space of the tank.

(4) To prevent cargo tank rupture in a loading or unloading accident, the loading or

unloading rate used must be less than or equal to that indicated on the cargo tank specification plate, except as specified in §173.318(b)(6). If no loading or unloading rate is marked on the specification plate, the loading or unloading rate and pressure used must be limited such that the pressure in the tank may not exceed 130% of the MAWP.

(c) *Maximum Lading Pressure. (1) Prior to loading and offering a cargo tank motor vehicle for transportation with material that requires the use of a specification cargo tank, the person must confirm that the cargo tank motor vehicle conforms to the specification required for the lading and that the MAWP of the cargo tank is greater than or equal to the largest pressure obtained under the following conditions:*

(i) For compressed gases and certain refrigerated liquids that are not cryogenic liquids, the pressure prescribed in §173.315 of this subchapter.

(ii) For cryogenic liquids, the pressure prescribed in §173.318 of this subchapter.

(iii) For liquid hazardous materials loaded in DOT specification cargo tanks equipped with a 1 psig normal vent, the sum of the tank static head plus 1 psig. In addition, for hazardous materials loaded in these cargo tanks, the vapor pressure of the lading at 115 ^{o}F. must be not greater than 1 psig, except for gasoline transported in accordance with Special Provision B33 in §172.102(c)(3) of this subchapter.

(iv) For liquid hazardous materials not covered in paragraph (c)(1)(i), (ii), or (iii) of this section, the sum of the vapor pressure of the lading at 115 ^{o}F, plus the tank static head exerted by the lading, plus any pressure exerted by the gas padding, including air in the ullage space or dome.

(v) The pressure prescribed in subpart B, D, E, F, G, or H of this part, as applicable.

(vi) The maximum pressure in the tank during loading or unloading.

(2) Any Specification MC 300, MC 301, MC 302, MC 303, MC 305, MC 306 or MC 312, cargo tank motor vehicle with no marked design pressure or marked with a design pressure of 3 psig or less may be used for an authorized lading where the pressure derived from §173.33(c)(1) is less than or equal to 3 psig. After December 31, 1990, a cargo tank may not be loaded and offered for transportation unless marked or remarked with an MAWP or design pressure in accordance with 49 CFR 180.405(k).

(3) Any Specification MC 310 or MC 311 cargo tank motor vehicle may be used for an authorized lading where the pressure derived from §173.33(c)(1) is less than or equal to the MAWP or MWP, respectively, as marked on the specification plate.

(4) Any cargo tank marked or certified before August 31, 1995, marked with a design pressure rather than an MAWP may be used for an authorized lading where the largest pressure derived from §173.33(c)(1) is less than or equal to the design pressure marked on the cargo tank.

(5) Any material that meets the definition of a Division 6.1, Packing Group I or II (poisonous liquid) material must be loaded in a cargo tank motor vehicle having a MAWP of 25 psig or greater.

(d) *Relief system. (1) Non-reclosing pressure relief devices are not authorized in any cargo tank except when in series with a reclosing pressure relief device. However, a cargo tank marked or certified before August 31, 1995 which is fitted with non-reclosing pressure relief devices may continue to be used in any hazardous material service for which it is authorized. The requirements in this paragraph do not apply to MC 330, MC*

331 and MC 338 cargo tanks.

(2) Each cargo tank motor vehicle used to transport a liquid hazardous material with a gas pad must have a pressure relief system that provides the venting capacity prescribed in §178.345-10(e) of this subchapter. The requirements in this paragraph do not apply to MC 330, MC 331 and MC 338 cargo tanks.

(3) A cargo tank motor vehicle made to a specification listed in column 1 may have pressure relief devices or outlets conforming to the applicable specification to which the tank was constructed, or the pressure relief devices or outlets may be modified to meet the applicable requirement for the specification listed in column 2 without changing the markings on the tank specification plate. The venting capacity requirements of the original DOT cargo tank specification must be met whenever a pressure relief valve is modified.

Column 1	Column 2
MC 300, MC 301, MC 302, MC 303, MC 305	MC 306 or DOT 406.
MC 306	DOT 406.
MC 304	MC 307 or DOT 407.
MC 307	DOT 407.
MC 310, MC 311	MC 312 or DOT 412.
MC 312	DOT 412.
MC 330	MC 331.

(e) *Retention of hazardous materials in product piping during transportation. DOT specification cargo tanks used for the transportation of any material that is a Division 6.1 (poisonous liquid) material, oxidizer liquid, liquid organic peroxide or corrosive liquid (corrosive to skin only) may not be transported with hazardous materials lading retained in the piping, unless the cargo tank motor vehicle is equipped with bottom damage protection devices meeting the requirements of §178.337-10 or §178.345-8(b) of this subchapter, or the accident damage protection requirements of the specification under which it was manufactured. This requirement does not apply to a residue which remains after the piping is drained. A sacrificial device (see §178.345-1 of this subchapter) may not be used to satisfy the accident damage protection requirements of this paragraph.*

(f) An MC 331 type cargo tank may be used where MC 306, MC 307, MC 312, DOT 406, DOT 407 or DOT 412 type cargo tanks are authorized. An MC 307, MC 312, DOT 407 or DOT 412 type cargo tank may be used where MC 306 or DOT 406 type cargo tanks are authorized. A higher integrity tank used instead of a specified tank must meet the same design profile (for example, an MC 331 cargo tank must be lined if used in place of a lined MC 312 cargo tank.)

(g) Unless otherwise specified, where MC 307, MC 312, DOT 407 or DOT 412 cargo tanks are authorized, minimum tank design pressure is 172.4 kPa (25 psig) for any Packing Group I or Packing Group II liquid lading that meets more than one hazard class definition.

(h) Each liquid or vapor discharge opening in an MC 330 or MC 331 cargo tank and each liquid filling and liquid discharge line in an MC 338 cargo tank must be provided with a remotely controlled internal self-closing stop valve, except when an MC 330 or MC 331 cargo tank is marked and used exclusively to transport carbon dioxide, or except when an MC 338 is used to transport argon, carbon dioxide, helium, krypton, neon, nitrogen, and xenon. However, if the cargo tank motor vehicle was certified before January 1, 1995, this requirement is applicable only when an MC 330 or MC 331 cargo tank is used to transport a flammable liquid, flammable gas, hydrogen chloride (refrigerated liquid), or anhydrous ammonia; or when an MC 338 cargo tank is used to transport flammable ladings.

[Amdt. 173-212, 54 FR 25005, June 12, 1989, as amended at 55 FR 37048, Sept. 7, 1990; Amdt. 173-224, 55 FR 52616 Dec. 21, 1990; Amdt. 173-212, 56 FR 27875, June 17, 1991; 57 FR 45461, Oct. 1, 1992; Amdt. 173-212, 58 FR 12905, Mar. 8, 1993; Amdt. 173-212, 59 FR 1786, Jan. 12, 1994; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994; Amdt. 173-240, 59 FR 55172, Nov. 3, 1994; Amdt. 173-241, 59 FR 67492, Dec. 29, 1994; 63 FR 52849, Oct. 1, 1998]

§173.34 Qualification, maintenance and use of cylinders.

(a) *General qualification for use of cylinders. (See §§173.1 through 173.30 for requirements applying to all shipments.)*

(1) No person may charge or fill a cylinder unless it is as specified in this part and part 178 of this subchapter. A cylinder that leaks, is bulged, has defective valves or safety devices, bears evidence of physical abuse, fire or heat damage, or detrimental rusting or corrosion, must not be used unless it is properly repaired and requalified as prescribed in these regulations.

(2) When cylinders with a marked pressure limit are prescribed, other cylinders made under the same specification but with a higher marked service pressure limit are authorized. For example, cylinders marked DOT-4B500 may be used where DOT-4B300 is specified.

(b) *Grandfather clause. A cylinder in domestic use previous to the date upon which the specification therefor was first made effective in these regulations may be used if the cylinder has been properly tested and otherwise complies with the requirements applicable for the gas with which it is charged.*

(c) Cylinder marking. Each required marking on a cylinder must be maintained so that it is legible. Retest markings and original markings which are becoming illegible may be reproduced by stamping on a metal plate which must be permanently secured to the cylinder.

(1) Additional information not affecting the markings prescribed in the applicable cylinder specification may be placed on the cylinder. No indentation may be made in the sidewall of the cylinder unless specifically permitted in the applicable specification.

(2) When the space originally provided for dates of subsequent retests becomes

filled, the stamping of additional test dates into the external surface of the footring of a cylinder is authorized.

(3) Except for marked service pressure, markings required on cylinders may not be altered or removed. The marked service pressure may be changed only upon application to the Associate Administrator for Hazardous Materials Safety and receipt of written instructions as to the procedure to be followed. A service pressure change is not authorized for a cylinder which fails to pass the prescribed periodic hydrostatic retest, unless it is reheat treated and requalified in accordance with this section.

(d) *Pressure relief device systems. No person may offer a cylinder charged with a compressed gas for transportation in commerce unless the cylinder is equipped with one or more pressure relief devices sized and selected as to type, location, and quantity and tested in accordance with CGA Pamphlet S-1.1 (compliance with paragraph 9.1.1.1 of CGA Pamphlet S-1.1 is not required). The pressure relief device system must be capable of preventing rupture of the normally charged cylinder when subjected to a fire test conducted in accordance with CGA Pamphlet C-14, or in the case of an acetylene cylinder, CGA Pamphlet C-12. Cylinders shall not be shipped with leaking safety relief devices. Safety relief devices must be tested for leaks before the charged cylinder is shipped from the cylinder filling plant; it is expressly forbidden to repair leaking fuse plug devices, where leak is through the fusible metal or between the fusible metal and the opening in the plug body, (except by removal of the device and replacement of the fusible metal.) Exceptions are as follows:*

(1) Except as provided in paragraphs (d)(1) (i) through (iii) of this section, a pressure relief device is not required on a cylinder 12 inches or less in length, exclusive of neck, and $4^{1/2}$ inches or less in outside diameter.

(i) A pressure relief device is required on a specification 9, 39 (§178.65 of this subchapter), 40, or 41 cylinder. A metal pressure relief valve is required on a specification 39 cylinder used for a liquefied flammable gas. A fusible pressure relief device is not authorized on a specification 39 cylinder containing a liquefied compressed gas.

(ii) A pressure relief device is required on a cylinder charged with a liquefied gas for which this part requires a service pressure of 1800 psi or higher.

(iii) A pressure relief device is required on a cylinder charged with a nonliquefied gas to a pressure of 1,800 psi or higher at 70 ^{o}F.

(2) Except for a specification 39 cylinder and a cylinder used for acetylene in solution, a pressure relief device is not required on a cylinder charged with a nonliquefied gas under pressure of 300 psi or less at 70 ^{o}F.

(3) A pressure relief device is prohibited on a cylinder charged with a Division 2.3 or Division 6.1 material in Hazard Zone A.

(4) A pressure relief device is prohibited on a cylinder charged with fluorine.

(5) A pressure relief device is not required on a cylinder charged with methyl mercaptan; with mono-, di-, or trimethylamine, anhydrous; with not over 10 pounds of nitrosyl chloride; or with less than 165 pounds of anhydrous ammonia.

(6) Pressure relief devices, if used, must be in the vapor space of cylinders containing pyroforic liquids, inorganic or organic, n.o.s., covered by §173.124.

(e) *Periodic qualification and marking of cylinders. Each cylinder that becomes due for periodic retest as specified in the following table must be retested and marked in conformance with the requirements of this paragraph (e):*

Retest and Inspection of Cylinders[1]

Specification under which cylinder was made	Minimum retest pressure (p.s.i.)	Retest period (years)
DOT-3	3,000 p.s.i	5
DOT-3A, 3AA	5/3 times service pressure, except non-corrosive service (see §173.34(e)(13))	5, 10, or 12 (see §173.34 (e)(14), (e)(12), (e)(16), and (e)(19))
DOT-3AL	5/3 times service pressure	5 or 12 (see (e)(19))
DOT-3AX, 3AAX	5/3 times service pressure	5
3B, 3BN	2 times service pressure (see §173.34(e)(13))	5 or 10 (see §173.34(e)(12))
3C	Retest not required.	-
3D	5/3 times service pressure	5
3E	Retest not required.	-
3HT	5/3 times service pressure	3 (see §173.34(e)(15))
3T	5/3 times service pressure	5
4	700 p.s.i	10
4A	5/3 times service pressure (see §173.34(e)(13))	5 or 10 (see §173.34(e)(12))
4AA480	2 times service pressure (see §173.34(e)(13))	5 or 10 (see §173.34(e)(14))
4B, 4BA, 4BW, 4B-240ET	2 times service pressure, except non-corrosive service (see §173.34(e)(13))	5, 10 or 12 (see §173.34 (e)(11), (e)(12) and (e)(19))
4C	Retest not required.	-
4D, 4DA, 4DS	2 times service pressure	5
DOT-4E	2 times service pressure, except non-corrosive service (see §173.34(e)(13))	5
4L	Retest not required.	-
8, 8AL	-	10 or 20 (see §173.34(e)(18))
DOT-9	400 p.s.i. (maximum 600 p.s.i.)	5
25	500 p.s.i	5
26 for filling at over 450 p.s.i	5/3 times service pressure	5
26 for filling at 450 p.s.i. and below	2 times service pressure, except non-corrosive service (see §173.34(e)(13))	5 or 10 (see §173.34(e)(11))
33	800 p.s.i	5
38	500 p.s.i	5
Exemption cylinder	See current exemption	See current exemption
Foreign cylinder (see §173.301(j) for restrictions on use)[4]	As marked on the cylinder, but not less than 5/3 of any service or working pressure marking	5

[1]Any cylinder not exceeding two inches outside diameter and less than two feet in length is excepted from hydrostatic retest.

[2]A cylinder in chlorine or sulfur dioxide service made before April 20, 1915, must be retested at 500 psi.

[3]For cylinders not marked with a service pressure, see §173.301(e)(1).

[4] For CTC cylinders, see §173.301(i). The retest period for CTC cylinders authorized under §173.301(i) is the period specified in the table for the corresponding DOT specification cylinder.

(1) *General requirements. (i) Each cylinder bearing a DOT specification marking (including a cylinder remarked in conformance with §173.23) must be inspected, retested and marked in conformance with this section, at the frequency specified in the Retest and Inspection of Cylinders Table in this paragraph (e). Each cylinder bearing a DOT exemption number must be inspected, retested and marked in conformance with this section and the terms of the applicable exemption, at the frequency specified in the exemption.*

(ii) No cylinder required to be retested by paragraph (e)(1)(i) of this section may be charged or filled with a hazardous material and transported in commerce unless that cylinder has been inspected and retested in accordance with this section and the retester has marked the cylinder by stamping the date of retest, the cylinder retester identification number unless excepted under this section, and any other marking required by this section. No person may mark a test date or a retester identification number on a DOT specification or exemption cylinder unless all applicable requirements of this section have been met.

(2) *Retester authorization. (i) No person may mark a cylinder with a test date or retester identification number, or otherwise represent that a DOT specification or exemption cylinder has been retested under this section, unless that person holds a current retester identification number issued by the Associate Administrator for Hazardous Material Safety and operates in compliance with the terms of the retester identification number issuance letter. With the exception of visual inspections, all functions under this section must be performed or supervised by an individual named as qualified in the retester identification number application or a notification pursuant to paragraph (e)(2)(iv) of this section. A person is not required to obtain a retester identification number, if the person only performs visual inspections on DOT specification or exemption cylinders.*

(ii) Any person seeking approval as a cylinder retester shall arrange for an independent inspection agency, approved by the Associate Administrator for Hazardous Material Safety pursuant to §173.300a, to inspect its retest facility. The person seeking approval shall bear the cost of the inspection. Independent inspection agencies are not RSPA agents or representatives. A list of approved independent inspection agencies is available from the Associate Administrator for Hazardous Materials Safety, Office of Hazardous Materials Exemptions and Approvals (DHM-32), Research and Special Programs Administration, U.S. Department of Transportation, Washington, DC 20590-0001. Assistance in obtaining an approval may be requested from the same address.

(A) After the inspection, the person seeking approval must submit a letter of recommendation and inspection report from the independent inspection agency and a completed request for approval to the Associate Administrator for Hazardous Materials Safety at the address listed in this paragraph (e)(2)(ii). An applicant must include the following information: company name; facility location; mailing address (if different from location of facility); business telephone number; name of facility manager; the DOT specification/exemption cylinders that will be tested at the facility; a certification that the facility will operate in compliance with the applicable requirements of this subchapter, the date and an authorized signature.

(B) The Associate Administrator for Hazardous Materials Safety reviews the application, the inspection report and recommendation submitted by the independent inspection agency, and other available information. The Associate Administrator for Hazardous Materials Safety issues a retester identification number upon a finding that the applicant's facility and qualifications are adequate to properly inspect, test and mark cylinders under this section. Unless otherwise provided in the retester identification number issuance letter, a retester identification number expires five years from the date of issuance.

(iii) An approved retester shall apply for retester identification number renewal in a timely manner. A new inspection report and recommendation of an independent inspection agency are required for each renewal. If the Associate Administrator for Hazardous Materials Safety receives a renewal application with the accompanying inspection report and recommendation at least 50 days before expiration of the retester identification number, the retester identification number remains in effect until the Associate Administrator for Hazardous Materials Safety issues a renewal or notifies the retester that its request for renewal of the retester identification number is denied. The Associate Administrator for Hazardous Materials Safety considers renewal of a retester identification number in accordance with the standard in paragraph (e)(2)(ii)(B) of this section.

(iv) The retester identification number holder shall report in writing any change in its name, address, ownership, testing equipment, or management or personnel performing any function under this section, to the Associate Administrator for Hazardous Materials Safety (DHM-32) within 20 days of the change. A retester identification number remains valid only if the retester's facility and qualifications are maintained at or above the level observed at the time of inspection by the independent inspection agency.

(v) A retester shall maintain, at each location at which it inspects, retests or marks cylinders under this section:

(A) Current copies of those portions of this subchapter that apply to its cylinder inspection, retesting and marking activities at that location.

(B) Current copies of all exemptions governing exemption cylinders inspected, retested or marked by the retester at that location.

(C) Copies of each CGA pamphlet incorporated by reference in §171.7 of this subchapter that applies to the retester's cylinder inspection, retesting and marking activities at that location. The publication maintained must be the edition incorporated by reference in §171.7 of this subchapter.

(3) *Visual inspection. Except as otherwise provided in this section, each time a*

cylinder is retested, it must be visually inspected, internally and externally, in accordance with CGA Pamphlets C-6, C-6.1, C-6.2, or C-6.3, as applicable. The cylinder must be approved, rejected or condemned according to the criteria in the applicable CGA pamphlet. Internal inspection may be omitted for cylinders of the type and in the service described under paragraph (e)(13) of this section. DOT 3BN cylinders must be inspected in accordance with CGA Pamphlet C-6.

(4) Pressure retest. (i) Unless otherwise provided, each cylinder required to be retested under this section must be retested by means suitable for measuring the expansion of the cylinder under pressure. Bands and other removable attachments must be loosened or removed before testing so that the cylinder is free to expand in all directions.

(ii) The pressure-indicating device of the testing apparatus must permit reading of pressures to within 1% of the minimum prescribed test pressure of each cylinder tested, except that for an analog device, interpolation to $^{1/2}$ of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cubic centimeter, whichever is larger. Midpoint visual interpolation is permitted.

(iii) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator for Hazardous Materials Safety that:

(A) The pressure-indicating device, as part of the retest apparatus, is accurate within +1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of +0.5%, or better, of its full range, and must permit readings of pressure from 90%-110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at any point within 500 psi of the actual test pressure for test pressures at or above 3000 psi, or 10% of the actual test pressure for test pressures below 3000 psi; and

(B) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to +1.0% of the total expansion of any cylinder tested or 0.1 cubic centimeter, whichever is larger. The expansion-indicating device itself must have an accuracy of +0.5%, or better, of its full scale.

(iv) The test equipment must be verified to be accurate within +1.0% of the calibrated cylinder's pressure and corresponding expansion values. This may be accomplished by bringing the pressure to a value shown on the calibration certificate for the calibrated cylinder used and verifying that the resulting total expansion is within +1.0% of the total expansion shown on the calibration certificate. Alternatively, calibration may be demonstrated by bringing the total expansion to a known value on the calibration certificate for the calibrated cylinder used and verifying that the resulting pressure is within +1.0% of the pressure shown on the calibration certificate. The calibrated cylinder must show no permanent expansion. The retester shall demonstrate calibration in conformance with this paragraph (e)(4) to an authorized inspector on any day that it retests cylinders. A retester shall maintain calibrated cylinder certificates in conformance with paragraph (e)(8)(iii) of this section.

(v) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10 percent or 100 psi, whichever is less. This paragraph (e)(4) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (e)(6) of this section.

(5) *Cylinder rejection. (i) A retester shall reject a cylinder when on visual inspection, it meets a rejection standard in CGA Pamphlets C-6, C-6.1, C-6.2, or C-6.3, as applicable.*

(ii) Except as provided in paragraph (e)(5)(iv) of this section, a cylinder that is rejected may not be marked as meeting the requirements of this section.

(iii) When a cylinder is rejected, the retester shall notify the cylinder owner, in writing, that the cylinder has been rejected and, unless requalified as provided in paragraph (e)(5)(iv) of this section, may not be filled with a hazardous material for transportation in commerce where use of a specification packaging is required.

(iv) A rejected cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently reinspected and retested in conformance with-

(A) CGA Pamphlets C-6, C-6.1, C-6.2, or C-6.3, as applicable;

(B) Parts 173 and 178 of this subchapter;

(C) Any exemption specific to that cylinder; and

(D) Any approval required under paragraphs (i) and (l) of this section.

(6) *Cylinder condemnation. (i) A cylinder must be condemned when-*

(A) On inspection, it meets a condition for condemnation in CGA Pamphlets C-6, C-6.1, C-6.2, or C-6.3, as applicable;

(B) The cylinder leaks through its wall;

(C) Evidence of cracking exists to the extent that the cylinder is likely to be weakened appreciably;

(D) For a DOT specification cylinder other than a DOT 4E aluminum cylinder, permanent expansion exceeds 10 percent of total expansion;

(E) For a DOT 4E aluminum cylinder, permanent expansion exceeds 12 percent of total expansion;

(F) For a DOT exemption cylinder, permanent expansion exceeds the limit in the applicable exemption, or the cylinder meets another criterion for condemnation in the applicable exemption; or

(G) For a DOT specification 3HT cylinder, elastic expansion exceeds the marked rejection elastic expansion.

(ii) When a cylinder is required to be condemned, the retester shall stamp a series of X's over the DOT specification number and the marked service pressure or stamp "CONDEMNED" on the shoulder, top head, or neck using a steel stamp. Alternatively, at the direction of the owner, the retester may render the cylinder incapable of holding pressure.

(iii) When a cylinder is required to be condemned, the retester shall notify the cylinder owner, in writing, that the cylinder is condemned and may not be filled with hazardous material for transportation in commerce where use of a specification packaging is required.

(iv) A cylinder that is condemned may not be filled with hazardous material for transportation in commerce where use of a specification packaging is required and may not be marked as meeting the requirements of this section or any DOT exemption. No person may remove or obliterate the "CONDEMNED" marking.

(7) *Retester markings. (i) Each cylinder passing retest must be marked with the retester's identification number set in a square pattern, between the month and year of the retest date, in characters not less than 1/8-inch high. The first character of the retester identification number must appear in the upper left corner of the square pattern; the second in the upper right; the third in the lower right, and the fourth in the lower left. Example: A cylinder retested in May 1994, and approved by a person who has been issued retester identification number "A123", would be marked plainly and permanently into the metal of the cylinder in accordance with location requirements of the cylinder specification or on a metal plate permanently secured to the cylinder in accordance with paragraph (c) of this section:*

[ILLUSTRATION GOES HERE]

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(ii) Markings of previous tests may not be obliterated. A cylinder that is subject to the requirements of paragraph (e) (10), (11) (modified hydrostatic test only), (13) or (14) of this section is not required to be marked with a retester identification number. A cylinder requalified by the modified hydrostatic test method or external inspection must be marked after a retest or an inspection by stamping the date of retest or reinspection on the cylinder followed by the symbol "E" (external inspection) or "S" (modified hydrostatic test method) as appropriate. However, a cylinder subject to the requirements of §173.301(j) may not be marked with a retester identification number. Variation from the marking requirement may be approved on written request to the Associate Administrator for Hazardous Materials Safety.

(8) Recordkeeping. A retester shall maintain the following records at the retesting location, on paper or in a form from which a paper copy can be produced on request.

(i) Records of authority to inspect, retest and mark must be maintained, as follows:

(A) Current retester identification number issuance letter;

(B) If the retester identification number has expired and renewal is pending, a copy of the renewal request; and

(C) Copies of notifications to Associate Administrator for Hazardous Materials Safety required under paragraph (e)(2)(iv) of this section.

(ii) Daily records of visual inspection and hydrostatic retest must be maintained until either the expiration of the retest period or until the cylinder is again reinspected or retested, whichever occurs first. A single date may be used for each retest sheet, provided each retest on the sheet was conducted on that date. Ditto marks or a solid vertical line may be used to indicate repetition of the preceding entry for the following entries: date; actual dimensions or a symbol; if present, manufacturer's name or symbol; if present, owner's name or symbol and retest operator. Blank spaces may not be used to indicate repetition of a prior entry. Records must include-

(A) For each test to demonstrate calibration, the date; serial number of the calibrated cylinder; calibration test pressure; total, elastic and permanent expansions; and legible identification of retest operator. The retest operator must be able to demonstrate that the results of the daily calibration verification correspond to the hydrostatic retests that were performed on that day. The daily verification of calibration(s) may be recorded on the same sheets as, and with, retest records for that date;

(B) For each cylinder retested or visually inspected, records containing the date; serial number; ICC/DOT specification or exemption number; service pressure; actual dimensions or a symbol; if present, manufacturer's name or symbol; if present, owner's name or symbol; result of visual inspection; actual test pressure; total, elastic and permanent expansions; percent permanent expansion; disposition, with reason for any repeated retest, rejection or condemnation; and legible identification of test operator. For each cylinder marked pursuant to §173.302(c)(5), the retest sheet must indicate the method by which any average or maximum wall stress was computed. Records must be kept for all completed retests, as well as unsuccessful retests under paragraph (e)(4)(v) of this section. The entry for a later retest under paragraph (e)(4)(v) of this section after a failure to hold test pressure, or retest of a cylinder requalified after rejection, must indicate the date of the earlier inspection or retest; and

(C) Calculations of average and maximum wall stress pursuant to §173.302(c)(3), if performed.

(iii) The most recent certificate of calibration must be maintained for each calibrated cylinder used by the retester.

(9) *DOT 4-series cylinders. A DOT 4-series cylinder, except 4L cylinders, that at any time shows evidence of a leak or of internal or external corrosion, denting, bulging or rough usage to the extent that it is likely to be weakened appreciably; or that has lost five percent or more of its official tare weight must be retested before being recharged and shipped. (Refer to CGA Pamphlet C-6 or C-6.3, as applicable, regarding cylinder weakening.) After retest, the actual tare weight must be recorded as the new tare weight.*

(10) Cylinders 12 pounds or less with service pressures of 300 psi or less. A cylinder of 12 pounds or less water capacity authorized for service pressure of 300 psi or less must be given a complete external visual inspection at the time periodic retest becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.3. The cylinder may be hydrostatically retested without a water jacket and without determining total and permanent expansions. The retest is successful if the cylinder, when examined under test pressure, does not display a defect described in paragraph (e)(6)(i) (B) or (C) of this section.

(11) Modified hydrostatic retest. A cylinder made in compliance with specification DOT 4B, DOT 4BA, DOT 4BW, DOT 4E or ICC-26-300[2] (§§178.50, 178.51, 178.61,

178.68 of this subchapter) that is used exclusively for anhydrous dimethylamine; anhydrous methylamine; anhydrous trimethylamine; methyl chloride; liquefied petroleum gas; methylacetylene-propadiene stabilized; or dichlorodifluoromethane, difluoroethane, difluorochloroethane, chlorodifluoromethane, chlorotetrafluoroethane, trifluorochloroethylene, or mixture thereof, or mixtures of one or more with trichlorofluoromethane; and that is commercially free from corroding components and protected externally by a suitable corrosion-resistant coating (such as galvanizing or painting) may be given a hydrostatic retest every 12 years instead of every five years. Alternatively, the cylinder may be subjected to internal hydrostatic pressure of at least two times the marked service pressure without determination of expansions, but this latter type of test must be repeated every seven years after expiration of the first 12-year period. When subjected to the latter test, the cylinder must be carefully examined under test pressure and removed from service if a leak or other harmful defect exists. A cylinder requalified by the modified hydrostatic test method must be marked after a retest or an inspection by stamping the date of retest or reinspection on the cylinder followed by a "S".

[2]For filling at 450 p.s.i. and below. Use of existing cylinders authorized; new construction not authorized.

(12) A cylinder made in conformance with specification DOT-3A, DOT-3AA, DOT-3B, DOT-4BA or DOT-4BW (§§178.36, 178.37, 178.38, 178.51, 178.61 of this subchapter) having a service pressure of 300 psi or less that is used exclusively for methyl bromide, liquid; mixtures of methyl bromide and ethylene dibromide, liquid; mixtures of methyl bromide and chlorpicrin, liquid; mixtures of methyl bromide and petroleum solvents, liquid; or methyl bromide and nonflammable, nonliquefied compressed gas mixtures, liquid; that is commercially free of corroding components, and that is protected externally by a suitable corrosion resistant coating (such as galvanizing or painting) and internally by a suitable corrosion resistant lining (such as galvanizing) may be tested every 10 years instead of every five years, provided that a visual internal and external examination of the cylinder is conducted every five years in accordance with CGA Pamphlet C-6. The cylinder must be examined at each filling, and rejected if a dent, corroded area, leak or other condition indicates possible weakness.

(13) A cylinder made in conformance with a specification listed in the table in this paragraph (e)(13) and used exclusively in the service indicated may, instead of a periodic hydrostatic retest, be given a complete external visual inspection at the time periodic retest becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.3. When this inspection is used instead of hydrostatic retesting, subsequent inspections are required at five-year intervals after the first inspection. Inspections must be made only by competent persons and the results recorded and maintained in accordance with paragraph (e)(8) of this section. Records shall include: date of inspection (month and year); DOT specification number; cylinder identification (registered symbol and serial number, date of manufacture, and owner); type of cylinder protective coating (including statement as to need of refinishing or recoating); conditions checked (e.g., leakage, corrosion, gouges, dents or digs in shell or heads, broken or damaged footring or protective ring or fire damage); disposition of

cylinder (returned to service, returned to cylinder manufacturer for repairs or scrapped). A cylinder that passes inspection shall be marked with the date in accordance with paragraph (e)(7) of this section. An "E" after the date indicates requalification by the external inspection method. Specification cylinders must be in exclusive service as follows:

Cylinders made in compliance with-	Used exclusively for-
DOT-4, DOT-3A, DOT-3AA, DOT-3A480X, DOT-4A, DOT-4AA480.	Anhydrous ammonia of at least 99.95% purity.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, ICC-26-240,[1] ICC-26-300[1]	Butadiene, inhibited, which is commercially free from corroding components.
DOT-3A, DOT-3A480X, DOT-3AA, DOT-3B, DOT-4A, DOT-4AA480, DOT-4B, DOT-4BA, DOT-4BW	Cyclopropane which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E	Fluorinated hydrocarbons and mixtures thereof which are commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E, ICC-26-240,1 ICC-26-3001	Liquefied hydrocarbon gas which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E, ICC-26-2401, ICC-26-3001	Liquefied petroleum gas which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-4E	Methylacetylene-propadiene, stabilized, which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW	Anhydrous mono, di, trimethylamines which are commercially free from corroding components.
DOT-4B240, DOT-4BW240	Ethyleneimine, inhibited.

[1]Use of existing cylinders authorized; new construction not authorized.

(14) *Cylinders containing anhydrous ammonia. A cylinder made in compliance with specification DOT-3A, DOT-3A 480X, or DOT-4AA480 used exclusively for anhydrous ammonia, commercially free from corroding components, and protected externally by a suitable corrosion-resistant coating (such as painting) may be retested every 10 years instead of every five years.*

(15) 3HT cylinders. (i) In addition to the other requirements of this section, a cylinder marked DOT-3HT must be requalified in accordance with CGA Pamphlet C-8.

(ii) The cylinder must be condemned:

(A) If elastic expansion exceeds the marked rejection elastic expansion. A cylinder made before January 17, 1978, and not marked with a rejection elastic expansion in cubic centimeters near the marked original elastic expansion must be so marked before the next retest date. The rejection elastic expansion for a cylinder is 1.05 times its original elastic expansion.

(B) If there is evidence of denting or bulging.

(C) Twenty-four years after the date of the original test or after 4,380 pressurizations, whichever occurs first. If a cylinder is recharged, on average, more than once every other day, an accurate record of the number of rechargings must be maintained by the cylinder owner or his/her agent.

(iii) The retest date and retester identification number must be applied by low-stress steel stamp to a depth no greater than that of the marking at the time of manufacture. Stamping on the sidewall is not authorized.

(16) *DOT-3A or 3AA cylinders. (i) A cylinder made in conformance with specification DOT-3A or 3AA with a water capacity of 125 pounds or less that is removed from any cluster, bank, group, rack or vehicle each time it is filled, may be retested every ten years instead of every five years, provided the cylinder complies with all of the following-*

(A) The cylinder was manufactured after December 31, 1945;

(B) The cylinder is used exclusively for air, argon, cyclopropane, ethylene, helium, hydrogen, krypton, neon, nitrogen, nitrous oxide, oxygen, sulfur hexafluoride, xenon, permitted mixtures of these gases (see §173.301(a)) and permitted mixtures of these gases with up to 30 percent by volume of carbon dioxide, provided that the gas has a dew point at or below minus 52 ^{o}F at 1 atmosphere;

(C) Before each refill, the cylinder passes the hammer test specified in CGA Pamphlet C-6;

(D) The cylinder is dried immediately after hydrostatic testing to remove all traces of free water;

(E) The cylinder is not used for underwater breathing; and

(F) Each cylinder is stamped with a five-point star at least one-fourth of an inch high immediately following the test date.

(ii) If, since the last required hydrostatic retest, a cylinder has not been used exclusively as specified in paragraph (e)(16)(i)(B) of this section, but currently conforms with all other provisions of paragraph (e)(16)(i) of this section, it may be retested every 10 years instead of every five years, provided it is first retested and examined as prescribed by §173.302(c)(2), (3) and (4).

(iii) Except as specified in paragraph (e)(16)(ii) of this section, if a cylinder marked with a star is charged with a compressed gas other than as specified in this paragraph (e)(16), the star following the most recent test date must be obliterated. The cylinder must be retested five years from the marked retest date, or prior to the first charging with a compressed gas, if the required five-year retest period has passed.

(17) *Cylinders containing corrosive materials. (i) A cylinder that previously contained a Class 8 (corrosive) material may not be used to transport a compressed gas in commerce unless the following requirements are met-*

(A) The cylinder is visually inspected, internally and externally, in accordance with CGA Pamphlet C-6;

(B) Regardless of the date of previous retest, the cylinder is subjected to and passes inspection and hydrostatic retest in accordance with this section; and

(C) The record prescribed in paragraph (e)(8) of this section includes: the month and year of inspection and test; the cylinder identification (including ICC or DOT specification number, registered symbol, serial number, date of manufacture and owner); the conditions checked (e.g., leakage, corrosion, gouges, dents, or digs in shell or heads, broken or damaged footrings, fire damage) and the disposition of the cylinder (returned to service, returned to the manufacturer for repairs, or scrapped).

(ii) A cylinder requalified for compressed gas service in accordance with this paragraph (e)(17) may have its next retest and inspection scheduled from the date of the inspection and retest prescribed in this paragraph (e). If decontamination cannot remove all significant residue or impregnation by the Class 8 material, the cylinder may not be used to transport compressed gas in commerce.

(18) *DOT 8 and 8AL cylinders. (i) Each owner of a DOT 8 or 8AL cylinder used to transport acetylene must have the cylinder shell and the porous filler requalified in accordance with CGA Pamphlet C-13. Requalification must be performed in accordance with the following schedule:*

Date of cylinder manufacture	Shell (visual inspection) requalification		Porous filler requalification	
-	Initial	Subsequent	Initial	Subsequent
Before January 1, 1991	Before January 1, 2001	10 yrs	Before January 1, 2011	Not required.
On or after January 1, 1991	10 yrs[1]	10 yrs	3 to 20 yrs[2]	Not required.

[1]Years from date of cylinder manufacture.

[2]For a cylinder manufactured on or after January 1, 1991, requalification of the porous filler must be performed no sooner than 3 years, and no later than 20 years, from the date of manufacture.

(ii) Unless requalified and marked in accordance with CGA Pamphlet C-13 before October 1, 1994, an acetylene cylinder must be requalified by a person who holds a valid retester identification number. Each cylinder successfully passing a shell or filler requalification must be marked with the retester's identification number in accordance with paragraph (e)(7) of this section. In addition, the cylinder must be marked to identify the type of requalification performed in accordance with paragraph 5.6 of CGA Pamphlet C-13. For example, the letter "S" must be used for a shell requalification and the letter "F" for a porous filler requalification.

(iii) If a cylinder valve is replaced, a cylinder valve of the same weight must be used or the tare weight of the cylinder must be adjusted to compensate for valve weight differential.

(19) *Cylinders used as fire extinguishers. Only DOT specification cylinders used as fire extinguishers and meeting Special Provision 18 in §172.102(c)(1) of this subchapter may be retested in accordance with this paragraph (e)(19).*

(i) A DOT specification 4B, 4BA, 4B240ET or 4BW (§§178.50, 178.51, 178.55 and 178.61 of this subchapter) cylinder may be retested as follows:

(A) For a cylinder with a water capacity of 12 pounds or less by hydrostatic test using the water jacket method or by hydrostatic test without determination of expansion (modified hydrostatic test method). A retest must be performed 12 years after the original test date and at 12-year intervals thereafter.

(B) For a cylinder having a water capacity over 12 pounds-

(*1) By hydrostatic test without determination of expansion (modified hydrostatic test method). A retest must be performed 12 years after the original test date and at 7-year intervals; or*

(2) By hydrostatic test using the water jacket method. A retest must be performed 12 years after the original test date and at 12-year intervals thereafter.

(ii) A DOT specification 3A, 3AA, or 3AL (§§178.36, 178.37 and 178.46 of this subchapter) cylinder may be retested by hydrostatic test using the water jacket method. A retest must be performed 12 years after the original test date and at 12-year intervals thereafter.

(f) *Cylinders subjected to the action of fire. A cylinder which has been subjected to the action of fire must not again be placed in service until it has been properly reconditioned as follows:*

(1) A cylinder made of plain carbon steel with not over 0.25 percent carbon nor over 0.90 manganese need not be reheat-treated but must pass the periodic retest requirements as specified in paragraph (e) of this section.

(2) DOT 8 and 8AL cylinders made entirely of carbon steel with 0.25 percent or less carbon and with 0.90 percent or less manganese, must be reinspected to determine the condition of the cylinder and the porous filler, as prescribed in CGA Pamphlet C-13. If the cylinder has been damaged, the porous filler must be removed and the cylinder must be heat treated and retested. The porous filler must be replaced in accordance with the specification to which the cylinder was made. A cylinder may be returned to service without reheat treatment or retest if the cylinder has no fire or mechanical damage and the porous filler is unchanged and intact.

(3) The inner cylinders made under specification DOT-4L (§178.57 of this chapter) may be used after again passing the original hydrostatic test.

(4) DOT 3AL and DOT 4E aluminum cylinders may not be reheat treated and must be removed from service.

(5) Other cylinders must be reheat treated and reconditioned as specified in paragraph (g) of this section.

(g) *Reheat treatment. (1) Previous to the reheat treatment procedure hereinafter prescribed, each cylinder must be subjected to a careful internal and external inspection.*

(2) Cylinders must be segregated for reheat treatment in lots of 100 or less cylinders of the same general size having practically the same chemical composition.

(3) The reheat treatment operation must be carried out, supervised, and reported as prescribed for the heat treatment in the specification covering the manufacture of the cylinder in question. Data from the original reports of manufacture of the cylinders must be available.

(4) The reheat treatment must be followed by hydrostatic retest, such retest to be carried out, supervised, and reported as prescribed for the hydrostatic tests in the specification covering the manufacture of the cylinder in question. The results of the retest must meet either of the following conditions:

(i) The permanent expansion shall be from zero to 10 percent of the total expansion in the hydrostatic retest and one cylinder from each lot shall pass the requirements of the flattening and physical tests prescribed. Failure to pass the flattening or physical tests will reject the lot or;

(ii) The permanent expansion shall not be less than 3 percent nor more than 10 percent of the total expansion in the hydrostatic retest, in which case the flattening and physical tests are not required. For this alternative method the hydrostatic retest pressure may not exceed 115 percent of the minimum prescribed test pressure.

(h) *Repair by welding or brazing of specifications DOT-3A, 3AA, 3B, 3C cylinders. Repair of specifications DOT-3A, 3AA, 3B or 3C (§§178.36(e), 178.37(e), 178.38(e), and 178.40(e) of this subchapter) cylinders by welding or brazing authorized, but only for the removal and replacement of neckrings and footrings attached to cylinders originally manufactured to conform to §§178.36-9(a), 178.37-9(a), 178.38-9(a), and 178.40-9(a) of this subchapter. Removal and replacement must be done by a regular manufacturer of this type of cylinder. After removal and before replacement of such parts, cylinders must be inspected, and defective ones rejected. Cylinders, neckrings, footrings, and method of replacement must conform to §178.36(e), 178.37(e), 178.38(e), or 178.40(e) of this subchapter whichever applies. Replacement must be followed by reheat treating, testing, inspection, and supervised and reported as prescribed by the specification covering their original manufacture. Inspector's reports must conform with that required by the specification covering original manufacture with the word "repaired" substituted for "manufactured." Show original markings and the new additional markings added, and statement: "Cylinders were carefully inspected for defects after removal of neckrings and footrings and after replacement, which replacement was made by process of _____ (Welding-brazing)."*

(i) Repair by welding or brazing of DOT-4 series and DOT-8, welded or brazed cylinders. Repairs on DOT-4 series and DOT-8 series welded or brazed cylinders are authorized to be made by welding or brazing. Such repairs must be made by a manufacturer of these types of DOT cylinders or by a repair facility approved by the Associate Administrator for Hazardous Materials Safety and by a process similar to that used in its manufacture and under the following specific requirements:

(1) Cylinders with injurious defects in welded joints in or on pressure parts must be repaired by completely removing the defect prior to rewelding.

(2) Cylinders with injurious defects in brazed joints in or on pressure parts must be repaired by rebrazing.

(3) Cylinders during welding must be free of materials in contact with the welded joint that may impair the serviceability of the metal in or adjacent to the weld. (Precautions must be taken to prevent acetylene cylinder steels from picking up carbon during repair.)

(4) Neckrings, footrings, or other nonpressure attachments authorized by the specification may be replaced or repaired. Repair or replacement of footrings, neckrings, or other nonpressure attachments authorized by the specification for DOT-4BA and 8AL (§§178.51 and 178.60 of this subchapter) cylinders may be made without conforming to the requirements of paragraph (i)(6) of this section provided the following requirements are met:

(i) Must be done by a manufacturer of these types of DOT cylinders or by a repair facility approved by the Associate Administrator for Hazardous Materials Safety.

(ii) The welder shall have available to him information as to the procedure equipment, and rod used during manufacture and shall use a similar method for repair.

(iii) Repairs must be by metal arc welding only. Welds shall be 3 inches maximum length and spaced at least 3 inches apart.

(iv) Welds shall not be made on or near a brazed joint (to prevent the possibility of copper penetration).

(v) After repair the welds are to be inspected visually for weld quality.

(vi) After repair the weld area is to be leak tested at the service pressure of the cylinder.

(5) After removal, and before replacement of attachments, cylinders must be inspected and defective ones rejected, repaired or rebuilt.

(6) After repair, cylinders must be reheat-treated, tested, inspected and reported when and as prescribed by the specification covering their original manufacture when welding or brazing seams in a pressure part of a cylinder; or when welding or brazing on pressure parts of cylinders of plain carbon steels with carbon over 0.25 percent or manganese over 1.00 percent or of alloy steels except as provided in §173.34(i)(7).

Note 1: Heat-treatment is not required after welding or brazing weldable low carbon parts to attachments of similar material which has been previously welded or brazed to the top or bottom of cylinders and properly heat-treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400 ^{o}F. in any part of the top or bottom material.

(7) Repair of cylinders must be followed by a proof pressure leakage test at prescribed test pressure and visual examination for weld quality when welding on pressure parts of cylinders of plain carbon 0.25 percent or less and manganese 1.00 percent or less, or when repairing steel types 1315, NAX and GLX by the following procedure:

(i) Leakage through the welding metal may be repaired without subsequent reheat treatment of the cylinder.

(ii) Repair permitted only by either the metal arc or tungsten inert gas shielded arc process. E7015, 7016, or 7018 electrodes not larger than $^{1/8}$ inch diameter shall be used for the metal arc process.

(iii) Weld defects must be removed by grinding or chipping before repair by the metal arc process. The tungsten inert gas shielded arc process may be used for repair only when such repair can be made by puddling. Repair weld shall not exceed 1 inch in length nor be closer than 3 inches to the next repair area.

(iv) Repair of weld defects which have any cracking is not permitted.

(j) *Repair of non-pressure attachments. Repair of non-pressure attachments by welding or brazing without affecting a pressure part of the cylinder must be followed by visual examination for weld quality.*

(k) Prohibited repairs. Walls, heads or bottoms of cylinders with injurious defects or leaks in base metal shall not be repaired, but may be replaced as provided for in paragraph (l) of this section.

(l) Rebuilding of DOT-4 series and DOT-8, welded or brazed cylinders. Rebuilding of DOT-4 series and DOT-8 series, welded or brazed cylinders is authorized. Such rebuilding must be done by a manufacturer of these types of DOT cylinders or by a repair facility approved by the Associate Administrator for Hazardous Materials Safety and by a process similar to that used in its original manufacture and under the following specific requirements:

(1) The replacement of a pressure part such as wall, heads, or bottoms of cylinders or the replacement of the porous filling material, shall be considered as rebuilding.

(2) Rebuilt cylinders shall be considered as new cylinders and shall conform to all the requirements of the specifications applying, including verification of material, examination, inspection, etc., and the rendering of the proper reports to the purchaser, cylinder rebuilder, and the Associate Administrator for Hazardous Materials Safety. Report must show that cylinders were rebuilt.

(3) Information in sufficient detail regarding previous serial numbers and identification symbols must be filed with the Associate Administrator for Hazardous Materials Safety.

(Approved by the Office of Management and Budget under control number 2137-0022)

[29 FR 18671, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.34, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.35 Hazardous materials in intermediate bulk containers (IBCs).

(a) No person may offer or accept a hazardous material for transportation in an intermediate bulk container except as authorized by this subchapter. Each intermediate bulk container used for the transportation of hazardous materials must conform to the requirements of its specification and regulations for the transportation of the particular commodity. A specification intermediate bulk container, for which the prescribed periodic retest or inspection under subpart D of part 180 of this subchapter is past due, may not be filled and offered for transportation until the retest or inspection have been successfully completed. This requirement does not apply to any intermediate bulk container filled prior to the retest or inspection due date.

(b) Initial use and reuse of IBCs. An IBC other than a multiwall paper IBC (13M1 and 13M2) may be reused. If an inner liner is required, the inner liner must be replaced before each reuse. Before an IBC is filled and offered for transportation, the IBC and its service equipment must be given an external visual inspection, by the person filling the IBC, to ensure that:

(1) The IBC is free from corrosion, contamination, cracks, cuts, or other damage which

would render it unable to pass the prescribed design type test to which it is certified and marked; and
(2) The IBC is marked in accordance with requirements in §178.703 of this subchapter. Additional marking allowed for each design type may be present. Required markings that are missing, damaged or difficult to read must be restored or returned to original condition.
(c) A metal intermediate bulk container, or a part thereof, subject to thinning by mechanical abrasion or corrosion due to the lading, must be protected by providing a suitable increase in thickness of material, a lining or some other suitable method of protection. Increased thickness for corrosion or abrasion protection must be added to the wall thickness specified in §178.705(c)(1)(iv) of this subchapter.
(d) Notwithstanding requirements in §173.24b of this subpart, when filling an intermediate bulk container with liquids, sufficient ullage must be left to ensure that, at the mean bulk temperature of 50 ^{o}C (122 ^{o}F), the intermediate bulk container is not filled to more than 98 percent of its water capacity.
(e) Where two or more closure systems are fitted in series, the system nearest to the hazardous material being carried must be closed first.
(f) During transportation-
(1) No hazardous material may remain on the outside of the intermediate bulk container; and
(2) Each intermediate bulk container must be securely fastened to or contained within the transport unit.
(g) Each intermediate bulk container used for transportation of solids which may become liquid at temperatures likely to be encountered during transportation must also be capable of containing the substance in the liquid state.
(h) Liquid hazardous materials may only be offered for transportation in a metal, rigid plastic, or composite intermediate bulk container that is appropriately resistant to an increase of internal pressure likely to develop during transportation.
(1) A rigid plastic or composite intermediate bulk container may only be filled with a liquid having a vapor pressure less than or equal to the greater of the following two values: the first value is determined from any of the methods in paragraphs (h)(1) (i), (ii) or (iii) of this section. The second value is determined by the method in paragraph (h)(1)(iv) of this section.
(i) The gauge pressure (pressure in the intermediate bulk container above ambient atmospheric pressure) measured in the intermediate bulk container at 55 ^{o}C (131 ^{o}F). This gauge pressure must not exceed two-thirds of the marked test pressure and must be determined after the intermediate bulk container was filled and closed at 15 ^{o}C (60 ^{o}F) to less than or equal to 98 percent of its capacity.
(ii) The absolute pressure (vapor pressure of the hazardous material plus atmospheric pressure) in the intermediate bulk container at 50 ^{o}C (122 ^{o}F). This absolute pressure must not exceed four-sevenths of the sum of the marked test pressure and 100 kPa (14.5 psi).
(iii) The absolute pressure (vapor pressure of the hazardous material plus atmospheric pressure) in the intermediate bulk container at 55 ^{o}C (131 ^{o}F). This absolute pressure

must not exceed two-thirds of the sum of the marked test pressure and 100 kPa (14.5 psi).
(iv) Twice the static pressure of the substance, measured at the bottom of the intermediate bulk container. This value must not be less than twice the static pressure of water.
(2) Gauge pressure (pressure in the intermediate bulk container above ambient atmospheric pressure) in metal intermediate bulk containers must not exceed 110 kPa (16 psig) at 50 ^oC (122 ^oF) or 130 kPa (18.9 psig) at 55 ^oC (131 ^oF).
(i) The requirements in this section do not apply to DOT-56 or -57 portable tanks.
(j) No intermediate bulk container may be filled with a Packing Group I liquid. Rigid plastic, composite, flexible, wooden or fiberboard intermediate bulk containers used to transport Packing Group I solid materials may not exceed 1.5 cubic meters (53 cubic feet) capacity. For Packing Group I solids, a metal intermediate bulk container may not exceed 3 cubic meters (106 cubic feet) capacity.
(k) When an intermediate bulk container is used for the transportation of liquids with a flashpoint of 60.5 ^oC (141 ^oF) (closed cup) or lower, or powders with the potential for dust explosion, measures must be taken during product loading and unloading to prevent a dangerous electrostatic discharge.
(l) *Intermediate bulk container filling limits. (1) Except as provided in this section, an intermediate bulk container may not be filled with a hazardous material in excess of the maximum gross mass marked on that container.*
(2) An intermediate bulk container which is tested and marked for Packing Group II liquid materials may be filled with a Packing Group III liquid material to a gross mass not exceeding 1.5 times the maximum gross mass marked on that container, if all the performance criteria can still be met at the higher gross mass.
(3) An intermediate bulk container which is tested and marked for liquid hazardous materials may be filled with a solid hazardous material to a gross mass not exceeding the maximum gross mass marked on that container. In addition, an intermediate bulk container intended for the transport of liquids which is tested and marked for Packing Group II liquid materials may be filled with a Packing Group III solid hazardous material to a gross mass not exceeding the marked maximum gross mass multiplied by 1.5 if all the performance criteria can still be met at the higher gross mass.
(4) An intermediate bulk container which is tested and marked for Packing Group I solid materials may be filled with a Packing Group II solid material to a gross mass not exceeding the maximum gross mass marked on that container, multiplied by 1.5, if all the performance criteria can be met at the higher gross mass; or a Packing Group III solid material to a gross mass not exceeding the maximum gross mass marked on the intermediate bulk container, multiplied by 2.25, if all the performance criteria can be met at the higher gross mass. An intermediate bulk container which is tested and marked for Packing Group II solid materials may be filled with a Packing Group III solid material to a gross mass not exceeding the maximum gross mass marked on the intermediate bulk container, multiplied by 1.5.

[Amdt. 173-238, 59 FR 38064, July 26, 1994, as amended by Amdt. 173-243, 60 FR

40038, Aug. 4, 1995; 64 FR 10777, Mar. 5, 1999]

§173.40 General packaging requirements for poisonous materials required to be packaged in cylinders.

When this section is referenced in the packaging section for a hazardous material elsewhere in this part, the following requirements are applicable to cylinders used for that material:

(a) *Authorized cylinders. A cylinder must conform to one of the specifications for cylinders in subpart C of part 178 of this subchapter, except that Specification 8, 8AL and 39 cylinders are not authorized.*

(b) Outage and pressure requirements. The pressure of the hazardous material at 55 ^{o}C (131 ^{o}F) must not exceed the service pressure of the cylinder. Sufficient outage shall be provided so that the cylinder will not be liquid full at 55 ^{o}C (131 ^{o}F).

(c) Closures. Each cylinder must be closed with a plug or valve conforming to the following:

(1) Each plug or valve must have a taper-threaded connection directly to the cylinder and be capable of withstanding the test pressure of the cylinder;

(2) Each valve must be of the packless type with non-perforated diaphragm, except that for corrosive materials, a valve may be of the packed type provided the assembly is made gas-tight by means of a seal cap with gasketed joint attached to the valve body or the cylinder to prevent loss of material through or past the packing;

(3) Each valve outlet must be sealed by a threaded cap or threaded solid plug, and

(4) Cylinder, valves, plugs, outlet caps, luting and gaskets must be compatible with each other and with the lading.

(d) *Additional protection. Additional protection requirements for thin-walled cylinders and for cylinders equipped with valves are as follows:*

(1) Each cylinder which has a wall thickness at any point of less than 2.03 mm (0.080 inch) and each cylinder which does not have fitted valve protection must be overpacked in a box. The box must conform to overpack provisions in §173.25. Box and valve protection must be of sufficient strength to protect all parts of the cylinder and valve, if any, from deformation and breakage resulting from a drop of 2.0 m (7 ft) or more onto a concrete floor, impacting at an orientation most likely to cause damage.

(2) Each cylinder equipped with a valve, if not overpacked in a box in accordance with paragraph (d)(1) of this section, must be equipped with a protective cap or other means of valve protection sufficient to protect the valve from deformation and breakage resulting from a drop of 2.0 m (7 ft) or more onto a concrete floor, impacting at an orientation most likely to cause damage.

(e) *Interconnection. Cylinders may not be interconnected.*

[Amdt. 173-224, 55 FR 52616, Dec. 21, 1990, as amended at 63 FR 37461, July 10, 1998]

[CFR] PART 173 SUBPART C - Definitions, Classification and Packaging for Class 1

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART C]

Subpart C - Definitions, Classification and Packaging for Class 1

Source: Amdt. 173-224, 55 FR 52617, Dec. 21, 1990, unless otherwise noted.

§173.50 Class 1-Definitions.
(a) Explosive. For the purpose of this subchapter, an *explosive means any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid release of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion, unless the substance or article is otherwise classed under the provision of this subchapter.*
(b) Explosives in Class 1 are divided into six divisions as follows:
(1) *Division 1.1 consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.*
(2) Division 1.2 consists of explosives that have a projection hazard but not a mass explosion hazard.
(3) Division 1.3 consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.
(4) Division 1.4 consists of explosives that present a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package.
(5) Division 1.5[1] consists of very insensitive explosives. This division is comprised of substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.
[1]The probability of transition from burning to detonation is greater when large quantities are transported in a vessel.
(6) Division 1.6[2] consists of extremely insensitive articles which do not have a mass explosive hazard. This division is comprised of articles which contain only extremely insensitive detonating substances and which demonstrate a negligible probability of

accidental initiation or propagation.
[2]The risk from articles of Division 1.6 is limited to the explosion of a single article.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991]

§173.51 Authorization to offer and transport explosives.

(a) Unless otherwise provided in this subpart, no person may offer for transportation or transport an explosive, unless it has been tested and classed and approved by the Associate Administrator for Hazardous Materials Safety (§173.56).

(b) Reports of explosives approved by the Department of Defense or the Department of Energy must be filed with, and receive acknowledgement in writing by, the Associate Administrator for Hazardous Materials Safety prior to such explosives being offered for transportation.

§173.52 Classification codes and compatibility groups of explosives.

(a) The classification code for an explosive, which is assigned by the Associate Administrator for Hazardous Materials Safety in accordance with this subpart, consists of the division number followed by the compatibility group letter. Compatibility group letters are used to specify the controls for the transportation, and storage related thereto, of explosives and to prevent an increase in hazard that might result if certain types of explosives were stored or transported together. Transportation compatibility requirements for carriers are prescribed in §§174.81, 175.78. 176.83 and 177.848 of this subchapter for transportation by rail, air, vessel, and public highway, respectively, and storage incidental thereto.

(b) Compatibility groups and classification codes for the various types of explosives are set forth in the following tables. Table 1 sets forth compatibility groups and classification codes for substances and articles described in the first column of table 1. Table 2 shows the number of classification codes that are possible within each explosive division. Altogether, there are 35 possible classification codes for explosives.

Table 1-Classification Codes

Description of substances or article to be classified	Compatibility group	Classification code
Primary explosive substance	A	1.1A
Article containing a primary explosive substance and not containing two or more effective protective features. Some articles, such as detonators for blasting, detonator assemblies for blasting and primers, cap-type, are included, even though they do not	B	1.1B 1.2B 1.4B

contain primary explosives.		
Propellant explosive substance or other deflagrating explosive substance or article containing such explosive substance	C	1.1C 1.2C 1.3C 1.4C
Secondary detonating explosive substance or black powder or article containing a secondary detonating explosive substance, in each case without means of initiation and without a propelling charge, or article containing a primary explosive substance and containing two or more effective protective features	D	1.1D 1.2D 1.4D 1.5D
Article containing a secondary detonating explosive substance, without means of initiation, with a propelling charge (other than one containing flammable liquid or gel or hypergolic liquid)	E	1.1E 1.2E 1.4E
Article containing a secondary detonating explosive substance with its means of initiation, with a propelling charge (other than one containing flammable liquid or gel or hypergolic liquid) or without a propelling charge	F	1.1F 1.2F 1.3F 1.4F
Pyrotechnic substance or article containing a pyrotechnic substance, or article containing both an explosive substance and an illuminating, incendiary, tear-producing or smoke-producing substance (other than a water-activated article or one containing white phosphorus, phosphide or flammable liquid or gel or hypergolic liquid)	G	1.1G 1.2G 1.3G 1.4G
Article containing both an explosive substance and white phosphorus	H	1.2H 1.3H
Article containing both an explosive substance and flammable liquid or gel	J	1.1J 1.2J 1.3J
Article containing both an explosive substance and a toxic chemical agent	K	1.2K 1.3K
Explosive substance or article containing an explosive substance and presenting a special risk (e.g., due to water-activation or presence of hybergolic liquids, phosphides or pyrophoric substances) needing isolation of each type	L	1.1L 1.2L 1.3L
Articles containing only extremely insensitive detonating substances.	N	1.6N
Substance or article so packed or designed that any hazardous effects arising from accidental functioning are limited to the extent that they do not significantly hinder or prohibit fire fighting or other emergency response efforts in the immediate vicinity of the package	S	1.4S

Table 2-Scheme of Classification of Explosives, Combination of Hazard division With Compatibility Group

Hazard division	Compatibility group													
	A	B	C	D	E	F	G	H	J	K	L	N	S	A-S
1.1	1.1A	1.1B	1.1C	1.1D	1.1E	1.1F	1.1G	-	1.1J	-	1.1L	-	-	9
1.2	-	1.2B	1.2C	1.2D	1.2E	1.2F	1.2G	1.2H	1.2J	1.2K	1.2L	-	-	10
1.3	-	-	1.3C	-	-	1.3F	1.3G	1.3H	1.3J	1.3K	1.3L	-	-	7
1.4	-	1.4B	1.4C	1.4D	1.4E	1.4F	1.4G	-	-	-	-	-	1.4S	7
1.5	-	-	-	1.5D	-	-	-	-	-	-	-	-	-	1
1.6	-	-	-	-	-	-	-	-	-	-	-	1.6N	-	1
1.6	1	3	4	4	3	4	4	2	3	2	3	1	1	35

[Amdt. 173-224, 55 FR 52617, Dec. 21, 1990, as amended by Amdt. 173-241, 59 FR 67492, Dec. 29, 1994; 64 FR 51918, Sept. 27, 1999]

§173.53 Provisions for using old classifications of explosives.

Where the classification system in effect prior to January 1, 1991, is referenced in State or local laws, ordinances or regulations not pertaining to the transportation of hazardous materials, the following table may be used to compare old and new hazard class names:

Current classification	Class name prior to Jan. 1, 1991
Division 1.1	Class A explosives.
Division 1.2	Class A or Class B explosives.
Division 1 3	Class B explosive.
Division 1.4	Class C explosives.
Division 1.5	Blasting agents.
Division 1.6	No applicable hazard class.

§173.54 Forbidden explosives.

Unless otherwise provided in this subchapter, the following explosives shall not be offered for transportation or transported:

(a) An explosive that has not been approved in accordance with §173.56 of this subpart.

(b) An explosive mixture or device containing a chlorate and also containing:

(1) An ammonium salt, including a substituted ammonium or quaternary ammonium salt; or

(2) An acidic substance, including a salt of a weak base and a strong acid.

(c) A leaking or damaged package of explosives.

(d) Propellants that are unstable, condemned or deteriorated.

(e) Nitroglycerin. diethylene glycol dinitrate, or any other liquid explosives not specifically authorized by this subchapter.

(f) A loaded firearm (except as provided in 14 CFR 108.11).

(g) Fireworks that combine an explosive and a detonator.

(h) Fireworks containing yellow or white phosphorus.

(i) A toy torpedo, the maximum outside dimension of which exceeds 23 mm (0.906 inch), or a toy torpedo containing a mixture of potassium chlorate, black antimony

(antimony sulfide), and sulfur, if the weight of the explosive material in the device exceeds 0.26 g (0.01 ounce).

(j) Explosives specifically forbidden in the §172.101 table of this subchapter.

(k) Explosives not meeting the acceptance criteria specified in §173.57 of this subchapter.

(l) An explosive article with its means of initiation or ignition installed, unless approved in accordance with §173.56.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991; Amdt. 173-236, 58 FR 50236, Sept. 24, 1993]

§173.55 [Reserved]

§173.56 New explosives-definition and procedures for classification and approval.

(a) Definition of new explosive. For the purposes of this subchapter a *new explosive means an explosive produced by a person who:*

(1) Has not previously produced that explosive; or

(2) Has previously produced that explosive but has made a change in the formulation, design or process so as to alter any of the properties of the explosive. An explosive will not be considered a "new explosive" if an agency listed in paragraph (b) of this section has determined, and confirmed in writing to the Associate Administrator for Hazardous Materials Safety, that there are no significant differences in hazard characteristics from the explosive previously approved.

(b) Examination, classing and approval. Except as provided in paragraph (j) of this section, no person may offer a new explosive for transportation unless that person has specified to the examining agency the ranges of composition of ingredients and compounds, showing the intended manufacturing tolerances in the composition of substances or design of articles which will be allowed in that material or device, and unless it has been examined, classed and approved as follows:

(1) Except for an explosive made by or under the direction or supervision of the Department of Defense (DOD) or the Department of Energy (DOE), a new explosive must be examined and assigned a recommended shipping description, division and compatibility group, based on the tests and criteria prescribed in §§173.52, 173.57 and 173.58. The person requesting approval of the new explosive must submit to the Associate Administrator for Hazardous Materials Safety a report of the examination and assignment of a recommended shipping description, division, and compatibility group. If the Associate Administrator finds the approval request meets the regulatory criteria, the new explosive will be approved in writing and assigned an EX number. The examination must be performed by a person who is approved by the Associate Administrator under

the provisions of subpart H of part 107 of this chapter and who-

(i) Has (directly, or through an employee involved in the examination) at least ten years of experience in the examination, testing and evaluation of explosives;

(ii) Does not manufacture or market explosives, and is not controlled by or financially dependent on any entity that manufactures or markets explosives, and whose work with respect to explosives is limited to examination, testing and evaluation; and

(iii) Is a resident of the United States.

(2) A new explosive made by or under the direction or supervision of a component of the DOD may be examined, classed, and concurred in by:

(i) U.S. Army Technical Center for Explosives Safety (SMCAC-EST), Naval Sea Systems Command (SEA-9934), or Air Force Safety Agency (SEW), when approved by the Chairman, DOD Explosives Board, in accordance with the Department of Defense Explosives Hazard Classification Procedures (TB 700-2); or

(ii) The agencies and procedures specified in paragraph (b)(1) of this section.

(3) A new explosive made by or under the direction or supervision of the Department of Energy (DOE) may be-

(i) Examined by the DOE in accordance with the Explosives Hazard Classification Procedures (TB 700-2), and must be classed and approved by DOE; or

(ii) Examined, classed, and approved in accordance with paragraph (b)(1) of this section.

(4) For a material shipped under the description of "ammonium nitrate-fuel oil mixture (ANFO)", the only test required for classification purposes is the Cap Sensitivity Test (Test Method 5(a). prescribed in the Explosive Test Manual). The test must be performed by an agency listed in paragraph (b)(1), (b)(2), or (b)(3) of this section, the manufacturer, or the shipper. A copy of the test report must be submitted to the Associate Administrator for Hazardous Materials Safety before the material is offered for transportation, and a copy of the test report must be retained by the shipper for as long as that material is shipped. At a minimum, the test report must contain the name and address of the person or organization conducting the test, date of the test, quantitative description of the mixture. including prill size and porosity, and a description of the test results.

(c) Filing DOD or DOE approval report. DOD or DOE must file a copy of each approval, accompanied by supporting laboratory data, with the Associate Administrator for Hazardous Materials Safety and receive acknowledgement in writing before offering the new explosive for transportation, unless the new explosive is:

(1) Being transported under paragraph (d) or (e) of this section; or

(2) Covered by a national security classification currently in effect.

(d) Transportation of explosive samples for examination. Notwithstanding the requirements of paragraph (b) of this section with regard to the transportation of a new explosive that has not been approved, a person may offer a sample of a new explosive for transportation, by railroad, highway, or vessel from the place where it was produced to an agency identified in paragraph (b) of this section, for examination if-

(1) The new explosive has been assigned a tentative shipping description and class in writing by the testing agency;

(2) The new explosive is packaged as required by this part according to the tentative description and class assigned, unless otherwise specified in writing by the testing agency; and,

(3) The package is labeled as required by this subchapter and the following is marked on the package:

(i) The words "SAMPLE FOR LABORATORY EXAMINATION";

(ii) The net weight of the new explosive; and

(iii) The tentative shipping name and identification number.

(e) Transportation of unapproved explosives for developmental testing. Notwithstanding the requirements of paragraph (b) of this section, the owner of a new explosive that has not been examined or approved may transport that new explosive from the place where it was produced to an explosives testing range if-

(1) It is not a primary (a 1.1A initiating) explosive or a forbidden explosive according to this subchapter;

(2) It is described as a Division 1.1 explosive (substance or article) and is packed, marked, labeled, described on shipping papers and is otherwise offered for transportation in conformance with the requirements of this subchapter applicable to Division 1.1;

(3) It is transported in a motor vehicle operated by the owner of the explosive; and

(4) It is accompanied by a person, in addition to the operator of the motor vehicle, who is qualified by training and experience to handle the explosive.

(f) Notwithstanding the requirements of paragraphs (b) and (d) of this section, the Associate Administrator for Hazardous Materials Safety may approve a new explosive on the basis of an approval issued for the explosive by the competent authority of a foreign government, or when examination of the explosive by a person approved by the Associate Administrator for Hazardous Materials Safety is impracticable, on the basis of reports of tests conducted by disinterested third parties, or may approve the transportation of an explosives sample for the purpose of examination by a person approved by the Associate Administrator for Hazardous Materials Safety.

(g) Notwithstanding the requirements of paragraph (b) of this section, an explosive may be transported under §§171.11, 171.12, 171.12a or §176.11 of this subchapter without the approval of the Associate Administrator for Hazardous Materials Safety if the Associate Administrator for Hazardous Materials Safety has acknowledged, in writing, the acceptability of an approval issued by the competent authority of a foreign government pursuant to the provisions of the UN Recommendations, the ICAO Technical Instructions, the IMDG Code, or other national or international regulations based on the UN Recommendations. In such a case, a copy of the foreign competent authority approval, and a copy of the written acknowledgement of its acceptance must accompany each shipment of that explosive.

(h) The requirements of this section do not apply to cartridges, small arms which are:

(1) Not a forbidden explosive under §173.54 of this subchapter;

(2) Ammunition for rifle, pistol, or shotgun;

(3) Ammunition with inert projectile or blank ammunition; and

(4) Ammunition not exceeding 50 caliber for rifle or pistol cartridges or 8 gauge for

shotgun shells.

Cartridges, small arms meeting the criteria of this paragraph (h) may be assigned a classification code of 1.4S by the manufacturer.

(i) If experience or other data indicate that the hazard of a material or a device containing an explosive composition is greater or less than indicated according to the definition and criteria specified in §§173.50, 173.56, and 173.58 of this subchapter, the Associate Administrator for Hazardous Materials Safety may specify a classification or except the material or device from the requirements of this subchapter.

(j) Fireworks. Notwithstanding the requirements of paragraph (b) of this section, Division 1.3 and 1.4 fireworks may be classed and approved by the Associate Administrator for Hazardous Materials Safety without prior examination and offered for transportation if the following conditions are met:

(1) The fireworks are manufactured in accordance with the applicable requirements in APA Standard 87-1;

(2) A thermal stability test is conducted on the device by the BOE, the BOM, or the manufacturer. The test must be performed by maintaining the device, or a representative prototype of a large device such as a display shell, at a temperature of 75 ^{o}C (167 ^{o}F) for 48 consecutive hours. When a device contains more than one component, those components which could be in physical contact with each other in the finished device must be placed in contact with each other during the thermal stability test; and

(3) The manufacturer applies in writing to the Associate Administrator for Hazardous Materials Safety following the applicable requirements in APA Standard 87-1, and is notified in writing by the Associate Administrator for Hazardous Materials Safety that the fireworks have been classed, approved, and assigned an EX-number. Each application must be complete, including all relevant background data and copies of all applicable drawings, test results, and any other pertinent information on each device for which approval is being requested. The manufacturer must sign the application and certify that the device for which approval is requested conforms to APA Standard 87-1 and that the descriptions and technical information contained in the application are complete and accurate. If the application is denied, the manufacturer will be notified in writing of the reasons for the denial. The Associate Administrator for Hazardous Materials Safety may require that the fireworks be examined by an agency listed in paragraph (b)(1) of this section.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; 62 FR 51560, Oct. 1, 1997; 63 FR 37461, July 10, 1998; 64 FR 10777, Mar. 5, 1999]

§173.57 Acceptance criteria for new explosives.

(a) Unless otherwise excepted, an explosive substance must be subjected to the

Drop Weight Impact Sensitivity Test (Test Method 3(a)(i)), the Friction Sensitivity Test (Test Method 3(b)(iii)), the Thermal Stability Test (Test Method 3(c)) at 75 ^{o}C (167 ^{o}F) and the Small-Scale Burning Test (Test Method 3(d)(i)), each as described in the Explosive Test Manual (UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria (see §171.7 of this subchapter)). A substance is forbidden for transportation if any one of the following occurs:

(1) For a liquid, failure to pass the test criteria when tested in the Drop Weight Impact Sensitivity Test apparatus for liquids;

(2) For a solid, failure to pass the test criteria when tested in the Drop Weight Impact Sensitivity Test apparatus for solids;

(3) The substance has a friction sensitiveness equal to or greater than that of dry pentaerythrite tetranitrate (PETN) when tested in the Friction Sensitivity Test;

(4) The substance fails to pass the test criteria specified in the Thermal Stability Test at 75 ^{o}C (167 ^{o}F); or

(5) Explosion occurs when tested in the Small-Scale Burning Test.

(b) An explosive article, packaged or unpackaged, or a packaged explosive substance must be subjected to the Thermal Stability Test for Articles and Packaged Articles (Test method 4(a)(i)) and the Twelve Meter Drop Test (Test Method 4(b)(ii)), when appropriate, in the Explosive Test Manual. An article or packaged substance is forbidden for transportation if evidence of thermal instability or excessive impact sensitivity is found in those tests according to the criteria and methods of assessing results prescribed therein.

(c) Dynamite (explosive, blasting, type A) is forbidden for transportation if any of the following occurs:

(1) It does not have uniformly mixed with the absorbent material a satisfactory antacid in a quantity sufficient to have the acid neutralizing power of an amount of magnesium carbonate equal to one percent of the nitroglycerin or other liquid explosive ingredient;

(2) During the centrifuge test (Test Method D-2, in appendix D to this part) or the compression test (Test Method D-3 in appendix D to this part), a non-gelatin dynamite loses more than 3 percent by weight of the liquid explosive or a gelatin dynamite loses more than 10 percent by weight of the liquid explosive; or

(3) During the leakage test (Test Method D-1 in appendix D to this part), there is any loss of liquid.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 58 FR 51532, Oct. 1, 1993; 64 FR 51918, Sept. 27, 1999]

§173.58 Assignment of class and division for new explosives.

(a) Division 1.1., 1.2., 1.3., and 1.4 explosives. In addition to the test prescribed in §173.57 of this subchapter, a substance or article in these divisions must be subjected to Test Methods 6(a), 6(b), and 6(c), as described in the UN Manual of Tests and

Criteria, for assignment to an appropriate division. The criteria for assignment of class and division are as follows:

(1) Division 1.1 if the major hazard is mass explosion;

(2) Division 1.2 if the major hazard is dangerous projections;

(3) Division 1.3 if the major hazard is radiant heat or violent burning, or both, but there is no blast or projection hazard;

(4) Division 1.4 if there is a small hazard with no mass explosion and no projection of fragments of appreciable size or range;

(5) Division 1.4 Compatibility Group S (1.4S) if the hazardous effects are confined within the package or the blast and projection effects do not significantly hinder emergency response efforts; or

(6) Not in the explosive class if the substance or article does not have significant explosive hazard or if the effects of explosion are completely confined within the article.

(b) Division 1.5 explosive. Except for ANFO, a substance that has been examined in accordance with the provisions §173.57(a) of this subchapter, must be subjected to the following additional tests: Cap Sensitivity Test, Princess Incendiary Spark Test, DDT Test, and External Fire Test, each as described in the Explosive Test Manual. A material may not be classed as a Division 1.5 explosive if any of the following occurs:

(1) Detonation occurs in the Cap Sensitivity Test (Test Method 5(a));

(2) Detonation occurs in the DDT Test (Test Method 5(b)(ii));

(3) An explosion, evidenced by a loud noise and projection of fragments, occurs in the External Fire Test (Test Method 5(c), or

(4) Ignition or explosion occurs in the Princess Incendiary Spark Test (Test Method 5(d)).

(c) Division 1.6 explosive. (1) In order to be classed as a 1.6 explosive, an article must pass all of the following tests, as prescribed in the Explosive Test Manual:

(i) The 1.6 Article External Fire Test;

(ii) The 1.6 Article Slow Cook-off Test;

(iii) The 1.6 Article Propagation Test; and

(iv) The 1.6 Article Bullet Impact Test.

(2) A substance intended for use as the explosive load in an article of Division 1.6 must be an extremely insensitive detonating substance (EIDS). In order to determine if a substance is an EIDS, it must be subjected to the tests in paragraphs (c)(2)(i) through (c)(2)(x) of this section, which are described in the Explosive Test Manual. The substance must be tested in the form (i.e., composition, granulation, density, etc.) in which it is to be used in the article. A substance is not an EIDS if it fails any of the following tests:

(i) The Drop Weight Impact Sensitivity Test;

(ii) The Friction Sensitivity Test;

(iii) The Thermal Sensitivity Test at 75 ^{o}C (167 ^{o}F);

(iv) The Small Scale Burning Test;

(v) The EIDS Cap Test;

(vi) The EIDS Gap Test;

(vii) The Susan Test;

(viii) The EIDS Bullet Impact Test;
(ix) The EIDS External Fire Test; and
(x) The EIDS Slow Cook-off Test.

(d) The Associate Administrator for Hazardous Materials Safety may waive or modify certain test(s) identified in §§173.57 and 173.58 of this subchapter, or require additional testing, if appropriate. In addition, the Associate Administrator for Hazardous Materials Safety may limit the quantity of explosive in a device.

(e) Each explosive is assigned a compatibility group letter by the Associate Administrator for Hazardous Materials Safety based on the criteria prescribed in §173.52(b) of this subchapter.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991; 63 FR 52849, Oct. 1, 1998]

§173.59 Description of terms for explosives.

For the purpose of this subchapter, a description of the following terms is provided for information only. They must not be used for purposes of classification or to replace proper shipping names prescribed in §172.101 of this subchapter.

Ammonium-nitrate-fuel oil mixture (ANFO). A blasting explosive containing no essential ingredients other than prilled ammonium nitrate and fuel oil.

Ammunition. Generic term related mainly to articles of military application consisting of all types of bombs, grenades, rockets, mines, projectiles and other similar devices or contrivances.

Ammunition, illuminating, with or without burster, expelling charge or propelling charge. Ammunition designed to produce a single source of intense light for lighting up an area. The term includes illuminating cartridges, grenades and projectiles, and illuminating and target identification bombs. The term excludes the following articles which are listed separately: cartridges, signal; signal devices; hand signals; distress flares, aerial and flares, surface.

Ammunition, incendiary. Ammunition containing an incendiary substance which may be a solid, liquid or gel including white phosphorus. Except when the composition is an explosive per se, it also contains one or more of the following: a propelling charge with primer and igniter charge, or a fuze with burster or expelling charge. The term includes: Ammunition, incendiary, liquid or gel, with burster, expelling charge or propelling charge; Ammunition, incendiary with or without burster, expelling charge or propelling charge; and Ammunition, incendiary, white phosphorus, with burster, expelling charge or propelling charge.

Ammunition, practice. Ammunition without a main bursting charge, containing a burster or expelling charge. Normally it also contains a fuze and propelling charge. The term excludes the following article which is listed separately: Grenades, practice.

Ammunition, proof. Ammunition containing pyrotechnic substance, used to test the performance or strength of new ammunition, weapon component or assemblies.

Ammunition, smoke. Ammunition containing a smoke-producing substance such as chlorosulphonic acid mixture (CSAM), titanium tetrachloride (FM), white phosphorus, or smoke-producing substance whose composition is based on hexachlorothannol (HC) or red phosphorus. Except when the substance is an explosive per se, the ammunition also contains one or more of the following: a propelling charge with primer and igniter charge, or a fuze with burster or expelling charge. The term includes: Ammunition, smoke, with or without burster, expelling charge or propelling charge; Ammunition, smoke, white phosphorus with burster, expelling charge or propelling charge.

Ammunition, tear-producing with burster, expelling charge or propelling charge. Ammunition containing tear-producing substance. It may also contain one or more of the following: a pyrotechnic substance, a propelling charge with primer and igniter charge, or a fuze with burster or expelling charge.

Ammunition, toxic. Ammunition containing toxic agent. It may also contain one or more of the following: a pyrotechnic substance, a propelling charge with primer and igniter charge, or a fuze with burster or expelling charge.

Articles, explosive, extremely insensitive (Articles, EEI). Articles that contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation under normal conditions of transport and which have passed Test Series 7.

Articles, pyrophoric. Articles which contain a pyrophoric substance (capable of spontaneous ignition when exposed to air) and an explosive substance or component. The term excludes articles containing white phosphorus.

Articles, pyrotechnic for technical purposes. Articles which contain pyrotechnic substances and are used for technical purposes, such as heat generation, gas generation, theatrical effects, etc. The term excludes the following articles which are listed separately: all ammunition; cartridges, signal; cutters, cable, explosive; fireworks; flares, aerial; flares, surface; release devices, explosives; rivets, explosive; signal devices, hand; signals, distress; signals, railway track, explosive; and signals, smoke.

Black powder (gunpowder). Substance consisting of an intimate mixture of charcoal or other carbon and either potassium or sodium nitrate, and sulphur. It may be meal, granular, compressed, or pelletized.

Bombs. Explosive articles which are dropped from aircraft. They may contain a flammable liquid with bursting charge, a photo-flash composition or bursting charge. The term excludes torpedoes (aerial) and includes bombs, photo-flash; bombs with bursting charge; bombs with flammable liquids, with bursting charge.

Boosters. Articles consisting of a charge of detonating explosive without means of initiation. They are used to increase the initiating power of detonators or detonating cord.

Bursters, explosive. Articles consisting of a small charge of explosive to open projectiles or other ammunition in order to disperse their contents.

Cartridges, blank. Articles which consist of a cartridge case with a center or rim fire primer and a confined charge of smokeless or black powder, but no projectile. Used in training, saluting, or in starter pistols, etc.

Cartridges, flash. Articles consisting of a casing, a primer and flash powder, all assembled in one piece for firing.

Cartridges for weapons. (1) Fixed (assembled) or semi-fixed (partially assembled) ammunition designed to be fired from weapons. Each cartridge includes all the components necessary to function the weapon once. The name and description should be used for military small arms cartridges that cannot be described as cartridges, small arms. Separate loading ammunition is included under this name and description when the propelling charge and projectile are packed together (see also Cartridges, blank).

(2) Incendiary, smoke, toxic, and tear-producing cartridges are described under ammunition, incendiary, etc.

Cartridges for weapons, inert projectile. Ammunition consisting of a casing with propelling charge and a solid or empty projectile.

Cartridges, oil well. Articles consisting of a casing of thin fiber, metal or other material containing only propellant explosive. The term excludes charges, shaped, commercial.

Cartridges, power device. Articles designed to accomplish mechanical actions. They consist of a casing with a charge of deflagrating explosive and a means of ignition. The gaseous products of the deflagration produce inflation, linear or rotary motion; activate diaphragms, valves or switches, or project fastening devices or extinguishing agents.

Cartridges, signal. Articles designed to fire colored flares or other signals from signal pistols or devices.

Cartridges, small arms. Ammunition consisting of a cartridge case fitted with a center or rim fire primer and containing both a propelling charge and solid projectile(s). They are designed to be fired in weapons of caliber not larger than 19.1 mm. Shotgun cartridges of any caliber are included in this description. The term excludes: Cartridges, small arms, blank, and some military small arms cartridges listed under Cartridges for weapons, inert projectile.

Cases, cartridge, empty with primer. Articles consisting of a cartridge case made from metal, plastics or other non-flammable materials, in which only the explosive component is the primer.

Cases, combustible, empty, without primer. Articles consisting of cartridge cases made partly or entirely from nitrocellulose.

Charges, bursting. Articles consisting of a charge of detonating explosive such as hexolite, octolite, or plastics-bonded explosive designed to produce effect by blast or fragmentation.

Charges, demolition. Articles consisting of a charge of detonating explosive in a casing of fiberboard, plastics, metal or other material. The term excludes articles identified as bombs, mines, etc.

Charges, depth. Articles consisting of a charge of detonating explosive contained in a drum or projectile. They are designed to detonate under water.

Charges, expelling. A charge of deflagrating explosive designed to eject the payload from the parent article without damage.

Charges, explosive, without detonator. Articles consisting of a charge of detonating explosive without means of initiation, used for explosive welding, joining, forming, and other processes.

Charges, propelling. Articles consisting of propellant charge in any physical form, with or without a casing, for use in cannon or for reducing drag for projectiles or as a component of rocket motors.

Charges, propelling for cannon. Articles consisting of a propellant charge in any physical form, with or without a casing, for use in a cannon.

Charges, shaped, without detonator. Articles consisting of a casing containing a charge of detonating explosive with a cavity lined with rigid material, without means of initiation. They are designed to produce a powerful, penetrating jet effect.

Charges, shaped, flexible, linear. Articles consisting of a V-shaped core of a detonating explosive clad by a flexible metal sheath.

Charges, supplementary, explosive. Articles consisting of a small removable booster used in the cavity of a projectile between the fuze and the bursting charge.

Components, explosive train, n.o.s. Articles containing an explosive designed to transmit a detonation or deflagration within an explosive train.

Contrivance, water-activated with burster, expelling charge or propelling charge. Articles whose functioning depends of physico-chemical reaction of their contents with water.

Cord, detonating, flexible. Articles consisting of a core of detonating explosive enclosed in spun fabric with plastics or other covering.

Cord (fuse) detonating, metal clad. Articles consisting of a core of detonating explosive clad by a soft metal tube with or without protective covering. When the core contains a sufficiently small quantity of explosive, the words "mild effect" are added.

Cord igniter. Articles consisting of textile yarns covered with black powder or another fast-burning pyrotechnic composition and a flexible protective covering, or consisting of a core of black powder surrounded by a flexible woven fabric. It burns progressively along its length with an external flame and is used to transmit ignition from a device to a charge or primer.

Cutters, cable, explosive. Articles consisting of a knife-edged device which is driven by a small charge of deflagrating explosive into an anvil.

Detonator assemblies, non-electric, for blasting. Non-electric detonators assembled with and activated by such means as safety fuse, shock tube, flash tube, or detonating cord. They may be of instantaneous design or incorporate delay elements. Detonating relays incorporating detonating cord are included. Other detonating relays are included in Detonators, nonelectric.

Detonators. Articles consisting of a small metal or plastic tube containing explosives such as lead azide, PETN, or combinations of explosives. They are designed to start a detonation train. They may be constructed to detonate instantaneously, or may contain a delay element. They may contain no more than 10 g of total explosives weight, excluding ignition and delay charges, per unit. The term includes: detonators for ammunition; detonators for blasting, both electric and non-electric; and detonating relays without flexible detonating cord.

Dynamite. A detonating explosive containing a liquid explosive ingredient (generally nitroglycerin, similar organic nitrate esters, or both) that is uniformly mixed with an absorbent material, such as wood pulp, and usually contains materials such as nitrocellulose, sodium and ammonium nitrate.

Entire load and total contents. The phrase means such a substantial portion of the material explodes that the practical hazard should be assessed by assuming simultaneous explosion of the whole of the explosive content of the load or package.

Explode. The term indicates those explosive effects capable of endangering life and property through blast, heat, and projection of missiles. It encompasses both deflagration and detonation.

Explosion of the total contents. The phrase is used in testing a single article or package or a small stack of articles or packages.

Explosive, blasting. Detonating explosive substances used in mining, construction, and similar tasks. Blasting explosives are assigned to one of five types. In addition to the ingredients listed below for each type, blasting explosives may also contain inert components, such as kieselguhr, and other minor ingredients, such as coloring agents and stabilizers.

Explosive, blasting, type A. Substances consisting of liquid organic nitrates, such as nitroglycerin, or a mixture of such ingredients with one or more of the following: nitrocellulose, ammonium nitrate or other inorganic nitrates, aromatic nitro-derivatives, or combustible materials, such as wood-meal and aluminum powder. Such explosives must be in powdery, gelatinous, plastic or elastic form. The term includes dynamite, blasting gelatine and gelatine dynamites.

Explosive, blasting, type B. Substances consisting of a mixture of ammonium nitrate or other inorganic nitrates with an explosive, such as trinitrotoluene, with or without other substances, such as wood-meal or aluminum powder, or a mixture of ammonium nitrate or other inorganic nitrates with other combustible substances which are not explosive ingredients. Such explosives may not contain nitroglycerin, similar liquid organic nitrates, or chlorates.

Explosive, blasting, type C. Substances consisting of a mixture of either potassium or sodium chlorate or potassium, sodium or ammonium perchlorate with organic nitro-derivatives or combustible materials, such as wood-meal or aluminum powder, or a hydrocarbon. Such explosives must not contain nitroglycerin or any similar liquid organic nitrate.

Explosive, blasting, type D. Substances consisting of a mixture of organic nitrate compounds and combustible materials, such as hydrocarbons and aluminum powder. Such explosives must not contain nitroglycerin, any similar liquid organic nitrate, chlorate or ammonium-nitrate. The term generally includes plastic explosives.

Explosive, blasting, type E. Substances consisting of water as an essential ingredient and high proportions of ammonium nitrate or other oxidizer, some or all of which are in solution. The other constituents may include nitro-derivatives, such as trinitrotoluene, hydrocarbons or aluminum powder. The term includes: explosives, emulsion; explosives, slurry; and explosives, watergel.

Explosive, deflagrating. A substance, e.g., propellant, which reacts by deflagration rather than detonation when ignited and used in its normal manner.

Explosive, detonating. A substance which reacts by detonation rather than deflagration when initiated and used in its normal manner.

Explosive, extremely insensitive detonating substance (EIDS). A substance which, although capable of sustaining a detonation, has demonstrated through tests that it is so insensitive that there is very little probability of accidental initiation.

Explosive, primary. Explosive substance which is manufactured with a view to producing a practical effect by explosion, is very sensitive to heat, impact, or friction, and even in very small quantities, detonates. The major primary explosives are mercury fulminate, lead azide, and lead styphnate.

Explosive, secondary. An explosive substance which is relatively insensitive (when compared to primary explosives) and is usually initiated by primary explosives with or without the aid of boosters or supplementary charges. Such an explosive may react as a deflagrating or as a detonating explosive.

Fireworks. Pyrotechnic articles designed for entertainment.

Flares. Articles containing pyrotechnic substances which are designed to illuminate, identify, signal, or warn. The term includes: flares, aerial and flares, surface.

Flash powder. Pyrotechnic substance which, when ignited, produces an intense light.

Fracturing devices, explosive, for oil wells, without detonators. Articles consisting of a charge of detonating explosive contained in a casing without the means of initiation. They are used to fracture the rock around a drill shaft to assist the flow of crude oil from the rock.

Fuse/Fuze. Although these two words have a common origin (French fusee, fusil) and are sometimes considered to be different spellings, it is useful to maintain the convention that fuse refers to a cord-like igniting device, whereas fuze refers to a device used in ammunition which incorporates mechanical, electrical, chemical, or hydrostatic components to initiate a train by deflagration or detonation.

Fuse, igniter. Articles consisting of a metal tube with a core of deflagrating explosives.

Fuse, instantaneous, non-detonating (Quickmatch). Article consisting of cotton yarns impregnated with fine black powder. It burns with an external flame and is used in ignition trains for fireworks, etc.

Fuse, safety. Article consisting of a core of fine-grained black powder surrounded by a flexible woven fabric with one or more protective outer coverings. When ignited, it burns at a predetermined rate without any explosive effect.

Fuzes. Articles designed to start a detonation or deflagration in ammunition. They incorporate mechanical, electrical, chemical, or hydrostatic components and generally protective features. The term includes: Fuzes, detonating; fuzes detonating with protective features; and fuzes igniting.

Grenades, hand or rifle. Articles which are designed to be thrown by hand or to be projected by rifle. The term includes: grenades, hand or rifle, with bursting charge; and grenades, practice, hand or rifle. The term excludes: grenades, smoke.

Igniters. Articles containing one or more explosive substance used to start deflagration of an explosive train. They may be actuated chemically, electrically, or mechanically. The term excludes: cord, igniter; fuse, igniter; fuse, instantaneous, non-detonating; fuze, igniting; lighters, fuse, instantaneous, non-detonating; fuzes, igniting; lighters, fuse; primers, cap type; and primers, tubular.

Ignition, means of. A general term used in connection with the method employed to ignite a deflagrating train of explosive or pyrotechnic substances (for example: a primer for propelling charge, an igniter for a rocket motor or an igniting fuze).

Initiation, means of. (1) A device intended to cause the detonation of an explosive (for example: detonator, detonator for ammunition, or detonating fuze).

(2) The term with its own means of initiation means that the contrivance has its normal initiating device assembled to it and this device is considered to present a significant risk during transport but not one great enough to be unacceptable. The term does not apply, however, to a contrivance packed together with its means of initiation, provided the device is packaged so as to eliminate the risk of causing detonation of the contrivance in the event of functioning of the initiating device. The initiating device can even be assembled in the contrivance provided there are protective features ensuring that the device is very unlikely to cause detonation of the contrivance under conditions which are associated with transport.

(3) For the purposes of classification, any means of initiation without two effective protective features should be regarded as Compatibility Group B; an article with its own means of initiation, without two effective protective features, is Compatibility Group F. A means of initiation which itself possesses two effective protective features is Compatibility Group D, and an article with its own means of initiation which possesses two effective features is Compatibility Group D or E. A means of initiation, adjudged as having two effective protective features, must be approved by the Associate Administrator for Hazardous Materials Safety. A common and effective way of achieving the necessary degree of protection is to use a means of initiation which incorporates two or more independent safety features.

Jet perforating guns, charged, oil well, without detonator. Articles consisting of a steel tube or metallic strip, into which are inserted shaped charges connected by detonating cord, without means of initiation.

Lighters, fuse. Articles of various design actuated by friction, percussion, or electricity and used to ignite safety fuse.

Mass explosion. Explosion which affects almost the entire load virtually instantaneously.

Mines. Articles consisting normally of metal or composition receptacles and bursting charge. They are designed to be operated by the passage of ships, vehicles, or personnel. The term includes Bangalore torpedoes.

Powder cake (powder paste). Substance consisting of nitrocellulose impregnated with not more than 60 percent of nitroglycerin or other liquid organic nitrates or a mixture of these.

Powder, smokeless. Substance based on nitrocellulose used as propellant. The term includes propellants with a single base (nitrocellulose (NC) alone), those with a double base (such as NC and nitroglycerin (NG)) and those with a triple base (such as NC/NG/nitroguanidine). Cast pressed or bag-charges of smokeless powder are listed under charges, propelling and charges, propelling for cannon.

Primers, cap type. Articles consisting of a metal or plastic cap containing a small amount of primary explosive mixture that is readily ignited by impact. They serve as igniting elements in small arms cartridges and in percussion primers for propelling charges.

Primers, tubular. Articles consisting of a primer for ignition and an auxiliary charge of deflagrating explosive, such as black powder, used to ignite the propelling charge in a cartridge case for cannon, etc.

Projectiles. Articles, such as a shell or bullet, which are projected from a cannon or other artillery gun, rifle, or other small arm. They may be inert, with or without tracer, or may contain a burster, expelling charge or bursting charge. The term includes: projectiles, inert, with tracer; projectiles, with burster or expelling charge; and projectiles, with bursting charge.

Propellant, liquid. Substances consisting of a deflagrating liquid explosive, used for propulsion.

Propellant, solid. Substances consisting of a deflagrating solid explosive, used for propulsion.

Propellants. Deflagrating explosives used for propulsion or for reducing the drag of projectiles.

Release devices, explosive. Articles consisting of a small charge of explosive with means of initiation. They sever rods or links to release equipment quickly.

Rocket motors. Articles consisting of a solid, liquid, or hypergolic propellant contained in a cylinder fitted with one or more nozzles. They are designed to propel a rocket or guided missile. The term includes: rocket motors; rocket motors with hypergolic liquids with or without an expelling charge; and rocket motors, liquid fuelled.

Rockets. Articles containing a rocket motor and a payload which may be an explosive warhead or other device. The term includes: guided missiles; rockets, line-throwing; rockets, liquid fuelled, with bursting charge; rockets, with bursting charge; rockets, with expelling charge; and rockets, with inert head.

Signals. Articles consisting of pyrotechnic substances designed to produce signals by means of sound, flame, or smoke or any combination thereof. The term includes: signal devices, hand; signals, distress ship; signals, railway track, explosive; signals, smoke.

Sounding devices, explosive. Articles consisting of a charge of detonating explosive. They are dropped from ships and function when they reach a predetermined depth or the sea bed.

Substance, explosive, very insensitive (Substance, EVI) N.O.S. Substances which present a mass explosive hazard but which are so insensitive that there is very little probability of initiation, or of transition from burning to detonation under normal conditions of transport and which have passed test series 5.

Torpedoes. Articles containing an explosive or non-explosive propulsion system and designed to be propelled through water. They may contain an inert head or warhead. The term includes: torpedoes, liquid fuelled, with inert head; torpedoes, liquid fuelled, with or without bursting charge; and torpedoes, with bursting charge.

Tracers for ammunition. Sealed articles containing pyrotechnic substances, designed to reveal the trajectory of a projectile.

Warheads. Articles containing detonating explosives, designed to be fitted to a rocket, guided missile, or torpedo. They may contain a burster or expelling charge or bursting charge. The term includes: warhead rocket with bursting charge; and warheads, torpedo, with bursting charge.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991; Amdt. 173-241, 59 FR 67492, Dec. 29, 1994; 64 FR 10777, Mar. 5, 1999]

§173.60 General packaging requirements for explosives.

(a) Unless otherwise provided in this subpart and in §173.7(a), packaging used for Class 1 (explosives) materials must meet Packing Group II requirements. Each packaging used for an explosive must be capable of meeting the test requirements of subpart M of part 178 of this subchapter, at the specified level of performance, and the applicable general packaging requirements of paragraph (b) of this section.

(b) The general requirements for packaging of explosives are as follows:

(1) Nails, staples, and other closure devices, made of metal, having no protective covering may not penetrate to the inside of the outer packaging unless the inner packaging adequately protects the explosive against contact with the metal.

(2) The closure device of containers for liquid explosives must provide double protection against leakage, such as a screw cap secured in place with tape.

(3) Inner packagings, fittings, and cushioning materials, and the placing of explosive substances or articles in packages, must be such that the explosive substance is prevented from becoming loose in the outer packaging during transportation. Metallic components of articles must be prevented from making contact with metal packagings. Articles containing explosive substances not enclosed in an outer casing must be separated from each other in order to prevent friction and impact. Padding, trays, partitioning in the inner or outer packaging, molded plastics or receptacles may be used for this purpose.

(4) When the packaging includes water that could freeze during transportation, a sufficient amount of anti-freeze, such as denatured ethyl alcohol, must be added to the water to prevent freezing. If the anti-freeze creates a fire hazard, it may not be used. When a percentage of water in the substance is specified, the combined weight of water and anti-freeze may be substituted.

(5) If an article is fitted with its own means of ignition or initiation, it must be effectively protected from accidental actuation during normal conditions of transportation.

(6) The entry of explosive substances into the recesses of double-seamed metal packagings must be prevented.

(7) The closure device of a metal drum must include a suitable gasket; if the closure device includes metal-to-metal screw-threads, the ingress of explosive substances into the threading must be prevented.

(8) Whenever loose explosive substances or the explosive substance of an uncased or partly cased article may come into contact with the inner surface of metal packagings (1A2, 1B2, 4A, 4B and metal receptacles), the metal packaging should be provided with

an inner liner or coating.

(9) Packagings must be made of materials compatible with, and impermeable to, the explosives contained in the package, so that neither interaction between the explosives and the packaging materials, nor leakage, causes the explosive to become unsafe in transportation, or the hazard division or compatibility group to change (*see §173.24(e)(2)).*

(10) An explosive article containing an electrical means of initiation that is sensitive to external electromagnetic radiation, must have its means of initiation effectively protected from electromagnetic radiation sources (for example, radar or radio transmitters) through either design of the packaging or of the article, or both.

(11) Plastic packagings may not be able to generate or accumulate sufficient static electricity to cause the packaged explosive substances or articles to initiate, ignite or inadvertently function. Metal packagings must be compatible with the explosive substance they contain.

(12) Explosive substances may not be packed in inner or outer packagings where the differences in internal and external pressures, due to thermal or other effects, could cause an explosion or rupture of the package.

(13) Packagings for water soluble substances must be water resistant. Packagings for desensitized or phlegmatized substances must be closed to prevent changes in concentration during transport. When containing less alcohol, water, or phlegmatizer than specified in its proper shipping description, the substance is a "forbidden" material.

[Amdt. 173-260, 62 FR 24719, May 6, 1997]

§173.61 Mixed packaging requirements.

(a) Unless specifically authorized in this subchapter, an explosive may not be packed in the same outside packaging with any other material, unless packaged by the DOD or DOE in accordance with §173.7(a) of this subchapter.

(b) Hardware necessary for assembly of explosive articles at the point-of-use may be packed in the same outside packaging with the explosive articles. The hardware must be securely packed in a separate inside packaging. Sufficient cushioning materials must be used to ensure that all inside packagings are securely packed in the outside packaging.

(c) The following explosives may not be packed together with other Class 1 explosives: UN 0029, UN 0030, UN 0073, UN 0106, UN 0107, UN 0255, UN 0257, UN 0267, UN 0360, UN 0361, UN 0364, UN 0365, UN 0366, UN 0367, UN 0408, UN 0409, UN 0410, UN 0455, UN 0456, and NA 0350. These explosives may be mix-packed with each other in accordance with the compatibility requirements prescribed in paragraph (e).

(d) Division 1.1 and 1.2 explosives may not be packed with the following explosives: UN 0333, UN 0334, UN 0335, UN 0336, and UN 0337.

(e) Except as prescribed in paragraphs (c) and (d) of this section, different explosives may be packed in one outside packaging in accordance with the following compatibility requirements:

(1) Explosives of the same compatibility group and same division number may be packed together.

(2) Explosives of the same compatibility group or authorized combination of compatibility group but different division number may be packed together, provided that the whole package is treated as though its entire contents were comprised of the lower division number. For example, a mixed package of Division 1.2 explosives (Class A explosive) and Division 1.4 explosives (Class C explosive), compatibility group D, must be treated as 1.2D explosives. However, when 1.5D explosives (blasting agents) are packed together with 1.2D explosives (Class A explosives), the whole package must be treated as 1.1D explosives.

(3) Explosives of compatibility group S may be packed with explosives of all other compatibility group except A and L.

(4) Explosives of compatibility group L shall only be packed with an identical explosive.

(5) Explosives articles of compatibility groups C, D, or E may be packed together and the entire package shall be treated as belonging to compatibility group E.

(6) Explosives articles of compatibility groups C, D, E, or N may be packed together and the entire package shall be treated as belonging to compatibility group D.

(7) Explosives substances of compatibility groups C and D may be packaged together and the entire package shall be treated as belonging to compatibility group D.

[Amdt. 173-224, 55 FR 52617 Dec. 21, 1990, as amended at 56 FR 66267, Dec. 20, 1991]

§173.62 Specific packaging requirements for explosives.

(a) Except as provided in paragraph (d) of this section, when the §172.101 table specifies that an explosive must be packaged in accordance with this section, only non-bulk packagings which conform to the provisions of paragraphs (b), (c) and (d) of this section and the applicable requirements in §§173.60 and 173.61 may be used unless otherwise approved by the Associate Administrator. Intermediate bulk packagings may be used for explosives assigned to Packing Instruction 117 in paragraph (b) of this section. Intermediate bulk packagings must conform with the requirements of this subchapter.

(b) *Explosives Table. The Explosives Table specifies the Packing Instructions assigned to each explosive. Explosives are identified in the first column in numerical sequence by their identification number (ID #), which is listed in column 4 of the §172.101 table, of this subchapter. The second column of the Explosives Table specifies the Packing Instruction (PI) which must be used for packaging the explosive. The Explosives Packing Method Table in paragraph (c) of this section defines the methods of packaging. The Packing Instructions are identified using a 3 digit* *designation. The Packing Instruction prefixed by the letters "US" is particular to the United States and not found in applicable international regulations.*

Explosives Table

ID#	PI
UN0004	112
UN0005	130
UN0006	130
UN0007	130
UN0009	130
UN0010	130
UN0012	130
UN0014	130
UN0015	130
UN0016	130
UN0018	130
UN0019	130
UN0020	101
UN0021	101
UN0027	113
UN0028	113
UN0029	131
UN0030	131
UN0033	130
UN0034	130
UN0035	130
UN0037	130
UN0038	130
UN0039	130
UN0042	132
UN0043	133
UN0044	133
UN0048	130
UN0049	135
UN0050	135
UN0054	135
UN0055	136
UN0056	130
UN0059	137
UN0060	132
UN0065	139
UN0066	140
UN0070	134
UN0072	112(a)
UN0073	133
UN0074	110(a) or 110(b)
UN0075	115
UN0076	112
UN0077	114(a) or 114(b)
UN0078	112
UN0079	112(b) or 112(c)

UN0081	116
UN0082	116 or 117
UN0083	116
UN0084	116
UN0092	135
UN0093	135
UN0094	113
UN0099	134
UN0101	140
UN0102	139
UN0103	140
UN0104	139
UN0105	140
UN0106	141
UN0107	141
UN0110	141
UN0113	110(a) or 110(b)
UN0114	110(a) or 110(b)
UN0118	112
UN0121	142
UN0124	US1
UN0129	110(a) or 110(b)
UN0130	110(a) or 110(b)
UN0131	142
UN0132	114(b)
UN0133	112(a)
UN0135	110(a) or 110(b)
UN0136	130
UN0137	130
UN0138	130
UN0143	115
UN0144	115
UN0146	112
UN0147	112(b)
UN0150	112(a) or 112(b)
UN0151	112
UN0153	112(b) or 112(c)
UN0154	112
UN0155	112(b) or 112(c)
UN0159	111
UN0160	114(b)
UN0161	114(b)
UN0167	130
UN0168	130
UN0169	130
UN0171	130
UN0173	134
UN0174	134
UN0180	130
UN0181	130
UN0182	130
UN0183	130
UN0186	130
UN0190	101

UN0191	135
UN0192	135
UN0193	135
UN0194	135
UN0195	135
UN0196	135
UN0197	135
UN0204	134
UN0207	112(b) or 112(c)
UN0208	112(b) or 112(c)
UN0209	112
UN0212	133
UN0213	112(b) or 112(c)
UN0214	112
UN0215	112
UN0216	112(b) or 112(c)
UN0217	112(b) or 112(c)
UN0218	112(b) or 112(c)
UN0219	112
UN0220	112
UN0221	130
UN0222	112(b) or 112(c)
UN0224	110(a) or 110(b)
UN0225	133
UN0226	112(a)
UN0234	114(a) or 114(b)
UN0235	114(a) or 114(b)
UN0236	114(a) or 114(b)
UN0237	138
UN0238	130
UN0240	130
UN0241	116 or 117
UN0242	130
UN0243	130
UN0244	130
UN0245	130
UN0246	130
UN0247	101
UN0248	144
UN0249	144
UN0250	101
UN0254	130
UN0255	131
UN0257	141
UN0266	112
UN0267	131
UN0268	133
UN0271	143
UN0272	143
UN0275	134
UN0276	134
UN0277	134
UN0278	134
UN0279	130

UN0280	130
UN0281	130
UN0282	112
UN0283	132
UN0284	141
UN0285	141
UN0286	130
UN0287	130
UN0288	138
UN0289	139
UN0290	139
UN0291	130
UN0292	141
UN0293	141
UN0294	130
UN0295	130
UN0296	134
UN0297	130
UN0299	130
UN0300	130
UN0301	130
UN0303	130
UN0305	113
UN0306	133
UN0312	135
UN0313	135
UN0314	142
UN0315	142
UN0316	141
UN0317	141
UN0318	141
UN0319	133
UN0320	133
UN0321	130
UN0322	101
UN0323	134
UN0324	130
UN0325	142
UN0326	130
UN0327	130
UN0328	130
UN0329	130
UN0330	130
UN0331	116 or 117
UN0332	116 or 117
UN0333	135
UN0334	135
UN0335	135
UN0336	135
UN0337	135
UN0338	130
UN0339	130
UN0340	112(a) or 112(b)
UN0341	112(b)

UN0342	114(a)
UN0343	111
UN0344	130
UN0345	130
UN0346	130
UN0347	130
UN0348	130
UN0349	101
UN0350	101
UN0351	101
UN0352	101
UN0353	101
UN0354	101
UN0355	101
UN0356	101
UN0357	101
UN0358	101
UN0359	101
UN0360	131
UN0361	131
UN0362	130
UN0363	130
UN0364	133
UN0365	133
UN0366	133
UN0367	141
UN0368	141
UN0369	130
UN0370	130
UN0371	130
UN0372	141
UN0373	135
UN0374	134
UN0375	134
UN0376	133
UN0377	133
UN0378	133
UN0379	136
UN0380	101
UN0381	134
UN0382	101
UN0383	101
UN0384	101
UN0385	112(b) or 112(c)
UN0386	112(b) or 112(c)
UN0387	112(b) or 112(c)
UN0388	112(b) or 112(c)
UN0389	112(b) or 112(c)
UN0390	112(b) or 112(c)
UN0391	112(a)
UN0392	112(b) or 112(c)
UN0393	112(b)
UN0394	112(a)
UN0395	101

UN0396	101
UN0397	101
UN0398	101
UN0399	101
UN0400	101
UN0401	112
UN0402	112(b) or 112(c)
UN0403	135
UN0404	135
UN0405	135
UN0406	114(b)
UN0407	114(b)
UN0408	141
UN0409	141
UN0410	141
UN0411	112(b) or 112(c)
UN0412	130
UN0413	130
UN0414	130
UN0415	143
UN0417	130
UN0418	135
UN0419	135
UN0420	135
UN0421	135
UN0424	130
UN0425	130
UN0426	130
UN0427	130
UN0428	135
UN0429	135
UN0430	135
UN0431	135
UN0432	135
UN0433	111
UN0434	130
UN0435	130
UN0436	130
UN0437	130
UN0438	130
UN0439	137
UN0440	137
UN0441	137
UN0442	137
UN0443	137
UN0444	137
UN0445	137
UN0446	136
UN0447	136
UN0448	114(b)
UN0449	101
UN0450	101
UN0451	130
UN0452	141

UN0453	130
UN0454	142
UN0455	131
UN0456	131
UN0457	130
UN0458	130
UN0459	130
UN0460	130
UN0461	101
UN0462	101
UN0463	101
UN0464	101
UN0465	101
UN0466	101
UN0467	101
UN0468	101
UN0469	101
UN0470	101
UN0471	101
UN0472	101
UN0473	101
UN0474	101
UN0475	101
UN0476	101
UN0477	101
UN0478	101
UN0479	101
UN0480	101
UN0481	101
UN0482	101
UN0483	112(b) or 112(c)
UN0484	112(b) or 112(c)
UN0486	101
UN0487	135
UN0488	130
UN0489	112(b) or 112(c)
UN0490	112(b) or 112(c)
UN0491	143
UN0492	135
UN0493	135
UN0494	US1
UN0495	115
UN0496	112(b) or 112(c)
UN0497	115
UN0498	114(b)
UN0499	114(b)
UN0500	131
NA0124	US1
NA0276	134
NA0323	134
NA0331	116 or 117
NA0337	135
NA0349	133
NA0494	US1

(c) *Explosives Packing Instruction Table. Explosives must be packaged in accordance with the following table:*

(1) The first column lists, in alphanumeric sequence, the packing methods prescribed for explosives in the Explosives Table of paragraph (b) of this section.

(2) The second column specifies the inner packagings that are required. If inner packagings are not required, a notation of "Not necessary" appears in the column. The term "Not necessary" means that a suitable inner packaging may be used but is not required.

(3) The third column specifies the intermediate packagings that are required. If intermediate packagings are not required, a notation of "Not necessary" appears in the column. The term "Not necessary" means that a suitable intermediate packaging may be used but is not required.

(4) The fourth column specifies the outer packagings which are required. If inner packagings and/or intermediate packagings are specified in the second and third columns, then the packaging specified in the fourth column must be used as the outer packaging of a combination packaging; otherwise it may be used as a single packaging.

(5) Packing Instruction 101 may be used for any explosive substance or article if an equivalent level of safety is shown to be maintained subject to the approval of the Associate Administrator for Hazardous Materials Safety.

Table of Packing Methods

Packing instruction	Inner packagings	Intermediate packagings	Outer packagings
101	-	-	-
(02)This Packing Instruction may be used as an alternative to a specifically assigned packing method with the approval of the Associate Administrator for Hazardous Materials Safety prior to transportation. When this packing instruction is used, the following must be marked on the shipping documents: "Packaging approved by the competent authority of the United States of America (USA)".	-	-	-
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. Samples of new or existing explosive substances or articles may be transported as directed by the Associate Administrator for Hazardous Materials Safety for purposes including: testing, classification, research and development, quality control, or as a commercial sample. Explosive samples which are wetted or desensitized must be limited to 25 kg. Explosive samples which are not wetted	-	-	-

or desensitized must be limited to 10 kg in small packages as specified by the Associate Administrator for Hazardous Materials Safety			
110(a)	Bags	Bags	Drums.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. The Intermediate packagings must be filled with water saturated material such as an anti-freeze solution or wetted cushioning 2. Outer packagings must be filled with water saturated material such as an anti-freeze solution or wetted cushioning. Outer packagings must be constructed and sealed to prevent evaporation of the wetting solution, except when 0224 is being carried dry	plastics textile, plastic coated or lined rubber textile, rubberized textile	plastics textile, plastic coated or lined rubber textile, rubberized Receptacles plastics metal	steel, removable head (1A2). plastics, removable head (1H2)
110(b)	Bags	Dividing partitions	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS For UN 0074, 0113, 0114, 0129, 0130, 0135 and 0224, the following conditions must be satisfied: a. inner packagings must not contain more than 50 g of explosive substance (quantity corresponding to dry substance); b. each inner packaging must be separated from other inner packagings by dividing partitions; and c. the outer packaging must not be partitioned with more than 25 compartments	rubber, conductive plastics, conductive Receptacles metal wood rubber, conductive plastics, conductive	metal wood plastics fibreboard	natural wood, sift-proof wall (4C2). plywood (4D). reconstituted wood (4F).
111 PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: For UN 0159, inner packagings are not required when metal (1A2 or 1B2) or plastics (1H2) drums are used as outer packagings	Bags paper, waterproofed plastics textile, rubberized Sheets plastics textile, rubberized	Not necessary	Boxes. steel (4A). aluminium (4B). natural wood, ordinary (4C1). natural wood, sift proof (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, expanded (4H1). plastics, solid (4H2). Drums steel, removable head (1A2). aluminum, removable head (1B2). plywood (1D). fibreboard (1G). plastics, removable head (1H2).
112(a) This packing instruction applies to wetted solids	Bags	Bags	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN Nos. 0004, 0076, 0078, 0154, 0219 and 0394, packagings must be lead	paper, multiwall, water resistant plastics textile textile, rubberized	plastics textile, plastic coated or lined Receptacles metal plastics	steel (4A). aluminium (4B). natural wood, ordinary (4C1).

free 2. Intermediate packagings are not required if leakproof drums are used as the outer packaging 3. For UN 0072 and UN 0226, intermediate packagings are not required	woven plastics Receptacles metal plastics		natural wood, sift proof (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, expanded (4H1). plastics, solid (4H2). Drums steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).
112(b) This packing instruction applies to dry solids other than powders PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0004, 0076, 0078, 0154, 0216, 0219 and 0386, packagings must be lead free 2. For UN 0209, bags, sift-proof (5H2) are recommended for flake or prilled TNT in the dry state and a maximum net mass of 30 kg. 3. For UN 0222 and UN 0223, inner packagings are not required	Bags paper, Kraft paper, multiwall, water resistant plastics textile textile, rubberized plastics woven plastics	Bags (for UN 0150 only) plastics textile, plastic coated or lined	Bags. woven plastics sift-proof (5H2/3). plastics, film (5H4). textile, sift-proof (5L2). textile, water resistant (5L3). paper, multiwall, water resistant (5M2). Boxes steel (4A). aluminium (4B). natural wood, ordinary (4C1). natural wood, sift proof (4C2). plywood (4D) reconstituted wood (4F). fibreboard (4G). plastics, expanded (4H1). plastics, solid (4H2). Drums steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).
112(c) This packing instruction applies to solid dry powders	Bags	Bags	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0004, 0076, 0078, 0154, 0216, 0219 and 0386, packagings must be lead free 2. For UN 0209, bags, sift-proof (5H2) are recommended for flake or prilled TNT in the dry state. Bags must not exceed a maximum net mass of 30 kg. 3.	paper, multiwall, water resistant plastics woven plastics Receptacles fibreboard metal plastics wood	paper, multiwall, water resistant with inner lining plastics Receptacles metal plastics	steel (4A). natural wood, ordinary (4C1). natural wood, sift proof (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G).

Inner packagings are not required if drums are used as the outer packaging. 4. At least one of the packagings must be sift-proof			plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G).
113	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0094 and UN 0305, no more than 50 g of substance must be packed in an inner packaging 2. For UN 0027, inner packagings are not necessary when drums are used as the outer packaging 3. At least one of the packagings must be sift- proof 4. Sheets must only be used for UN 0028	paper plastics textile, rubberized Receptacles fibreboard metal plastics wood Sheets paper, kraft paper, waxed	-	steel (4A). natural wood, ordinary (4C1). natural wood, sift-proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G).
114(a) This packing instruction applies to wetted solids PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0077, 0234, 0235 and 0236, packagings must be lead free 2. For UN 0342, inner packagings are not required when metal (1A2 or 1B2) or plastics (1H2) drums are used as outer packagings 3. Intermediate packagings are not required if leakproof removable head drums are used as the outer packaging	Bags plastics textile woven plastics Receptacles metal plastics	Bags plastics textile, plastic coated or lined Receptacles metal plastics	Boxes. steel (4A). natural wood, ordinary (4C1). natural wood, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). plywood (1D). fibre (1G). plastics, removable head (1H2).
114(b) This packing instruction applies to dry solids	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0077, 0132, 0234, 0235 and 0236, packagings must be lead free 2. For UN 0160 and UN 0161, when metal drums (1A2 or 1B2) are used as the outer packaging, metal packagings must be so constructed that the risk of explosion, by reason of increased internal pressure from internal or external causes is prevented 3. For UN 0160 and UN 0161, inner packagings are not required if drums	paper, kraft plastics textile, sift-proof woven plastics, sift-proof Receptacles fibreboard metal paper plastics woven plastics, sift-proof	-	natural wood, ordinary (4C1). natural wood, sift proof walls (4C2) plywood (4D). reconstituted wood (4F). fibreboard (4G). Drums. steel, removable head (1A2). aluminium, removable head

are used as the outer packaging			(1B2) plywood (1D). fibre (1G). plastics, removable head (1H2)
115	Receptacles	Bags	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For liquid explosives, inner packagings must be surrounded with non-combustible absorbent cushioning material in sufficient quantity to absorb the entire liquid content. Metal receptacles should be cushioned from each other. The net mass of explosive per package may not exceed 30 kg when boxes are used as outer packaging. The net volume of explosive in each package other than boxes must not exceed 120 litres 2. For UN 0075, 0143, 0495 and 0497 when boxes are used as the outer packaging, inner packagings must have taped screw cap closures and be not more than 5 litres capacity each. A composite packaging consisting of a plastic receptacle in a metal drum (6HA1) may be used in lieu of combination packagings. Liquid substances must not freeze at temperatures above -15 ^{o}C (+5 ^{o}F) 3. For UN 0144, intermediate packagings are not necessary.	metal plastics	plastics in metal receptacles Drums metal	natural wood, ordinary (4C1). natural wood, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). Drums. steel, removable head (1A2). aluminium, removable head (1B2). plywood (1D). fibre (1G). Specification MC-200 containers may be used for transport by motor vehicle.
116	Bags	Not necessary	Bags.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0082, 0241, 0331 and 0332, inner packagings are not necessary if leakproof removable head drums are used as the outer packaging 2. For UN 0082, 0241, 0331 and 0332, inner packagings are not required when the explosive is contained in a material impervious to liquid 3. For UN 0081, inner packagings are not required when contained in rigid plastic which is impervious to nitric esters 4. For UN 0331, inner packagings are not required when bags (5H2), (5H3) or (5H4) are used as outer packagings 5. Bags (5H2 or 5H3) must be used only for UN 0082, 0241, 0331 and 0332 6. For UN 0081, bags must not be used as outer packagings	paper, water and oil resistant plastics texitile, plasic coated or lined woven plasics, sift-proof Receptacles fibreboard, water resistant metal plastics wood, sift-proof Sheets paper, water resistant paper, waxed plastics	-	woven plastics (5H1/2/3). paper, mulitwall, water resistant (5M2). plastics, film (5H4). textile, sift-proof (5L2). textile, water resistant (5L3). Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). natural wood, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics,

			removable head (1H2). Jerricans. steel, removable head (3A2). plastics, removable head (3H2).
117	Not necessary	Not necessary	IBCs.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. This packing instruction may only be used for explosives of 0082 when they are mixtures of ammonium nitrate or other inorganic nitrates with other combustible substances which are not explosive ingredients. Such explosives must not contain nitroglycerin, similar liquid organic nitrates, liquid or solid nitrocarbons, or chlorates. 2. This packing instruction may only be used for explosives of UN 0241 which consist of water as an essential ingredient and high proportions of ammonium nitrate or other oxidizers, some or all of which are in solution. The other constituents may include hydrocarbons or aluminium powder, but must not include nitro-derivatives such as trinitrotoluene. 3. Metal IBCs must not be used for UN 0082 and 0241. 4. Flexible IBCs may only be used for solids.	-	-	metal (11A), (11B), (11N), (21A), (21B), (21N), (31A), (31B), (31N). flexible (13H2), (13H3), (13H4), (13L2), (13L3), (13L4), (13M2). rigid plastics (11H1), (11H2), (21H1), (21H2), (31H1), (31H2). composite (11HZ1), (11HZ2), (21HZ1), (21HZ2), (31HZ1), (31HZ2).
130	Not necessary	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. The following applies to UN 0006, 0009, 0010, 0015, 0016, 0018, 0019, 0034, 0035, 0038, 0039, 0048, 0056, 0137, 0138, 0168, 0169, 0171, 0181, 0182, 0183, 0186, 0221, 0238, 0243, 0244, 0245, 0246, 0254, 0280, 0281, 0286, 0287, 0297, 0299, 0300, 0301, 0303, 0321, 0328, 0329, 0344, 0345 0346, 0347, 0362, 0363, 0370, 0412, 0424, 0425, 0434, 0435, 0436, 0437, 0438, 0451, 0459 and 0488. Large and robust explosives articles, normally intended for military use, without their means of initiation or with their means of initiation containing at least two effective protective features, may be carried unpackaged. When such articles have propelling charges or are self-propelled, their ignition systems must be protected against stimuli encountered during normal conditions of transport. A negative result in Test Series 4 on an unpackaged article indicates that the article can be considered for transport unpackaged. Such unpackaged articles may be fixed to cradles or contained in	-	-	steel (4A). aluminium (4B). wood natural, ordinary (4C1). natural wood, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, expanded (4H1). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).

crates or other suitable handling devices.			
131	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0029, 0267 and 0455, bags and reels may not be used as inner packagings 2. For UN 0030, 0255 and 0456, inner packagings are not required when detonators are packed in pasteboard tubes, or when their leg wires are wound on spools with the caps either placed inside the spool or securely taped to the wire on the spool, so as to restrict freedom of movement of the caps and to protect them from impact forces 3. For UN 0360, 0361 and 0500, detonators are not required to be attached to the safety fuse, metal-clad mild detonating cord, detonating cord, or shock tube. Inner packagings are not required if the packing configuration restricts freedom of movement of the caps and protects them from impact forces	paper plastics Receptacles fibreboard metal plastics wood Reels	-	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). natural wood, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).
132(a)	Not necessary	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2).
132(b)	Receptacles fibreboard metal plastics Sheets paper plastics	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2).
133	Receptacles	Receptacles	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0043, 0212, 0225, 0268 and 0306 trays are not authorized as inner packagings	Intermediate packagings are only required when trays are used as inner packagings fibreboard metal plastics wood Trays, fitted with dividing partitions	fibreboard metal plastics wood	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G).

	fibreboard plastics wood		plastics, solid (4H2).
134	Bags water resistant Receptacles fibreboard metal plastics wood Sheets fibreboard, corrugated Tubes fibreboard	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2).
135	Bags paper plastics Receptacles fibreboard metal plastics wood Sheets paper plastics	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, expanded (4H1). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).
136	Bags plastics textile Boxes. fibreboard plastics wood Dividing partitions in the outer packagings	Not necessary	Boxes. steel (4A). aluminium (4B) wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics,

			removable head (1H2).
137	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: For UN 0059, 0439, 0440 and 0441, when the shaped charges are packed singly, the conical cavity must face downwards and the package marked "THIS SIDE UP".	When the shaped charges are packed in pairs, the conical cavities must face inwards to minimize the jetting effect in the event of accidental initiation Boxes fibreboard Tubes fibreboard metal plastics Dividing partitions in the outer packagings	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G).	-
138	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: If the ends of the articles are sealed, inner packagings are not necessary	plastics	-	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2).
139	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0065, 0102, 0104, 0289 and 0290, the ends of the detonating cord must be sealed, for example, by a plug firmly fixed so that the explosive cannot escape. The ends of CORD DETONATING flexible must be fastened securely 2. For UN 0065 and UN 0289, inner packagings are not required when they are fastened securely in coils	plastics Receptacles fibreboard metal plastics wood Reels Sheets paper plastics	-	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). plywood (1D). fibre (1G). plastics, removable head (1H2).

140	Bags	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. If the ends of UN 0105 are sealed, no inner packagings are required 2. For UN 0101, the packaging must be sift-proof except when the fuse is covered by a paper tube and both ends of the tube are covered with removable caps 3. For UN 0101, steel or aluminium boxes or drums must not be used	plastics Reels Sheets paper, kraft plastics	-	steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G).
141	Receptacles fibreboard metal plastics wood Trays, fitted with dividing partitions plastics wood Dividing partitions in the outer packagings	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).
142	Bags paper plastics Receptacles fibreboard metal plastics wood Sheets paper Trays, fitted with dividing partitions plastics	Not necessary	Boxes. steel (4A). aluminium (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). fibre (1G). plastics, removable head (1H2).

143	Bag	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: 1. For UN 0271, 0272, 0415 and 0491 when metal packagings are used, metal packagings must be so constructed that the risk of explosion, by reason of increase in internal pressure from internal or external causes is prevented 2. Composite packagings (6HH2) (plastic receptacle with outer solid box) may be used in lieu of combination packagings	paper, kraft plastics textile textile, rubberized Receptacles fibreboard metal plastics Trays, fitted with dividing partitions plastics wood	-	steel (4A). aluminum (4B). wood, natural, ordinary (4C1). wood, natural, sift proof walls (4C2). plywood (4D). reconstituted wood (4F). fibreboard (4G). plastics, solid (4H2). Drums. steel, removable head (1A2). aluminium, removable head (1B2). plywood (1D). fibre (1G). plastics, removable head (1H2).
144	Receptacles	Not necessary	Boxes.
PARTICULAR PACKING REQUIREMENTS OR EXCEPTIONS: For UN 0248 and UN 0249, packagings must be protected against the ingress of water. When CONTRIVANCES, WATER ACTIVATED are transported unpackaged, they must be provided with at least two independent protective features which prevent the ingress of water	fibreboard metal plastics Dividing partitions in the outer packagings	-	2steel (4A). aluminum (4B). wood, natural, ordinary (4C1) with metal liner. plywood (4D) with metal liner. reconstituted wood (4F) with metal liner. plastics, expanded (4H1).
US 1	-	-	-
1. A jet perforating gun, charged, oil well may be transported under the following conditions:	-	-	-
a. Initiation devices carried on the same motor vehicle or offshore supply vessel must be segregated; each kind from every other kind, and from any gun, tool or other supplies, unless approved in accordance with §173.56. Segregated initiation devices must be carried in a container having individual pockets for each such device or in a fully enclosed steel container lined with a non-sparking material. No more than two segregated initiation devices per gun may be carried on the same motor vehicle.	-	-	-
b. Each shaped charge affixed to the gun may not contain more than 112 g (4 ounces) of explosives.	-	-	-
c. Each shaped charge if not completely enclosed in glass or metal, must be fully	-	-	-

protected by a metal cover after installation in the gun.			
d. A jet perforating gun classed as 1.1D or 1.4D may be transported by highway by private or contract carriers engaged in oil well operations.	-	-	-
(i) A motor vehicle transporting a gun must have specially built racks or carrying cases designed and constructed so that the gun is securely held in place during transportation and is not subject to damage by contact, one to the other or any other article or material carried in the vehicle; and	-	-	-
(ii) The assembled gun packed on the vehicle may not extend beyond the body of the motor vehicle.	-	-	-
e. A jet perforating gun classed as 1.4D may be transported by a private offshore supply vessel only when the gun is carried in a motor vehicle as specified in paragraph (d) of this packing method or on offshore well tool pallets provided that:	-	-	-
(i) All the conditions specified in paragraphs (a), (b), and (c) of this packing method are met;	-	-	-
(ii) The total explosive contents do not exceed 90.8 kg (200 pounds) per tool pallet;	-	-	-
(iii) Each cargo vessel compartment may contain up to 90.8 kg (200 pounds) of explosive content if the segregation requirements in §176.83(b)(3) of this subchapter are met; and	-	-	-
(iv) When more than one vehicle or tool pallet is stowed "on deck" a minimum horizontal separation of 3 m (9.8 feet) must be provided.	-	-	-

(d) Class 1 (explosive) materials owned by the Department of Defense and packaged prior to January 1, 1990, in accordance with the requirements of this subchapter in effect at that time, are excepted from the requirements of part 178 of this subchapter provided the packagings have maintained their integrity and the explosive material is declared as government-owned goods packaged prior to January 1, 1990.

[Amdt. 173-260, 62 FR 24720, May 6, 1997; 62 FR 45702, Aug. 28, 1997; 62 FR 51560, Oct. 1, 1997; 63 FR 1884, Jan. 12, 1998; 63 FR 52849, Oct. 1, 1998; 64 FR 51918, Sept. 27, 1999]

§173.63 Packaging exceptions.

(a) Cord, detonating (UN 0065), having an explosive content not exceeding 6.5 g (0.23 ounces) per 30 centimeter length (one linear foot) may be offered for transportation domestically and transported as Cord, detonating (UN 0289), Division 1.4 Compatibility Group D (1.4D) explosives, if the gross weight of all packages containing Cord, detonating (UN 0065), does not exceed 45 kg (99 pounds) per:

(1) Transport vehicle, freight container, or cargo-only aircraft;

(2) Off-shore down-hole tool pallet carried on an off-shore supply vessel;

(3) Cargo compartment of a cargo vessel; or

(4) Passenger-carrying aircraft used to transport personnel to remote work sites, such as offshore drilling units.

(b) *Cartridges, small arms, and cartridges power devices. (1) Cartridges, small arms, and cartridges power devices (which are used to project fastening devices) which have been classed as a Division 1.4S explosive may be reclassed, offered for transportation, and transported as ORM-D material when packaged in accordance with paragraph (b)(2) of this section; such transportation is excepted from the requirements of subparts E (Labeling) and F (Placarding) of part 172 of this subchapter. Cartridges, small arms, and cartridges power devices that may be shipped as ORM-D material is limited to:*

(i) Ammunition for rifle, pistol or shotgun;

(ii) Ammunition with inert projectiles or blank ammunition;

(iii) Ammunition having no tear gas, incendiary, or detonating explosive projectiles;

(iv) Ammunition not exceeding 12.7 mm (50 caliber or 0.5 inch) for rifle or pistol, cartridges or 8 gauge for shotshells; and

(v) Cartridges, power devices which are used to project fastening devices.

(2) Packaging for cartridges, small arms, and cartridges power devices as ORM-D material must be as follows:

(i) Ammunition must be packed in inside boxes, or in partitions which fit snugly in the outside packaging, or in metal clips;

(ii) Primers must be protected from accidental initiation;

(iii) Inside boxes, partitions or metal clips must be packed in securely-closed strong outside packagings;

(iv) Maximum gross weight is limited to 30 kg (66 pounds) per package; and

(v) Cartridges, power devices which are used to project fastening devices and 22 caliber rim-fire cartridges may be packaged loose in strong outside packagings.

(c)-(e) [Reserved]

(f) Detonators containing no more than 1 g explosive (excluding ignition and delay charges) that are electric blasting caps with leg wires 4 feet long or longer, delay connectors in plastic sheaths, or blasting caps with empty plastic tubing 12 feet long or longer may be packed as follows in which case they are excepted from the packaging requirements of §173.62:

(1) No more than 50 detonators in one inner packaging;

(2) IME Standard 22 container or compartment is used as the outer packaging;

(3) No more than 1000 detonators in one outer packaging; and

(4) No material may be loaded on top of the IME Standard 22 container and no

material may be loaded against the outside door of the IME Standard 22 compartment.

(g) Detonators that are classed as 1.4B or 1.4S and contain no more than 1 g of explosive (excluding ignition and delay charges) may be packed as follows in which case they are excepted from the packaging requirements of §173.62:

(1) No more than 50 detonators in one inner packaging;

(2) IME Standard 22 container is used as the outer packaging;

(3) No more than 1000 detonators in one outer packaging; and

(4) Each inner packaging is marked "l.4B Detonators" or "1.4S Detonators", as appropriate.

[Amdt. 173-224, 55 FR 52617, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; Amdt. 173-236, 58 FR 50536, Sept. 24, 1993; Amdt. 173-253, 61 FR 27175, May 30, 1996]

[CFR] PART 173 SUBPART D - Definitions Classification, Packing Group Assignments and Exceptions for Hazardous Materials Other Than Class 1 and Class 7

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART D]

Subpart D - Definitions Classification, Packing Group Assignments and Exceptions for Hazardous Materials Other Than Class 1 and Class 7

Source: Amdt. 173-224, 55 FR 52634 Dec. 21, 1990, unless otherwise noted.

§173.115 Class 2, Divisions 2.1, 2.2, and 2.3-Definitions.

(a) *Division 2.1 (Flammable gas). For the purpose of this subchapter, a flammable gas (Division 2.1) means any material which is a gas at 20 °C (68 °F) or less and 101.3 kPa (14.7 psi) of pressure (a material which has a boiling point of 20 °C (68 °F) or less at 101.3 kPa (14.7 psi)) which-*

(1) Is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13 percent or less by volume with air; or

(2) Has a flammable range at 101.3 kPa (14.7 psi) with air of at least 12 percent regardless of the lower limit.

Except for aerosols, the limits specified in paragraphs (a)(1) and (a)(2) of this section shall be determined at 101.3 kPa (14.7 psi) of pressure and a temperature of 20 °C (68 °F) in accordance with ASTM E681-85, Standard Test Method for Concentration Limits of Flammability of Chemicals or other equivalent method approved by the Associate Administrator for Hazardous Materials Safety. The flammability of aerosols is determined by the tests specified in §173.306(i) of this part.

(b) *Division 2.2 (non-flammable, nonpoisonous compressed gas-including compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiant gas and oxidizing gas). For the purpose of this subchapter, a non-flammable, nonpoisonous compressed gas (Division 2.2) means any material (or mixture) which-*

(1) Exerts in the packaging an absolute pressure of 280 kPa (40.6 psia) or greater at 20 °C (68 °F), and

(2) Does not meet the definition of Division 2.1 or 2.3.

(c) *Division 2.3 (Gas poisonous by inhalation). For the purpose of this subchapter, a gas poisonous by inhalation (Division 2.3) means a material which is a gas at 20 °C (68 °F) or less and a pressure of 101.3 kPa (14.7 psi) (a material which has a boiling point of 20 °C (68 °F) or less at 101.3 kPa (14.7 psi)) and which-*

(1) Is known to be so toxic to humans as to pose a hazard to health during transportation, or

(2) In the absence of adequate data on human toxicity, is presumed to be toxic to humans because when tested on laboratory animals it has an LC50 value of not more than 5000 ml/m^3 (see §173.116(a) of this subpart for assignment of Hazard Zones A, B, C or D). LC50 values for mixtures may be determined using the formula in §173.133(b)(1)(i) of this subpart.

(d) *Non-liquefied compressed gas. A non-liquefied compressed gas means a gas, other than in solution, which in a packaging under the charged pressure is entirely gaseous at a temperature of 20 °C (68 °F).*

(e) Liquefied compressed gas. A liquefied compressed gas means a gas which in a packaging under the charged pressure, is partially liquid at a temperature of 20 °C (68 °F).

(f) Compressed gas in solution. A compressed gas in solution is a non-liquefied compressed gas which is dissolved in a solvent.

(g) Cryogenic liquid. A cryogenic liquid means a refrigerated liquefied gas having a boiling point colder than -90 °C (-130 °F) at 101.3 kPa (14.7 psi) absolute. A material meeting this definition is subject to requirements of this subchapter without regard to whether it meets the definition of a non-flammable, non-poisonous compressed gas in paragraph (b) of this section.

(h) Flammable range. The term flammable range means the difference between the minimum and maximum volume percentages of the material in air that forms a flammable mixture.

(i) Service pressure. The term service pressure means the authorized pressure marking on the packaging. For example, for a cylinder marked "DOT 3A1800", the service pressure is 12410 kPa (1800 psi).

(j) Refrigerant gas or Dispersant gas. The terms Refrigerant gas or Dispersant gas apply to all non-poisonous refrigerant gases, dispersant gases (fluorocarbons) listed in §§172.101, 173.304(a)(2), 173.314(c), 173.315(a)(1) and 173.315(h), and mixtures thereof, or any other compressed gas having a vapor pressure not exceeding 1792 kPa (260 psi) at 54 ^{o}C (130 ^{o}F), and restricted for use as a refrigerant, dispersant or blowing agent.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; 57 FR 45461, Oct. 1, 1992; Amdt. 173-236, 58 FR 50236, Sept. 24, 1993; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-241, 59 FR 67506, Dec. 29, 1994; Amdt. 173-255, 61 FR 50625, Sept. 26, 1996]

§173.116 Class 2-Assignment of hazard zone.

(a) The hazard zone of a Class 2, Division 2.3 material is assigned in column 7 of the §172.101 table. There are no hazard zones for Divisions 2.1 and 2.2. When the §172.101 table provides more than one hazard zone for a Division 2.3 material, or indicates that the hazard zone be determined on the basis of the grouping criteria for Division 2.3, the hazard zone shall be determined by applying the following criteria:

Hazard zone	Inhalation toxicity
A	$LC_5$0 less than or equal to 200 ppm.
B	$LC_5$0 greater than 200 ppm and less than or equal to 1000 ppm.
C	$LC_5$0 greater than 1000 ppm and less than or equal to 3000 ppm.
D	$LC_5$0 greater than 3000 ppm or less than or equal to 5000 ppm.

(b) The criteria specified in paragraph (a) of this section are represented graphically in §173.133, Figure 1.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994]

§173.117-173.119 [Reserved]

§173.120 Class 3-Definitions.

(a) *Flammable liquid. For the purpose of this subchapter, a flammable liquid (Class 3) means a liquid having a flash point of not more than 60.5 °C (141 °F), or any material in a liquid phase with a flash point at or above 37.8 °C (100 °F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging, with the following exceptions:*

(1) Any liquid meeting one of the definitions specified in §173.115.

(2) Any mixture having one or more components with a flash point of 60.5 °C (141 °F) or higher, that make up at least 99 percent of the total volume of the mixture, if the mixture is not offered for transportation or transported at or above its flash point.

(3) Any liquid with a flash point greater than 35 °C (95 °F) which does not sustain combustion according to ASTM 4206 or the procedure in appendix H of this part.

(4) Any liquid with a flash point greater than 35 °C (95 °F) and with a fire point greater than 100 °C (212 °F) according to ISO 2592.

(5) Any liquid with a flash point greater than 35 °C (95 °F) which is in a water-miscible solution with a water content of more than 90 percent by mass.

(b) Combustible liquid. (1) For the purpose of this subchapter, a *combustible liquid means any liquid that does not meet the definition of any other hazard class specified in this subchapter and has a flash point above 60.5 °C (141 °F) and below 93 °C (200 °F).*

(2) A flammable liquid with a flash point at or above 38 °C (100 °F) that does not meet the definition of any other hazard class may be reclassed as a combustible liquid. This provision does not apply to transportation by vessel or aircraft, except where other means of transportation is impracticable. An elevated temperature material that meets the definition of a Class 3 material because it is intentionally heated and offered for transportation or transported at or above its flash point may not be reclassed as a combustible liquid.

(3) A combustible liquid which does not sustain combustion is not subject to the requirements of this subchapter as a combustible liquid. Either the test method specified in ASTM 4206 or the procedure in appendix H of this part may be used to determine if a material sustains combustion when heated under test conditions and exposed to an external source of flame.

(c) Flash point. (1) *Flash point means the minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. It shall be determined as follows:*

(i) For a homogeneous, single-phase, liquid having a viscosity less than 45 S.U.S. at 38 °C (100 °F) that does not form a surface film while under test, one of the following test procedures shall be used:

(A) Standard Method of Test for Flash Point by Tag Closed Tester, (ASTM D 56);

(B) Standard Methods of Test for Flash Point of Liquids by Setaflash Closed Tester, (ASTM D 3278); or

(C) Standard Test Methods for Flash Point by Small Scale Closed Tester, (ASTM D 3828).

(ii) For a liquid other than one meeting all of the criteria of paragraph (c)(1)(i) of this section, one of the following test procedures shall be used:

(A) Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, (ASTM D 93). For cutback asphalt, use Method B of ASTM D 93 or alternate tests authorized in this standard; or

(B) Standard Methods of Test for Flash Point of Liquids by Setaflash Closed Tester (ASTM D 3278).

(2) For a liquid that is a mixture of compounds that have different volatility and flash points, its flash point shall be determined as specified in paragraph (c)(1) of this section, on the material in the form in which it is to be shipped. If it is determined by this test that the flash point is higher than -7 °C (20 °F) a second test shall be made as follows: a portion of the mixture shall be placed in an open beaker (or similar container) of such dimensions that the height of the liquid can be adjusted so that the ratio of the volume of the liquid to the exposed surface area is 6 to one. The liquid shall be allowed to evaporate under ambient pressure and temperature (20 to 25 °C (68 to 77 °F)) for a period of 4 hours or until 10 percent by volume has evaporated, whichever comes first. A flash point is then run on a portion of the liquid remaining in the evaporation container and the lower of the two flash points shall be the flash point of the material.

(3) For flash point determinations by Setaflash closed tester, the glass syringe specified need not be used as the method of measurement of the test sample if a minimum quantity of 2 ml (0.1 ounce) is assured in the test cup.

(d) If experience or other data indicate that the hazard of a material is greater or less than indicated by the criteria specified in paragraphs (a) and (b) of this section, the Associate Administrator for Hazardous Materials Safety may revise the classification or make the material subject or not subject to the requirements of parts 170-189 of this subchapter.

[Amdt. 173-224, 55 FR 52634 Dec. 21, 1990, as amended by Amdt. 173-227, 56 FR 49989, Oct. 2, 1991; 56 FR 66268, Dec. 20, 1991; 57 FR 45461, Oct. 1, 1992; Amdt. 173-241, 59 FR 67506, 67507, Dec. 29, 1994; Amdt. 173-255, 61 FR 50625, Sept. 26, 1996; Amdt. 173-261, 62 FR 24731, May 6, 1997]

§173.121 Class 3-Assignment of packing group.

(a) The packing group of a Class 3 material is as assigned in column 5 of the §172.101 table. When the §172.101 table provides more than one packing group for a hazardous material, the packing group shall be determined by applying the following criteria:

Packing group	Flash point (closed-cup)	Initial boiling point
I	-	>35°C (95°F)
II	<23°C (73°F)	>35°C (95°F)
III	"23°C, >60.5°C ("73°F, >141°F)	>35°C (95°F)

(b) *Criteria for inclusion of viscous Class 3 materials in Packing Group III. (1) Viscous Class 3 materials in Packing Group II with a flash point of less than 23 ^{o}C (73 ^{o}F) may be grouped in Packing Group III provided that-*

(i) Less than 3 percent of the clear solvent layer separates in the solvent separation test;

(ii) The mixture does not contain any substances with a primary or a subsidiary risk of Division 6.1 or Class 8;

(iii) The capacity of the packaging is not more than 30 L (7.9 gallons); and

(iv) The viscosity and flash point are in accordance with the following table:

Flow time t in seconds	Jet diameter in mm	Flash point c.c.
20<t>60	4	above 17 ^{o}C (62.6 ^{o}F).
60<t>100	4	above 10 ^{o}C (50 ^{o}F).
20<t>32	6	above 5 ^{o}C (41 ^{o}F).
32<t>44	6	above -1 ^{o}C (31.2 ^{o}F).
44<t>100	6	above -5 ^{o}C (23 ^{o}F).
100<t	6	-5 ^{o}C (23 ^{o}F) and below.

(2) The methods by which the tests referred to in paragraph (b)(1) of this section shall be performed are as follows:

(i) *Viscosity test. The flow time in seconds is determined at 23 ^{o}C (73.4 ^{o}F) using the ISO standard cup with a 4 mm (0.16 inch) jet (ISO 2431:1984). Where the flow time exceeds 100 seconds, a further test is carried out using the ISO standard cup with a 6 mm (0.24 inch) jet.*

(ii) Solvent Separation Test. This test is carried out at 23 ^{o}C (73 ^{o}F) using a 100.0 ml (3 ounces) measuring cylinder of the stoppered type of approximately 25.0 cm (9.8 inches) total height and of a uniform internal diameter of approximately 30 mm (1.2 inches) over the calibrated section. The sample should be stirred to obtain a uniform consistency, and poured in up to the 100 ml (3 ounces) mark. The stopper should be inserted and the cylinder left standing undisturbed for 24 hours. After 24 hours, the height of the upper separated layer should be measured and the percentage of this layer as compared with the total height of the sample calculated.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; Amdt. 173-241, 59 FR 67507, Dec. 29, 1994 Amdt. 173-255, 61 FR 50625, Sept. 26, 1996; 64 FR 10777, Mar. 5, 1999; 64 FR 51918, Sept. 27, 1999]

§173.124 Class 4, Divisions 4.1, 4.2 and 4.3-Definitions.

(a) *Division 4.1 (Flammable Solid). For the purposes of this subchapter, flammable solid (Division 4.1) means any of the following three types of materials:*

(1) Desensitized explosives that-

(i) When dry are Explosives of Class 1 other than those of compatibility group A, which are wetted with sufficient water, alcohol, or plasticizer to suppress explosive properties; and

(ii) Are specifically authorized by name either in the §172.101Table or have been assigned a shipping name and hazard class by the Associate Administrator for Hazardous Materials Safety under the provisions of-

(A) An exemption issued under subchapter A of this chapter; or

(B) An approval issued under §173.56(i) of this part.

(2)(i) Self-reactive materials are materials that are thermally unstable and that can undergo a strongly exothermic decomposition even without participation of oxygen (air). A material is excluded from this definition if any of the following applies:

(A) The material meets the definition of an explosive as prescribed in subpart C of this part, in which case it must be classed as an explosive;

(B) The material is forbidden from being offered for transportation according to §172.101 of this subchapter or §173.21;

(C) The material meets the definition of an oxidizer or organic peroxide as prescribed in subpart D of this part, in which case it must be so classed;

(D) The material meets one of the following conditions:

(*1) Its heat of decomposition is less than 300 J/g; or*

(2) Its self-accelerating decomposition temperature (SADT) is greater than 75 ^{o}C (167 ^{o}F) for a 50 kg package; or

(E) The Associate Administrator for Hazardous Materials Safety has determined that the material does not present a hazard which is associated with a Division 4.1 material.

(ii) *Generic types. Division 4.1 self-reactive materials are assigned to a generic system consisting of seven types. A self-reactive substance identified by technical name in the Self-Reactive Materials Table in §173.224 is assigned to a generic type in accordance with that table. Self-reactive materials not identified in the Self-Reactive Materials Table in §173.224 are assigned to generic types under the procedures of paragraph (a)(2)(iii) of this section.*

(A) Type A. Self-reactive material type A is a self-reactive material which, as packaged for transportation, can detonate or deflagrate rapidly. Transportation of type A self-reactive material is forbidden.

(B) Type B. Self-reactive material type B is a self-reactive material which, as packaged for transportation, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in a package.

(C) Type C. Self-reactive material type C is a self-reactive material which, as packaged for transportation, neither detonates nor deflagrates rapidly and cannot undergo a thermal explosion.

(D) Type D. Self-reactive material type D is a self-reactive material which-

(1) Detonates partially, does not deflagrate rapidly and shows no violent effect when

heated under confinement;

(2) Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or

(3) Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.

(E) Type E. Self-reactive material type E is a self-reactive material which, in laboratory testing, neither detonates nor deflagrates at all and shows only a low or no effect when heated under confinement.

(F) Type F. Self-reactive material type F is a self-reactive material which, in laboratory testing, neither detonates in the cavitated state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power.

(G) Type G. Self-reactive material type G is a self-reactive material which, in laboratory testing, does not detonate in the cavitated state, will not deflagrate at all, shows no effect when heated under confinement, nor shows any explosive power. A type G self-reactive material is not subject to the requirements of this subchapter for self-reactive material of Division 4.1 provided that it is thermally stable (self-accelerating decomposition temperature is 50 ^{o}C (122 ^{o}F) or higher for a 50 kg (110 pounds) package). A self-reactive material meeting all characteristics of type G except thermal stability is classed as a type F self-reactive, temperature control material.

(iii) Procedures for assigning a self-reactive material to a generic type. A self-reactive material must be assigned to a generic type based on-

(A) Its physical state (i.e. liquid or solid), in accordance with the definition of liquid and solid in §171.8 of this subchapter;

(B) A determination as to its control temperature and emergency temperature, if any, under the provisions of §173.21(f);

(C) Performance of the self-reactive material under the test procedures specified in the UN Recommendations on the Transport of Dangerous Goods, Tests and Criteria and the provisions of paragraph (a)(2)(iii) of this section; and

(D) Except for a self-reactive material which is identified by technical name in the Self-Reactive Materials Table in §173.224(b) or a self-reactive material which may be shipped as a sample under the provisions of §173.224, the self-reactive material is approved in writing by the Associate Administrator for Hazardous Materials Safety. The person requesting approval shall submit to the Associate Administrator for Hazardous Materials Safety the tentative shipping description and generic type and-

(*1) All relevant data concerning physical state, temperature controls, and tests results; or*

(2) An approval issued for the self-reactive material by the competent authority of a foreign government.

(iv) Tests. The generic type for a self-reactive material must be determined using the testing protocol from Figure 14.2 (Flow Chart for Assigning Self-Reactive Substances to Division 4.1) from the UN Recommendations on the Transport of Dangerous Goods, Tests and Criteria.

(3) Readily combustible solids are materials that-

(i) Are solids which may cause a fire through friction, such as matches;
(ii) Show a burning rate faster than 2.2 mm (0.087 inches) per second when tested in accordance with UN Manual of Tests and Criteria; or
(iii) Any metal powders that can be ignited and react over the whole length of a sample in 10 minutes or less, when tested in accordance with UN Manual of Tests and Criteria.
(b) *Division 4.2 (Spontaneously Combustible Material). For the purposes of this subchapter, spontaneously combustible material (Division 4.2) means-*
(1) A pyrophoric material. A pyrophoric material is a liquid or solid that, even in small quantities and without an external ignition source, can ignite within five (5) minutes after coming in contact with air when tested according to UN Manual of Tests and Criteria.
(2) A self-heating material. A self-heating material is a material that, when in contact with air and without an energy supply, is liable to self-heat. A material of this type which exhibits spontaneous ignition or if the temperature of the sample exceeds 200 ^{o}C (392 ^{o}F) during the 24-hour test period when tested in accordance with UN Manual of Tests and Criteria, is classed as a Division 4.2 material.
(c) *Division 4.3 (Dangerous when wet material). For the purposes of this chapter, dangerous when wet material (Division 4.3) means a material that, by contact with water, is liable to become spontaneously flammable or to give off flammable or toxic gas at a rate greater than 1 liter per kilogram of the material, per hour, when tested in accordance with UN Manual of Tests and Criteria.*

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; 57 FR 45461, Oct. 1, 1992; Amdt. 173-233, 58 FR 33305, June 16, 1993; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-241, 59 FR 67507, Dec. 29, 1994; Amdt. 173-261, 62 FR 24731, May 6, 1997]

§173.125 Class 4-Assignment of packing group.
(a) The packing group of a Class 4 material is assigned in column (5) of the §172.101 table. When the §172.101 table provides more than one packing group for a hazardous material, the packing group shall be determined on the basis of test results following test methods given in the UN Manual of Tests and Criteria and by applying the appropriate criteria given in this section.
(b) Packing group criteria for readily combustible materials of Division 4.1 are as follows:
(1) Powdered, granular or pasty materials must be classified in Division 4.1 when the time of burning of one or more of the test runs, in accordance with the UN Manual of Tests and Criteria, is less than 45 seconds or the rate of burning is more than 2.2 mm/s. Powders of metals or metal alloys must be classified in Division 4.1 when they can be ignited and the reaction spreads over the whole length of the sample in 10 minutes or less.
(2) Packing group criteria for readily combustible materials of Division 4.1 are

assigned as follows:

(i) For readily combustible solids (other than metal powders), Packing Group II if the burning time is less than 45 seconds and the flame passes the wetted zone. Packing Group II must be assigned to powders of metal or metal alloys if the zone of reaction spreads over the whole length of the sample in 5 minutes or less.

(ii) For readily combustible solids (other than metal powders), Packing Group III must be assigned if the burning rate time is less than 45 seconds and the wetted zone stops the flame propagation for at least 4 minutes. Packing Group III must be assigned to metal powders if the reaction spreads over the whole length of the sample in more than 5 minutes but not more than 10 minutes.

(c) Packing group criteria for Division 4.2 materials is as follows:

(1) Pyrophoric liquids and solids of Division 4.2 are assigned to Packing Group I.

(2) A self-heating material is assigned to-

(i) Packing Group II, if the material gives a positive test result when tested with a 25 mm cube size sample at 140 ^{o}C; or

(ii) Packing Group III, if-

(A) A positive test result is obtained in a test using a 100 mm sample cube at 140 ^{o}C and a negative test result is obtained in a test using a 25 mm sample cube at 140 ^{o}C and the substance is transported in packagings with a volume of more than 3 cubic meters; or

(B) A positive test result is obtained in a test using a 100 mm sample cube at 120 ^{o}C and a negative result is obtained in a test using a 25 mm sample cube at 140 ^{o}C and the substance is transported in packagings with a volume of more than 450 liters; or

(C) A positive result is obtained in a test using a 100 mm sample cube at 100 ^{o}C and a negative result is obtained in a test using a 25 mm sample cube at 140 ^{o}C and the substance is transported in packagings with a volume of less than 450 liters.

(d) A Division 4.3 dangerous when wet material is assigned to-

(1) Packing Group I, if the material reacts vigorously with water at ambient temperatures and demonstrates a tendency for the gas produced to ignite spontaneously, or which reacts readily with water at ambient temperatures such that the rate of evolution of flammable gases is equal or greater than 10 liters per kilogram of material over any one minute;

(2) Packing Group II, if the material reacts readily with water at ambient temperatures such that the maximum rate of evolution of flammable gases is equal to or greater than 20 liters per kilogram of material per hour, and which does not meet the criteria for Packing Group I; or

(3) Packing Group III, if the material reacts slowly with water at ambient temperatures such that the maximum rate of evolution of flammable gases is greater than 1 liter per kilogram of material per hour, and which does not meet the criteria for Packing Group I or II.

[Amdt. 173-224, 55 FR 52634 Dec. 21, 1990, as amended by Amdt. 173-255, 61 FR 50625, Sept. 26, 1996; Amdt. 173-261, 62 FR 24731, May 6, 1997; 62 FR 51560, Oct. 1, 1997]

§173.127 Class 5, Division 5.1-Definition and assignment of packing groups.

(a) *Definition. For the purpose of this subchapter, oxidizer (Division 5.1) means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials.*

(1) A solid material is classed as a Division 5.1 material if, when tested in accordance with the UN Manual of Tests and Criteria, its mean burning time is less than or equal to the burning time of a 3:7 potassium bromate/cellulose mixture.

(2) A liquid material is classed as a Division 5.1 material if, when tested in accordance with the UN Manual of Tests and Criteria, it spontaneously ignites or its mean time for a pressure rise from 690 kPa to 2070 kPa gauge is less then the time of a 1:1 nitric acid (65 percent)/cellulose mixture.

(b) *Assignment of packing groups. (1) The packing group of a Division 5.1 material which is a solid shall be assigned using the following criteria:*

(i) Packing Group I, for any material which, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture.

(ii) Packing Group II, for any material which, in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met.

(iii) Packing Group III for any material which, in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met.

(2) The packing group of a Division 5.1 material which is a liquid shall be assigned using the following criteria:

(i) Packing Group I for:

(A) Any material which spontaneously ignites when mixed with cellulose in a 1:1 ratio; or

(B) Any material which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50 percent)/cellulose mixture.

(ii) Packing Group II, any material which exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 aqueous sodium chlorate solution (40 percent)/cellulose mixture and the criteria for Packing Group I are not met.

(iii) Packing Group III, any material which exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65 percent)/cellulose mixture and the criteria for Packing Group I and II are not met.

[Amdt. 173-261, 62 FR 24732, May 6, 1997]

§173.128 Class 5, Division 5.2-Definitions and types.

(a) *Definitions. For the purposes of this subchapter, organic peroxide (Division 5.2) means any organic compound containing oxygen (O) in the bivalent -O-O- structure and which may be considered a derivative of hydrogen peroxide, where one or more of the hydrogen atoms have been replaced by organic radicals, unless any of the following paragraphs applies:*

(1) The material meets the definition of an explosive as prescribed in subpart C of this part, in which case it must be classed as an explosive;

(2) The material is forbidden from being offered for transportation according to §172.101 of this subchapter or §173.21;

(3) The Associate Administrator for Hazardous Materials Safety has determined that the material does not present a hazard which is associated with a Division 5.2 material; or

(4) The material meets one of the following conditions:

(i) For materials containing no more than 1.0 percent hydrogen peroxide, the available oxygen, as calculated using the equation in paragraph (a)(4)(ii) of this section, is not more than 1.0 percent, or

(ii) For materials containing more than 1.0 percent but not more than 7.0 percent hydrogen peroxide, the available oxygen, content (O_a) is not more than 0.5 percent, when determined using the equation:

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where, for a material containing k species of organic peroxides:

n_i = number of -O-O- groups per molecule of the *i th species*
c_i = concentration (mass percent) of the *i th species*
m_i = molecular mass of the *i th species*

(b) Generic types. Division 5.2 organic peroxides are assigned to a generic system which consists of seven types. An organic peroxide identified by technical name in the Organic Peroxides Table in §173.225 is assigned to a generic type in accordance with that table. Organic peroxides not identified in the Organic Peroxides table are assigned to generic types under the procedures of paragraph (c) of this section.

(1) Type A. Organic peroxide type A is an organic peroxide which can detonate or deflagrate rapidly as packaged for transport. Transportation of type A organic peroxides is forbidden.

(2) Type B. Organic peroxide type B is an organic peroxide which, as packaged for transport, neither detonates nor deflagrates rapidly, but can undergo a thermal explosion.

(3) Type C. Organic peroxide type C is an organic peroxide which, as packaged for transport, neither detonates nor deflagrates rapidly and cannot undergo a thermal

explosion.

(4) Type D. Organic peroxide type D is an organic peroxide which-

(i) Detonates only partially, but does not deflagrate rapidly and is not affected by heat when confined;

(ii) Does not detonate, deflagrates slowly, and shows no violent effect if heated when confined; or

(iii) Does not detonate or deflagrate, and shows a medium effect when heated under confinement.

(5) *Type E. Organic peroxide type E is an organic peroxide which neither detonates nor deflagrates and shows low, or no, effect when heated under confinement.*

(6) Type F. Organic peroxide type F is an organic peroxide which will not detonate in a cavitated state, does not deflagrate, shows only a low, or no, effect if heated when confined, and has low, or no, explosive power.

(7) Type G. Organic peroxide type G is an organic peroxide which will not detonate in a cavitated state, will not deflagrate at all, shows no effect when heated under confinement, and shows no explosive power. A type G organic peroxide is not subject to the requirements of this subchapter for organic peroxides of Division 5.2 provided that it is thermally stable (self-accelerating decomposition temperature is 50 ^{o}C (122 ^{o}F) or higher for a 50 kg (110 pounds) package). An organic peroxide meeting all characteristics of type G except thermal stability and requiring temperature control is classed as a type F, temperature control organic peroxide.

(c) Procedure for assigning an organic peroxide to a generic type. An organic peroxide shall be assigned to a generic type based on-

(1) Its physical state (i.e., liquid or solid), in accordance with the definitions for liquid and solid in §171.8 of this subchapter;

(2) A determination as to its control temperature and emergency temperature, if any, under the provisions of §173.21(f); and

(3) Performance of the organic peroxide under the test procedures specified in the UN Manual of Tests and Criteria, and the provisions of paragraph (d) of this section.

(d) *Approvals. (1) An organic peroxide must be approved, in writing, by the Associate Administrator for Hazardous Materials Safety, before being offered for transportation or transported, including assignment of a generic type and shipping description, except for-*

(i) An organic peroxide which is identified by technical name in the Organic Peroxides Table in §173.225(b);

(ii) A mixture of organic peroxides prepared according to §173.225(c)(5); or

(iii) An organic peroxide which may be shipped as a sample under the provisions of §173.225(c).

(2) A person applying for an approval must submit all relevant data concerning physical state, temperature controls, and tests results or an approval issued for the organic peroxide by the competent authority of a foreign government.

(e) *Tests. The generic type for an organic peroxide shall be determined using the testing protocol from Figure 20.1(a) (Classification and Flow Chart Scheme for Organic Peroxides) from the UN Manual of Tests and Criteria.*

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-241, 59 FR 67508, Dec. 29, 1994; Amdt. 173-261, 62 FR 24732, May 6, 1997]

§173.129 Class 5, Division 5.2-Assignment of packing group.

All Division 5.2 materials are assigned to Packing Group II in column 5 of the §172.101 table.

§173.132 Class 6, Division 6.1-Definitions.

(a) For the purpose of this subchapter, *poisonous material (Division 6.1) means a material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation, or which, in the absence of adequate data on human toxicity:*

(1) Is presumed to be toxic to humans because it falls within any one of the following categories when tested on laboratory animals (whenever possible, animal test data that has been reported in the chemical literature should be used):

(i) *Oral Toxicity. A liquid with an LD_50 for acute oral toxicity of not more than 500 mg/kg or a solid with an LD_50 for acute oral toxicity of not more than 200 mg/kg.*

(ii) Dermal Toxicity. A material with an LD_50 for acute dermal toxicity of not more than 1000 mg/kg.

(iii) Inhalation Toxicity. (A) A dust or mist with an LC_50 for acute toxicity on inhalation of not more than 10 mg/L; or

(B) A material with a saturated vapor concentration in air at 20 ^{o}C (68 ^{o}F) of more than one-fifth of the LC_50 for acute toxicity on inhalation of vapors and with an LC_50 for acute toxicity on inhalation of vapors of not more than 5000 ml/m^3; or

(2) Is an irritating material, with properties similar to tear gas, which causes extreme irritation, especially in confined spaces.

(b) For the purposes of this subchapter-

(1) LD_50 for acute oral toxicity means that dose of the material administered to both male and female young adult albino rats which causes death within 14 days in half the animals tested. The number of animals tested must be sufficient to give statistically valid results and be in conformity with good pharmacological practices. The result is expressed in mg/kg body mass.

(2) LD_50 for acute dermal toxicity means that dose of the material which, administered by continuous contact for 24 hours with the shaved intact skin (avoiding abrading) of an albino rabbit, causes death within 14 days in half of the animals tested. The number of animals tested must be sufficient to give statistically valid results and be in conformity with good pharmacological practices. The result is expressed in mg/kg body mass.

(3) LC_50 for acute toxicity on inhalation means that concentration of vapor, mist, or dust which, administered by continuous inhalation for one hour to both male and female

young adult albino rats, causes death within 14 days in half of the animals tested. If the material is administered to the animals as a dust or mist, more than 90 percent of the particles available for inhalation in the test must have a diameter of 10 microns or less if it is reasonably foreseeable that such concentrations could be encountered by a human during transport. The result is expressed in mg/L of air for dusts and mists or in mL/m^3 of air (parts per million) for vapors. See §173.133(b) for LC_50 determination for mixtures and for limit tests.
(i) When provisions of this subchapter require the use of the LC_50 for acute toxicity on inhalation of dusts and mists based on a one-hour exposure and such data is not available, the LC_50 for acute toxicity on inhalation based on a four-hour exposure may be multiplied by four and the product substituted for the one-hour LC_50 for acute toxicity on inhalation.
(ii) When the provisions of this subchapter require the use of the LC_50 for acute toxicity on inhalation of vapors based on a one-hour exposure and such data is not available, the LC_50 for acute toxicity on inhalation based on a four-hour exposure may be multiplied by two and the product substituted for the one-hour LC_50 for acute toxicity on inhalation.
(iii) A solid substance should be tested if at least 10 percent of its total mass is likely to be dust in a respirable range, e.g. the aerodynamic diameter of that particle-fraction is 10 microns or less. A liquid substance should be tested if a mist is likely to be generated in a leakage of the transport containment. In carrying out the test both for solid and liquid substances, more than 90% (by mass) of a specimen prepared for inhalation toxicity testing must be in the respirable range as defined in this paragraph (b)(3)(iii).
(c) For purposes of classifying and assigning packing groups to mixtures possessing oral or dermal toxicity hazards according to the criteria in §173.133(a)(1), it is necessary to determine the acute LD_50 of the mixture. If a mixture contains more than one active constituent, one of the following methods may be used to determine the oral or dermal LD_50 of the mixture:
(1) Obtain reliable acute oral and dermal toxicity data on the actual mixture to be transported;
(2) If reliable, accurate data is not available, classify the formulation according to the most hazardous constituent of the mixture as if that constituent were present in the same concentration as the total concentration of all active constituents; or
(3) If reliable, accurate data is not available, apply the formula:

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where:

C = the % concentration of constituent A, B ... Z in the mixture;
T = the oral LD_50 values of constituent A, B ... Z;

T_M = the oral LD_50 value of the mixture.

Note to formula in paragraph (c)(3): This formula also may be used for dermal toxicities provided that this information is available on the same species for all constituents. The use of this formula does not take into account any potentiation or protective phenomena.

(d) The foregoing categories shall not apply if the Associate Administrator for Hazardous Materials Safety has determined that the physical characteristics of the material or its probable hazards to humans as shown by documented experience indicate that the material will not cause serious sickness or death.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-261, 62 FR 24732, May 6, 1997; 62 FR 45702, August 28, 1997]

§173.133 Assignment of packing group and hazard zones for Division 6.1 materials.

(a) The packing group of Division 6.1 materials shall be as assigned in column 5 of the §172.101 table. When the §172.101 table provides more than one packing group or hazard zone for a hazardous material, the packing group and hazard zone shall be determined by applying the following criteria:

(1) The packing group assignment for routes of administration other than inhalation of vapors shall be in accordance with the following table:

Packing Group	Oral toxicity LD0 (mg/kg)	Dermal toxicity LD0 (mg/kg)	Inhalation toxicity by dusts and mists LC0 (mg/L)
I	> 5	> 40	> 0.5
II	> 5, > 50	> 40, > 200	> 0.5, >2
III	solids: > 50, > 200; liquids: > 50, > 500	> 200, > 1000	> 2, > 10

(2)(i) The packing group and hazard zone assignments for liquids (see §173.115(c) of this subpart for gases) based on inhalation of vapors shall be in accordance with the following table:

Packing Group	Vapor concentration and toxicity
I (Hazard Zone A)	V " 500 LC_50 and LC_50 > 200 mL/M^3.

I (Hazard Zone B)	V " 10 LC_50; LC_50 > 1000 mL/m^3; and the criteria for Packing Group I, Hazard Zone A are not met.
II	V " LC_50; LC_50 > 3000 mL/m^3; and the criteria for Packing Group I, are not met.
III	V " .2 LC_50; LC_50 > 5000 mL/m^3; and the criteria for Packing Groups I and II, are not met.

Note 1: V is the saturated vapor concentration in air of the material in mL/m^3 at 20C^o and standard atmospheric pressure.

Note 2: A liquid in Division 6.1 meeting criteria for Packing Group I, Hazard Zones A or B stated in paragraph (a)(2) of this section is a material poisonous by inhalation subject to the additional hazard communication requirements in §§172.203(m)(3), 172.313 and table 1 of §172.504(e) of this subchapter.

(ii) These criteria are represented graphically in Figure 1:

[ILLUSTRATION GOES HERE]

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(3) When the packing group determined by applying these criteria is different for two or more (oral, dermal or inhalation) routes of administration, the packing group assigned to the material shall be that indicated for the highest degree of toxicity for any of the routes of administration.

(4) Notwithstanding the provisions of this paragraph, the packing group and hazard zone of a tear gas substance is as assigned in column 5 of the §172.101 table.

(b) The packing group and hazard zone for Division 6.1 mixtures that are poisonous (toxic) by inhalation may be determined by one of the following methods:

(1) Where LC_50 data is available on each of the poisonous (toxic) substances comprising the mixture-

(i) The LC_50 of the mixture is estimated using the formula:

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where

f_i = mole fraction of the i^th component substance of the liquid.
$LC50_i$ = mean lethal concentration of the i^th component substance in ml/m^3

(ii) The volatility of each component substance is estimated using the formula:

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EC02MR91.065

where:

P_i = partial pressure of the i*th component substance in kPa at 20 °C and one atmospheric pressure. Pi may be calculated according to Raoult's Law using appropriate activity coefficients. Where activity coefficients are not available, the coefficient may be assumed to be 1.0.*

(iii) The ratio of the volatility to the LC_50 is calculated using the formula:

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(iv) Using the calculated values LC50 (mixture) and R, the packing group for the mixture is determined as follows:

Packaging group (hazard zone)	Ratio of volatility and LC0
I (Hazard Zone A)	R " 500 and LC_50 (mixture) > 200 ml/m^3.
I (Hazard Zone B)	R " 10 and LC_50 (mixture) > 1000 ml/m^3; and the criteria for Packing Group I, Hazard Zone A, are not met.
II	R " 1 and LC_50 (mixture) > 3000 ml/m^3; and the criteria for Packing Group I, Hazard Zones A and B are not met.
III	R " 1/5 and LC_50 (mixture) > 5000 ml/m^3; and the criteria for Packing Group I, Hazard Zones A and B, and Packing Group II are not met.

(2) In the absence of LC50 data on the poisonous (toxic) constituent substances, the mixture may be assigned a packing group and hazard zone based on the following simplified threshold toxicity tests. When these threshold tests are used, the most restrictive packing group and hazard zone must be determined and used for the transportation of the mixture.

(i) A mixture is assigned to Packing Group I, Hazard Zone A only if both the following criteria are met:

(A) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 200 ml/m^3 vaporized mixture in air. Ten albino rats (five male and five female) are exposed to the test atmosphere as determined by an analytical method appropriate for the material being classified for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have an LC50 equal to or less than 200 ml/m^3.

(B) A sample of the vapor in equilibrium with the liquid mixture is diluted with 499 equal volumes of air to form a test atmosphere. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have a volatility equal to or greater than 500 times the mixture LC50.

(ii) A mixture is assigned to Packing Group I, Hazard Zone B only if both the following criteria are met, and the mixture does not meet the criteria for Packing Group I, Hazard Zone A:

(A) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 1000 ml/m^3 vaporized mixture in air. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have an LC50 equal to or less than 1000 ml/m^3.

(B) A sample of the vapor in equilibrium with the liquid mixture is diluted with 9 equal volumes of air to form a test atmosphere. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have a volatility equal to or greater than 10 times the mixture LC50.

(iii) A mixture is assigned to Packing Group II only if both the following criteria are met, and the mixture does not meet the criteria for Packing Group I (Hazard Zones A or B):

(A) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 3000 ml/m^3 vaporized mixture in air. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have an LC50 equal to or less than 3000 ml/m^3.

(B) A sample of the vapor in equilibrium with the liquid mixture is used to form a test atmosphere. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have a volatility equal to or greater than the mixture LC50.

(iv) A mixture is assigned to Packing Group III only if both the following criteria are met, and the mixture does not meet the criteria for Packing Groups I (Hazard Zones A or B) or Packing Group II (Hazard Zone C):

(A) A sample of the liquid mixture is vaporized and diluted with air to create a test atmosphere of 5000 ml/m^3 vaporized mixture in air. Ten albino rats (five male and five female) are exposed to the test atmosphere for one hour and observed for fourteen days. If five or more of the animals die within the fourteen-day observation period, the mixture is presumed to have an LC50 equal to or less than 5000 ml/m^3.

(B) The vapor pressure of the liquid mixture is measured and if the vapor concentration is equal to or greater than 1000 ml/m^3, the mixture is presumed to have a volatility equal to or greater than $^{1/5}$ the mixture LC50.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66268-66270, Dec. 20, 1991; 57 FR 45461-45463, Oct. 1, 1992; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-138, 59 FR 49133, Sept. 26, 1994; Amdt. 173-255, 61 FR 50626, Sept. 26, 1996]

§173.134 Class 6, Division 6.2-Definitions, exceptions and packing group assignments.

(a) *Definitions. For the purposes of this subchapter, the categories of materials that constitute Division 6.2 are defined as follows:*

(1) An infectious substance means a viable microorganism, or its toxin, that causes or may cause disease in humans or animals, and includes those agents listed in 42 CFR 72.3 of the regulations of the Department of Health and Human Services and any other agent that causes or may cause severe, disabling or fatal disease. The terms infectious substance and etiologic agent are synonymous.

(2) A diagnostic specimen means any human or animal material including, but not limited to, excreta, secreta, blood, blood components, tissue, and tissue fluids, being shipped for purposes of diagnosis.

(3) A biological product means a material that is prepared and manufactured in accordance with the provisions of 9 CFR part 102 (Licenses for biological products), 9 CFR part 103 (Experimental products, distribution, and evaluation of biological products prior to licensing), 9 CFR part 104 (Permits for biological products), 21 CFR part 312 (Investigational new drug application), or 21 CFR parts 600 to 680 (Biologics).

(4) A regulated medical waste means a waste or reusable material, other than a culture or stock of an infectious substance, that contains an infectious substance and is generated in-

(i) The diagnosis, treatment or immunization of human beings or animals;

(ii) Research pertaining to the diagnosis, treatment or immunization of human beings or animals; or

(iii) The production or testing of biological products.

(b) *Exceptions. (1) The following are not subject to any requirements of this subchapter if the items as packaged do not contain any material otherwise subject to the requirements of this subchapter:*

(i) Biological products;

(ii) Diagnostic specimens;

(iii) Laundry or medical equipment that conforms to 29 CFR 1910.1030 of the regulations of the Occupational Safety and Health Administration of the Department of Labor;

(iv) A material, including waste, that previously contained an infectious substance and has been treated by steam sterilization, chemical disinfection, or other appropriate method, so that it no longer poses the hazard of an infectious substance;

(v) Any waste material, including garbage, trash and sanitary waste in septic tanks, derived from households, including but not limited to single and multiple residences, hotels and motels;

(vi) Corpses, remains and anatomical parts that are intended for ceremonial interment or cremation; and

(vii) Animal waste generated in animal husbandry or food production.

(2) A hazardous waste is not subject to regulation as a regulated medical waste.

(3) A regulated medical waste that is transported by a private or contract carrier is excepted from-

(i) The requirement of an "INFECTIOUS SUBSTANCE" label if the outer packaging is marked with a "BIOHAZARD" marking in accordance with 29 CFR 1910.1030; and

(ii) For other than a waste culture or stock of an infectious substance, the specific packaging requirements of §173.197, if packaged in a rigid non-bulk packaging conforming to-

(A) The general packaging requirements of §§173.24 and 173.24a; and

(B) Packaging requirements specified in 29 CFR 1910.1030.

(4) A waste culture or stock of infectious substances may be offered for transportation and transported as a regulated medical waste when the culture or stock-

(i) Conforms to Biosafety Level 1, 2 or 3, as defined in HHS Publication No. (CDC) 93-8395, *Biosafety in Microbiological and Biomedical Laboratories. 3rd Edition, May 1993, Section II;*

(ii) Is packaged in accordance with requirements specified in §173.197; and

(iii) Is transported by a private or contract carrier using a vehicle dedicated to the transportation of medical waste.

(c) *Assignment of packing groups and applicable packaging sections. (1) Division 6.2 materials, other than regulated medical waste, are not assigned a packing group. Packaging requirements for these materials are prescribed in §173.196.*

(2) Except as otherwise provided, regulated medical waste is assigned to Packing Group II and must be packaged as specified in §173.197.

[Amdt. 173-247, 60 FR 48787, Sept. 20, 1995, as amended by Amdt. 173-255, 61 FR 50626, Sept. 26, 1996]

§173.136 Class 8-Definitions.

(a) For the purpose of this subchapter, "corrosive material" (Class 8) means a liquid or solid that causes full thickness destruction of human skin at the site of contact within a specified period of time. A liquid that has a severe corrosion rate on steel or aluminum based on the criteria in §173.137(c)(2) is also a corrosive material.

(b) If human experience or other data indicate that the hazard of a material is greater or less than indicated by the results of the tests specified in paragraph (a) of this section, RSPA may revise its classification or make the determination that the material is not subject to the requirements of this subchapter.

(c) Skin corrosion test data produced no later than September 30, 1995, using the procedures of part 173, appendix A, in effect on September 30, 1995 (see 49 CFR part 173, appendix A, revised as of October 1, 1994) for appropriate exposure times may be used for classification and assignment of packing group for Class 8 materials corrosive to skin.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-241, 59 FR 67508, Dec. 29, 1994; Amdt. 173-261, 62 FR 24732, May 6, 1997]

§173.137 Class 8-Assignment of packing group.

The packing group of Class 8 material is indicated in column 5 of the §172.101 table. When the §172.101 table provides more than one packing group for a Class 8 material, the packing group must be determined using data obtained from tests conducted in accordance with the 1992 OECD Guideline for Testing of Chemicals, Number 404 "Acute Dermal Irritation/Corrosion" as follows:

(a) *Packing Group I. Materials that cause full thickness destruction of intact skin tissue within an observation period of up to 60 minutes starting after the exposure time of three minutes or less.*

(b) Packing Group II. Materials other than those meeting Packing Group I criteria that cause full thickness destruction of intact skin tissue within an observation period of up to 14 days starting after the exposure time of more than three minutes but not more than 60 minutes.

(c) Packing Group III. Materials, other than those meeting Packing Group I or II criteria-

(1) That cause full thickness destruction of intact skin tissue within an observation period of up to 14 days starting after the exposure time of more than 60 minutes but not more than 4 hours; or

(2) That do not cause full thickness destruction of intact skin tissue but exhibit a corrosion rate on steel or aluminum surfaces exceeding 6.25 mm (0.25 inch) a year at a test temperature of 55 ^{o}C (130 ^{o}F). For the purpose of testing steel P3 (ISO 9328-1) or a similar type, and for testing aluminum, non-clad types 7075-T6 or AZ5GU-T6 should be used. An acceptable test is described in ASTM G 31-72 (Reapproved 1995).

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-241, 59 FR 67508, Dec. 29, 1994; Amdt. 173-261, 62 FR 24733, May 6, 1997]

§173.140 Class 9-Definitions.

For the purposes of this subchapter, *miscellaneous hazardous material (Class 9)* *means a material which presents a hazard during transportation but which does not meet the definition of any other hazard class. This class includes:*

(a) Any material which has an anesthetic, noxious or other similar property which could cause extreme annoyance or discomfort to a flight crew member so as to prevent the correct performance of assigned duties; or

(b) Any material that meets the definition in §171.8 of this subchapter for an elevated temperature material, a hazardous substance, a hazardous waste, or a marine pollutant.

[Amdt. 173-224, 57 FR 45463, Oct. 1, 1992, as amended by Amdt. 173-231, 57 FR 52939, Nov. 5, 1992; Amdt. 173-233, 58 FR 33305, June 16, 1993]

§173.141 Class 9-Assignment of packing group.

The packing group of a Class 9 material is as indicated in column 5 of the §172.101 table.

§173.144 Other Regulated Materials (ORM)-Definitions.

For the purpose of this subchapter, "ORM-D material" means a material such as a consumer commodity, which, although otherwise subject to the regulations of this subchapter, presents a limited hazard during transportation due to its form, quantity and packaging. It must be a material for which exceptions are provided in the §172.101 table. Each ORM-D material and category of ORM-D material is listed in the §172.101 table.

§173.145 Other Regulated Materials-Assignment of packing group.

Packing groups are not assigned to ORM-D materials.

§173.150 Exceptions for Class 3 (flammable) and combustible liquids.

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter and the material does not meet the definition of another hazard class except Division 6.1, Packing Group III or Class 8, Packing Group III.*

(b) Limited quantities. Limited quantities of flammable liquids (Class 3) and combustible liquids are excepted from labeling requirements, unless offered for transportation or transported by aircraft, and the specification packaging requirements of this subchapter

when packaged in combination packagings according to this paragraph. In addition, shipments of limited quantities are not subject to subpart F (Placarding) of part 172 of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:
(1) For flammable liquids in Packing Group I, inner packagings not over 0.5 L (0.1 gallon) net capacity each, packed in strong outer packagings;
(2) For flammable liquids in Packing Group II, inner packagings not over 1.0 L (0.3 gallon) net capacity each, packed in strong outer packaging; and
(3) For flammable liquids in Packing Group III and combustible liquids, inner packagings not over 5.0 L (1.3 gallons) net capacity each, packed in strong outer packagings.
(c) *Consumer commodities. A limited quantity which conforms to the provisions of paragraph (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "Consumer commodity" and reclassed as ORM-D material. In addition to the exceptions provided by paragraph (b) of this section, shipments of ORM-D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, hazardous waste, marine pollutant, or are offered for transportation and transported by aircraft, and are eligible for the exceptions provided in §173.156.*
(d) Alcoholic beverages. An alcoholic beverage (wine and distilled spirits as defined in 27 CFR 4.10 and 5.11) is not subject to the requirements of this subchapter if it-
(1) Contains 24 percent or less alcohol by volume;
(2) Is in an inner packaging of five liters or less; or
(3) Is a Packing Group III alcoholic beverage in a packaging of 250 L (66 gallons) or less, unless transported by air.
(e) *Aqueous solutions of alcohol. An aqueous solution containing 24 percent or less alcohol by volume and no other hazardous material-*
(1) May be reclassed as a combustible liquid; and
(2) Is not subject to the requirements of this subchapter if it contains no less than 50 percent water.
(f) *Combustible liquids. (1) A flammable liquid with a flash point at or above 38 ^{o}C (100 ^{o}F) that does not meet the definition of any other hazard class may be reclassed as a combustible liquid. This provision does not apply to transportation by vessel or aircraft, except where other means of transportation is impracticable.*
(2) The requirements in this subchapter do not apply to a material classed as a combustible liquid in a non-bulk packaging unless the combustible liquid is a hazardous substance, a hazardous waste, or a marine pollutant.
(3) A combustible liquid that is in a bulk packaging or a combustible liquid that is a hazardous substance, a hazardous waste, or a marine pollutant is not subject to the requirements of this subchapter except those pertaining to:
(i) Shipping papers, waybills, switching orders, and hazardous waste manifests;
(ii) Marking of packages;
(iii) Display of identification numbers on bulk packages;

(iv) Placarding requirements of subpart F of part 172 of this subchapter;
(v) Carriage aboard aircraft and vessels (for packaging requirements for transport by vessel, see §176.340 of this subchapter);
(vi) Reporting incidents as prescribed by §§171.15 and 171.16 of this subchapter;
(vii) Packaging requirements of subpart B of this part and, in addition, non-bulk packagings must conform with requirements of §173.203; and
(viii) The requirements of §§173.1, 173.21, 173.24, 173.24a, 173.24b, 174.1, 177.804, 177.817, and 177.834 of this subchapter.
(4) A combustible liquid that is not a hazardous substance, a hazardous waste, or a marine pollutant is not subject to the requirements of this subchapter if it is a mixture of one or more components that-
(i) Has a flash point at or above 93 ^{o}C (200 ^{o}F),
(ii) Comprises at least 99 percent of the volume of the mixture, and
(iii) Is not offered for transportation or transported as a liquid at a temperature at or above its flash point.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-231, 57 FR 52939, Nov. 5, 1992; Amdt. 173-233, 58 FR 33305, June 16, 1993; Amdt. 173-241, 59 FR 67508, Dec. 29, 1994; Amdt. 173-242, 60 FR 26806, May 18, 1995; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; 64 FR 51919, Sept. 27, 1999]

§173.151 Exceptions for Class 4.

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter.*

(b) Limited quantities of Division 4.1 flammable solids. Limited quantities of flammable solids (Division 4.1) in Packing Groups II and III are excepted from labeling, unless offered for transportation or transported by aircraft, and the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of limited quantities are not subject to subpart F (Placarding) of part 172 of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For flammable solids in Packing Group II, inner packagings not over 1.0 kg (2.2 pounds) net capacity each, packed in strong outer packagings; and

(2) For flammable solids in Packing Group III, inner packagings not over 5.0 kg (11 pounds) net capacity each, packed in strong outer packagings.

(c) *Consumer commodities. A limited quantity which conforms to the provisions of paragraph (b) of this section, and charcoal briquettes in packagings not exceeding 30 kg (66 pounds) gross weight, may be renamed "Consumer commodity" and reclassed as ORM-D material, if the material is a "consumer commodity" as defined in §171.8 of* *this subchapter. In addition to the exceptions provided by paragraph (b) of this section, shipments are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered for transportation or transported by aircraft, and are eligible for the exceptions provided in §173.156.*

(d) Limited quantities of Division 4.3 (dangerous when wet) material. Limited quantities of Division 4.3 (dangerous when wet) solids in Packing Groups II and III are excepted from labeling, unless offered for transportation or transported by aircraft, and the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of limited quantities are not subject to subpart F (Placarding) of part 172 of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For Division 4.3 solids in Packing Group II, inner packagings not over 0.5 kg (1.1 pound) net capacity each, packed in strong outer packagings; and

(2) For Division 4.3 solids in Packing Group III, inner packagings not over 1 kg (2.2 pounds) net capacity each, packed in strong outer packagings.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-231, 57 FR 52940, Nov. 5, 1992; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-255, 61 FR 50626, Sept. 26, 1996]

§173.152 Exceptions for Division 5.1 (oxidizers) and Division 5.2 (organic peroxides).

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter.*

(b) Limited quantities. Limited quantities of oxidizers (Division 5.1) in Packing Groups II and III and organic peroxides (Division 5.2) are excepted from labeling, unless offered or intended for transportation by aircraft, and the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of these limited quantities are not subject to subpart F of part 172 (Placarding) of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For oxidizers in Packing Group II, inner packagings not over 1.0 L (0.3 gallon) net capacity each for liquids or not over 1.0 kg (2.2 pounds) net capacity each for solids, packed in strong outer packagings.

(2) For oxidizers in Packing Group III, inner packagings not over 4.0 L (1 gallon) net capacity each for liquids or not over 5.0 kg (11 pounds) net capacity each for solids, packed in strong outer packagings.

(3) For organic peroxides which do not require temperature control during transportation-

(i) For Type D, E, or F organic peroxides, inner packagings not over 125 ml (4.22 ounces) net capacity each for liquids or 500 g (17.64 ounces) net capacity for solids, packed in strong outer packagings.

(ii) For Type B or C organic peroxides, inner packagings not over 25 ml (0.845 ounces) net capacity each for liquids or 100 g (3.528 ounces) net capacity for solids, packed in strong outer packagings.

(4) For polyester resin kits consisting of a base material component (Class 3, Packing Group II or III) and an activator component (Type C, D, E, or F organic peroxide which does not require temperature control)-

(i) the organic peroxide component must be packed in inner packagings not over 125 ml (4.22 ounces) net capacity each for liquids or 500 g (17.64 ounces) net capacity each for solids;

(ii) The flammable liquid component must be packed in inner packagings not over 1.0 L (0.3 gallons) net capacity each for Packing Group II liquids or 5.0 L (1.3 gallons) net capacity each for Packing Group III liquids; and

(iii) The flammable liquid component and the organic peroxide component may be packed in the same strong outer packaging provided they will not interact dangerously in the event of leakage.

(c) *Consumer commodities. A limited quantity which conforms to the provisions of paragraph (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "Consumer commodity" and reclassed as ORM-D material. In addition to the exceptions provided by paragraph (b) of this section, shipments are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered for transportation or transported by aircraft, and are eligible for the exceptions provided in §173.156.*

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-231, 57 FR 52940, Nov. 5, 1992; Amdt. 173-241, 59 FR 67508, Dec. 29, 1994; Amdt. 173-261, 62 FR 24733, May 6, 1997]

§173.153 Exceptions for Division 6.1 (poisonous materials).

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter.*

(b) Limited quantities of Division 6.1 materials. Limited quantities of poisonous materials (Division 6.1) in Packing Group III are excepted from the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of these limited quantities are not subject to subpart F of part 172 (Placarding) of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For poisonous liquids, inner packagings not over 4.0 L (1 gallon) net capacity each, packed in strong outer packagings; and

(2) For poisonous solids, inner packagings not over 5.0 kg (11 pounds) net capacity each, packed in strong outer packagings.

(c) *Consumer commodities. The following provisions apply to consumer commodities:*

(1) A limited quantity which conforms to the provisions of paragraph (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "Consumer commodity" and reclassed as ORM-D material.

(2) A poisonous material which is a drug or medicine and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "Consumer commodity" and reclassed as ORM-D material if packaged in a combination packaging not exceeding 30 kg (66 pounds) with inner packagings not over 250 ml (8 ounces) net capacity for liquids or 250 g (8.8 ounces) net capacity for solids packed in strong outer packagings. Each package must conform to the packaging requirements of subpart B of this part.

(3) Packages of ORM-D material are excepted from the specification packaging requirements of this subchapter and from the labeling requirements of subpart E of part 172 of this subchapter. Shipments of ORM-D material are eligible for the exceptions provided in §173.156 and in paragraph (b) of this section and are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered for transportation or transported by aircraft.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-231, 57 FR 52940, Nov. 5, 1992]

§173.154 Exceptions for Class 8 (corrosive materials).

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter.*

(b) Limited quantities. Limited quantities of corrosive materials (Class 8) in Packing Groups II and III are excepted from labeling, unless offered or intended for transportation by aircraft, and the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of these limited quantities are not subject to subpart F (Placarding) of part 172 of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For corrosive materials in Packing Group II, in inner packagings not over 1.0 L (0.3 gallon) net capacity each for liquids or not over 1.0 kg (2.2 pounds) net capacity each for solids, packed in strong outer packagings.

(2) For corrosive materials in Packing Group III, in inner packagings not over 4.0 L (1 gallon) net capacity each for liquids or not over 5.0 kg (11 pounds) net capacity each for solids, packed in strong outer packagings.

(c) *Consumer commodities. A limited quantity which conforms to the provisions of paragraph (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter may be renamed "Consumer commodity" and reclassed as ORM-D material. In addition to the exceptions provided by paragraph (b) of this section, shipments of ORM-D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered or intended for transportation by aircraft, and are eligible for the exceptions provided in §173.156.*

(d) Materials corrosive to aluminum or steel only. Except for a hazardous substance, a hazardous waste, or a marine pollutant, a material classed as a Class 8, Packing Group III, material solely because of its corrosive effect-

(1) On aluminum is not subject to any other requirements of this subchapter when transported by motor vehicle or rail car in a packaging constructed of materials that will not react dangerously with or be degraded by the corrosive material; or

(2) On steel is not subject to any other requirements of this subchapter when transported by motor vehicle or rail car in a bulk packaging constructed of materials that will not react dangerously with or be degraded by the corrosive material.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-231, 57 FR 52940, Nov. 5, 1992]

§173.155 Exceptions for Class 9 (miscellaneous hazardous materials).

(a) *General. Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table of this subchapter.*

(b) Limited quantities. Limited quantities of miscellaneous hazardous materials (Class 9) are excepted from labeling, unless offered or intended for transportation by aircraft, and the specification packaging requirements of this subchapter when packaged in combination packagings according to this paragraph. In addition, shipments of these limited quantities are not subject to subpart F (Placarding) of part 172 of this subchapter. Each package must conform to the packaging requirements of subpart B of this part and may not exceed 30 kg (66 pounds) gross weight. The following combination packagings are authorized:

(1) For liquids, inner packagings not over 5.0 L (1.3 gallons) net capacity each. packed in strong outer packagings.

(2) For solids, inner packagings not over 5.0 kg (11 pounds) net capacity each, packed in strong outer packagings.

(c) *Consumer commodities. A limited quantity which conforms to the provisions of* *paragraph (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "Consumer commodity" and reclassed as ORM-D material. In addition to the exceptions provided by paragraph (b) of this section, shipments of ORM-D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance, a hazardous waste, or a marine pollutant or unless offered for transportation or transported by aircraft, and are eligible for the exceptions provided in §173.156.*

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-231, 57 FR 52940, Nov. 5, 1992; Amdt. 173-253, 61 FR 27174, May 30, 1996]

§173.156 Exceptions for ORM materials.

(a) Exceptions for hazardous materials shipments in the following paragraphs are permitted only if this section is referenced for the specific hazardous material in the §172.101 table or in a packaging section in this part.

(b) *ORM-D. Packagings for ORM-D materials are specified according to hazard class in §§173.150 through 173.155 and in §173.306. In addition to other exceptions specified for ORM-D materials in this part:*

(1) Strong outer packagings as specified in this part, marking requirements specified in subpart D of part 172 of this subchapter, and the 30 kg (66 pounds) gross weight limitation are not required for materials classed as ORM-D when-

(i) Unitized in cages, carts, boxes or similar overpacks;

(ii) Offered for transportation or transported by:

(A) Rail;

(B) Private or contract motor carrier; or

(C) Common carrier in a vehicle under exclusive use for such service; and

(iii) Transported to or from a manufacturer, a distribution center, or a retail outlet, or transported to a disposal facility from one offeror.

(2) The 30 kg (66 pounds) gross weight limitation does not apply to materials classed as ORM-D when offered for transportation, or transported, by highway or rail between a manufacturer, a distribution center, and a retail outlet provided-

(i) Inner packagings conform to the quantity limits for inner packagings specified in §§173.150(b), 173.152(b), 173.154(b), 173.155(b) and 173.306 (a) and (b), as appropriate;

(ii) The inner packagings are packed into corrugated fiberboard trays to prevent them from moving freely;

(iii) The trays are placed in a fiberboard box which is banded and secured to a wooden pallet by metal, fabric, or plastic straps, to form a single palletized unit;

(iv) The package conforms to the general packaging requirements of subpart B of this part;

(v) The maximum net quantity of hazardous material permitted on one palletized unit is 250 kg (550 pounds); and

(vi) The package is properly marked in accordance with §172.316 of this subchapter.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-255, 61 FR 50626, Sept. 26, 1996; 63 FR 37461, July 10, 1998]

[CFR] PART 173 SUBPART E - Non-bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART E]

Subpart E - Non-bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

Source: Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, unless otherwise noted.

§173.158 Nitric acid.

(a) Nitric acid exceeding 40 percent concentration may not be packaged with any other material.

(b) Nitric acid in any concentration which does not contain sulfuric acid or hydrochloric acid as impurities, when offered for transportation or transported by rail, highway, or water shall be packaged in specification containers as follows:

(1) 1A1 stainless steel drums are authorized, subject to the following limitations:

(i) Stainless steel used in drums must conform to the following thicknesses:

Nominal (marked) capacity (in liters) of 1A1 drum	Minimum thickness (in millimeters) of stainless steel
55	0.9
115	1.2
210	1.5
450	2.0

(ii) Drums weighing less than 85 percent of their original tare weight may not be used.

(iii) Type 304 or other grades of equivalent corrosion-resistant steels in the as-welded condition are permissible for nitric acid concentrations up to and including 78 percent.

(iv) For all concentrations of nitric acid, the following are permissible:
(A) Type 304 heat-treated (quenched in water at 1040 °C (1900 °F)),
(B) Stabilized Type 347 in the as-welded condition,
(C) Stabilized Type 347 stress-relieved (845-900 °C (1550-1650 °F)),
(D) Stabilized Type 347 heat-treated (quenched in water at 1040 °C (1900 °F)), or
(E) Other grades of equivalent corrosion resistance.

(v) All parts of drum exposed to lading must be capable of withstanding the corrosive effect of nitric acid to the extent that 65 percent boiling nitric acid does not penetrate the metal more than 0.0381 mm (0.002 inches) per month. (ASTM A 262-68 may be used for a suitable corrosion test procedure.)

(vi) In addition to marking required by §178.503 of this subchapter, the following marks, in lettering of at least 12.7 mm (0.5 inch) height, must be placed on drums used to transport nitric acid:

(A) The type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and, in addition, the letters "HT" following the steel designation on containers subject to stress relieving or heat treatment during manufacture.

(B) The thickness in millimeters of metal in thinnest part. When the thickness of metal in the body differs from that in the head, both must be indicated with slanting line between and with the gauge of the body indicated first.

(C) Original tare weight in kilograms, preceded by the letters "TW."

An example of the markings required by paragraphs (b)(1)(vi) (A), (B), and (C) of this section is "304HT/1.9/2.7/TW55."

(2) 4H1 expanded plastics outer packagings with glass inner receptacles of not greater than 2.5 L (0.66 gallon) capacity each. No more than four 2.5 L (0.66 gallon) inner receptacles may be packed in one outer packaging.

(c) Nitric acid of 80 percent or greater concentration which does not contain sulfuric acid or hydrochloric acid as impurities, when offered for transportation or transported by rail, highway, or water may be packaged in 1B1 aluminum drums.

(d) Nitric acid of 90 percent or greater concentration, when offered for transportation or transported by rail, highway, or water may be packaged as follows:

(1) In 4C1, 4C2, 4D or 4F wooden boxes with inner packagings consisting of glass bottles further individually overpacked in tightly closed metal packagings. Glass bottles must be of 2.5 L (0.66 gallon) or less capacity and cushioned with a non-reactive, absorbent material within the metal packagings.

(2) In combination packagings with 1A2, 1B2, 1D, 1G, 1H2, 3H2 or 4G outer packagings with inner glass packagings of 2.5 L (0.66 gallons) or less capacity cushioned with a non-reactive, absorbent material and packed within a tightly closed intermediate packaging of metal or plastic.

(e) Nitric acid of less than 90 percent concentration, when offered for transportation or transported by rail, highway, or water may be packaged in 4G fiberboard boxes or 4C1, 4C2, 4D or 4F wooden boxes with inside glass packagings of not over 2.5 L (0.66 gallon) capacity each.

(f) Nitric acid of 70 percent or less concentration, when offered for transportation or transported by rail, highway, or water, may be packaged as follows:

(1) In composite packagings 6PA1, 6PA2, 6PB1, 6PB2, 6PC, 6PD1, 6PH1, or 6PH2. 6HH1 and 6HA1 composite packaging with plastic inner receptacles meeting the compatibility requirements §173.24(e) (e.g., PFA Teflon) are authorized.

(2) In 4H1 expanded plastic boxes with inner glass packagings of not over 2.5 L (0.66 gallon) each.

(3) In combination packagings with 1A2, 1B2, 1D, 1G, 1H2, 3H2, 4C1, 4C2, 4D, 4F or 4G outer packagings and plastic inner packagings not over 2.5 L (0.66 gallon) capacity further individually overpacked in tightly closed metal packagings.

(g) Nitric acid of more than 70 percent concentration, when offered for transportation or transported by cargo aircraft only, must be packaged in combination packagings with 1A2, 1B2, 1D, 1G, 1H2, 3H2, 4C1, 4C2, 4D, 4F or 4G outer packagings with glass or earthenware inner packagings of not over 1 L (0.3 gallon) or glass ampoules of not over 0.5 L (0.1 gallon).

(h) Nitric acid of less than 70 percent concentration, when offered for transportation in cargo aircraft only must be packaged in combination packagings with 1A2, 1B2, 1D, 1G, 1H2, 3H2, 4C1, 4C2, 4D, 4F or 4G outer packagings with inner packagings of-

(1) Glass or earthenware not over 2.5 L (0.66 gallon) capacity;

(2) Plastic not over 2.5 L (0.66 gallon) capacity further individually overpacked in tightly closed metal packagings; or

(3) Glass ampoule not over 0.5 L (0.1 gallon) capacity.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-241, 59 FR 67509, Dec. 29, 1994; Amdt. 173-255, 61 FR 50626, Sept. 26, 1996]

§173.159 Batteries, wet.

(a) Electric storage batteries, containing electrolyte acid or alkaline corrosive battery fluid, must be completely protected so that short circuits will be prevented; they may not be packed with other materials except as provided in §§173.220 and 173.222 of this part and paragraph (h) of this section.

(b) The following specification packagings are authorized for batteries packed without other materials:

(1) 4C1, 4C2, 4D, or 4F wooden boxes.

(2) 4G fiberboard boxes.

(3) 1D plywood drums.

(4) 1G fiber drums.

(5) 1H2 and 3H2 plastic drums and jerricans.

(6) 4H2 plastic boxes.

(c) The following non-specification packagings are authorized for batteries packed without other materials:

(1) Electric storage batteries protected against short circuits and firmly secured to skids or pallets capable of withstanding the shocks normally incident to transportation, are authorized for transportation by rail, highway, or water. The height of the completed unit must not exceed $1^{1/2}$ times the width of the skid or pallet. The unit must be capable of withstanding, without damage, a superimposed weight equal to two times the weight of the unit or, if the weight of the unit exceeds 907 kg (2000 pounds), a superimposed weight of 1814 kg (4000 pounds). Battery terminals must not be relied upon to support any part of the superimposed weight.

(2) Electric storage batteries weighing 225 kg (500 pounds) or more, consisting of carriers' equipment, may be shipped by rail when mounted on suitable skids and protected against short circuits. Such shipments may not be offered in interchange service.

(3) One to three batteries not over 11.3 kg (25 pounds) each, packed in outer boxes. The maximum authorized gross weight is 34 kg (75 pounds).

(4) Not more than four batteries not over 7 kg (15 pounds) each, packed in strong outer fiberboard or wooden boxes. Batteries must be securely cushioned and packed to prevent short circuits. The maximum authorized gross weight is 30 kg (65 pounds).

(5) Not more than five batteries not over 4.5 kg (10 pounds) each, packed in strong outer fiberboard or wooden boxes. Batteries must be securely cushioned and packed to prevent short circuits. The maximum authorized gross weight is 30 kg (65 pounds).

(6) Single batteries not exceeding 34 kg (75 pounds) each, packed in 5-sided slip covers or in completely closed fiberboard boxes. Slip covers and boxes must be of solid or double-faced corrugated fiberboard of at least 91 kg (200 pounds) Mullen test strength. The slip cover or fiberboard box must fit snugly and provide inside top clearance of at least 1.3 cm (0.5 inch) above battery terminals and filler caps with reinforcement in place. Assembled for shipment, the bottom edges of the slipcover must come to within 2.5 cm (1 inch) of the bottom of the battery. The completed package (battery and box or slip cover) must be capable of withstanding a top-to-bottom compression test of at least 225 kg (500 pounds) without damage to battery terminals, cell covers or filler caps.

(7) Single batteries exceeding 34 kg (75 pounds) each may be packed in completely closed fiberboard boxes. Boxes must be of double-wall corrugated fiberboard of at least 181 kg (400 pounds) test, or solid fiberboard testing at least 181 kg (400 pounds); a box may have hand holes in its ends provided that the handholes will not materially weaken the box. Sides and ends of the box must have cushioning between the battery and walls of the box; combined thickness of cushioning material and walls of the box must not be less than 1.3 cm (0.5 inch); and cushioning must be excelsior pads, corrugated fiberboard, or other suitable cushioning material. The bottom of the battery must be protected by a minimum of one excelsior or double-wall corrugated fiberboard pad. The top of the battery must be protected by a wood frame, corrugated trays or scored sheets of corrugated fiberboard having minimum test of 91 kg (200 pounds), or other equally effective cushioning material. Top protection must bear evenly on connectors and/or edges of the battery cover to facilitate stacking of batteries. No more than one battery may be placed in one box. The maximum authorized gross weight is 91 kg (200

pounds).

(d) A nonspillable wet electric storage battery is excepted from all other requirements of this subchapter under the following conditions:

(1) The battery must be protected against short circuits and securely packaged;

(2) For batteries manufactured after September 30, 1995, the battery and the outer packaging must be plainly and durably marked "NONSPILLABLE" or "NONSPILLABLE BATTERY"; and

(3) The battery must be capable of withstanding the following two tests, without leakage of battery fluid from the battery:

(i) *Vibration test. The battery must be rigidly clamped to the platform of a vibration machine, and a simple harmonic motion having an amplitude of 0.8 mm (0.03 inches), with a 1.6 mm (0.063 inches) maximum total excursion must be applied. The frequency must be varied at the rate of 1 Hz/min between the limits of 10 Hz to 55 Hz. The entire range of frequencies and return must be traversed in 95+5 minutes for each mounting position (direction of vibrator) of the battery. The battery must be tested in three mutually perpendicular positions (to include testing with fill openings and vents, if any, in an inverted position) for equal time periods.*

(ii) Pressure differential test. Following the vibration test, the battery must be stored for six hours at 24 ^{o}C+4 ^{o}C (75 ^{o}F+7 ^{o}F) while subjected to a pressure differential of at least 88 kPa (13 psi). The battery must be tested in three mutually perpendicular positions (to include testing with fill openings and vents, if any, in an inverted position) for at least six hours in each position.

(e) Electric storage batteries containing electrolyte or corrosive battery fluid are not subject to the requirements of this subchapter for transportation by highway or rail if all of the following requirements are met:

(1) No other hazardous materials may be transported in the same vehicle;

(2) The batteries must be loaded or braced so as to prevent damage and short circuits in transit;

(3) Any other material loaded in the same vehicle must be blocked, braced, or otherwise secured to prevent contact with or damage to the batteries; and

(4) The transport vehicle may not carry material shipped by any person other than the shipper of the batteries.

(f) Electric storage batteries, containing electrolyte or corrosive battery fluid in a coil from which it is injected into the battery cells by a gas generator and initiator assembled with the battery, and which are nonspillable under the criteria of paragraph (d) of this section, are excepted from other requirements of this subchapter when examined by the Bureau of Explosives and approved by the Associate Administrator for Hazardous Materials Safety.

(g) Electrolyte, acid, or alkaline corrosive battery fluid, packed with storage batteries wet or dry, must be packed in one of the following specification packagings:

(1) In 4C1, 4C2, 4D, or 4F wooden boxes with inner receptacles of glass, not over 4.0 L (1 gallon) each with not over 8.0 L (2 gallons) total in each outside container. Inside containers must be well-cushioned and separated from batteries by a strong solid wooden partition. The completed package must conform to Packing Group III

requirements.

(2) Electrolyte, acid, or alkaline corrosive battery fluid included with storage batteries and filling kits may be packed in strong rigid outer packagings when shipments are made by, for, or to the Departments of the Army, Navy, or Air Force of the United States. Packagings must conform to military specifications. The electrolyte, acid, or alkaline corrosive battery fluid must be packed in polyethylene bottles of not over 1.0 L (0.3 gallon) capacity each. Not more than 24 bottles, securely separated from storage batteries and kits, may be offered for transportation or transported in each package.

(3) In 4G fiberboard boxes with not more than 12 inside packagings of polyethylene or other material resistant to the lading, each not over 2.0 L (0.5 gallon) capacity each. Completed packages must conform to Packing Group III requirements. Inner packagings must be adequately separated from the storage battery. The maximum authorized gross weight is 29 kg (64 pounds). These packages are not authorized for transportation by aircraft.

(h) Dry storage batteries or battery charger devices may be packaged in 4G fiberboard boxes with inner receptacles containing battery fluid. Completed packagings must conform to Packing Group III requirements. Not more than 12 inner receptacles may be packed in one outer box. The maximum authorized gross weight is 34 kg (75 pounds).

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-235, 58 FR 50502, Sept. 27, 1993; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; 64 FR 10777, Mar. 5, 1999]

§173.160 Bombs, smoke, non-explosive (corrosive).

Bombs, smoke, non-explosive' may be shipped provided they are without ignition elements, bursting charges, detonating fuses or other explosive components. They must be packaged in wooden (4C1, 4C2), plywood (4D) or reconstituted wood (4F) boxes, or plywood drums (1D), which meet Packing Group II requirements.

§173.161 Chemical kits.

(a) Except as otherwise provided, chemical kits must be packed, marked, and labeled as prescribed by this subchapter for the specific corrosive materials contained therein.

(b) Chemical kits containing limited quantities of corrosive liquids in inner receptacles of not over 177 ml (6 fluid ounces) capacity each are excepted from labeling (except when offered for transportation or transported by air) and the specification packaging requirements of this subchapter if all of the following requirements are met:

(1) The kit may contain only corrosive liquids for which packaging exceptions are provided in the §172.101 table.

(2) This kit must be a strong wooden or metal outer packaging, or must be packed in a strong wooden or metal packaging.
(3) The corrosive liquids must be cushioned with sufficient absorbent material to completely absorb the contents of the individual containers, and must be protected from damage by other materials in the kit.
(4) The contents of the kit must be of a nature and packed so there will be no possibility of the mixture of contents causing dangerous evolution of heat or gas.

In addition, chemical kits meeting these requirements are not subject to subpart F of part 172 of this subchapter (Placarding), to part 174 (Carriage by rail) of this subchapter except §174.24 (Shipping papers), and to part 177 (Carriage by highway) of this subchapter except §177.817 (Shipping papers).

(c) Except as provided in paragraph (b) of this section, chemical kits must be packed in 4G fiberboard boxes with inner glass receptacles of not over 1 L (0.3 gallon) capacity each, securely cushioned and separated from other inside containers. The contents of the kit must be of such a nature and so packed that there will be no possibility of the mixture of contents causing dangerous evolution of heat or gas.

§173.162 Gallium.

(a) Except when packaged in cylinders or steel flasks, gallium must be packaged in packagings which meet the requirements of part 178 of this subchapter at the Packing Group I performance level for transport by aircraft and the Packing Group III performance level for transport by highway, rail or vessel.
(1) In packagings intended to contain liquids consisting of glass, earthenware or rigid plastics with a maximum net mass of 10 kg (22 pounds) each. The inner packagings must be packed in wooden boxes (4C1, 4C2, 4D, 4F), fiberboard boxes (4G), plastics boxes (4H1, 4H2), fiber drums (1G) or removable head steel and plastic drums or jerricans (1A2, 1H2, 3A2 or 3H2) with sufficient cushioning material to prevent breakage. Either the inner packagings or the outer packagings must have inner liners or bags of strong leakproof and puncture-resistant material impervious to the contents and completely surrounding the contents to prevent it from escaping from the package, irrespective of its position.
(2) In packagings intended to contain liquids consisting of semi-rigid plastic inner packagings of not more than 2.5 kg (5.5 pounds) net capacity each, individually enclosed in a sealed, leak-tight bag of strong puncture-resistant material. The sealed bags must be packed in wooden (4C1, 4C2), plywood (4D), reconstituted wood (4F), fiberboard (4G) or plastic (4H1, 4H2) boxes or in fiber (1G) or steel (1A2) drums, which are lined with leak-tight, puncture-resistant material. Bags and liner material must be chemically resistant to gallium.
(3) Cylinders and steel flasks with vaulted bottoms are also authorized.
(b) When it is necessary to transport gallium at low temperatures in order to maintain it in a completely solid state, the above packagings may be overpacked in a strong,

water-resistant outer packaging which contains dry ice or other means of refrigeration. If a refrigerant is used, all of the above materials used in the packaging of gallium must be chemically and physically resistant to the refrigerant and must have impact resistance at the low temperatures of the refrigerant employed. If dry ice is used, the outer packaging must permit the release of carbon dioxide gas.
(c) Manufactured articles or apparatuses, each containing not more than 100 mg (0.0035 ounce) of gallium and packaged so that the quantity of gallium per package does not exceed 1 g (0.35 ounce) are not subject to the requirements of this subchapter.

[64 FR 10777, Mar. 5, 1999]

§173.163 Hydrogen fluoride.

Hydrogen fluoride (hydrofluoric acid, anhydrous) must be offered for transportation or transported in Specification 3, 3A, 3AA, 3B, 3BN, 3C, 3E, 4, 4A, 25, or 38 cylinders; or Specification 4B, 4BA, 4BW or 4C cylinders, if they are not brazed. Filling density must not exceed 85 percent of the water weight capacity of the cylinder. Cylinders used exclusively in this service may, in lieu of the periodic hydrostatic retest required by §173.34(e), be given a complete external visual inspection as described in CGA Pamphlet C-6, at the time such periodic retest becomes due. Such inspections shall be made on cylinders cleaned to bare metal. The results shall be recorded on a data sheet, completed copies of which shall be kept as prescribed in §173.34(e)(8). Items which must be checked and recorded on these data sheets are: Date of inspection (month and year); DOT specification number; cylinder identification (registered symbol and serial number, date of manufacture, and if needed for adequate identification, ownership symbol); tare weight; physical condition (record specifically any leakage, corrosion, gouges, dents or digs in shell or heads, broken or damaged footring or protective ring or fire damage); disposition of cylinders (returned to service, to cylinder manufacturer for repairs, or scrapped). A cylinder which passes the inspection prescribed must have the data recorded in the manner presently prescribed for the recording of the retest date except that an "E" is to follow the date (month and year) indicating requalification by the external inspection method. Cylinders removed from this service for any reason must be rendered unfit for any other regulated service.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended by Amdt. 173-236, 58 FR 50236, Sept. 24, 1993; Amdt. 173-251, 61 FR 26763, May 28, 1996]

§173.164 Mercury (metallic and articles containing mercury).

(a) For transportation by aircraft, mercury must be packaged in packagings which meet the requirements of part 178 of this subchapter at the Packing Group I performance level, as follows:

(1) In inner packagings of earthenware, glass or plastic containing not more than 3.5 kg (7.7 pounds) of mercury, or inner packagings which are glass ampoules containing not more than 0.5 kg (1.1 pounds) of mercury, or iron or steel quicksilver flasks containing not more than 35 kg (77 pounds) of mercury. The inner packagings or flasks must be packed in steel drums (1A2), steel jerricans (3A2), wooden boxes (4C1), (4C2), plywood boxes (4D), reconstituted wood boxes (4F), fiberboard boxes (4G), plastic boxes (4H2), plywood drums (1D) or fiber drums (1G).

(2) Packagings must meet the requirements of Part 178 of this subchapter at the Packing Group I performance level.

(3) When inner packagings of earthenware, glass or plastic are used, they must be packed in the outer packaging with sufficient cushioning material to prevent breakage.

(4) Either the inner packagings or the outer packagings must have inner linings or bags of strong leakproof and puncture-resistant material impervious to mercury, completely surrounding the contents, so that the escape of mercury will be prevented irrespective of the position of the package.

(b) Manufactured articles or apparatuses, each containing not more than 100 mg (0.0035 ounce) of mercury and packaged so that the quantity of mercury per package does not exceed 1 g (0.035 ounce) are not subject to the requirements of this subchapter.

(c) Manufactured articles or apparatuses containing mercury are excepted from the specification packaging requirements of this subchapter when packaged as follows:

(1) Manufactured articles or apparatuses of which metallic mercury is a component part, such as manometers, pumps, thermometers, switches, etc. (for electron tubes, mercury vapor tubes and similar tubes, see paragraph (c)(3) of this section), must be in strong outer packagings, having sealed inner liners or bags of strong leakproof and puncture-resistant material impervious to mercury, which will prevent the escape of mercury from the package irrespective of its position. Mercury switches and relays are excepted from these packaging requirements, if they are totally enclosed, leakproof and in sealed metal or plastic units.

(2) Thermometers, switches and relays, each containing a total quantity of not more than 15 g (0.53 ounces) of mercury, are excepted from the requirements of this subchapter if installed as an integral part of a machine or apparatus and so fitted that shock of impact damage, leading to leakage of mercury, is unlikely to occur under conditions normally incident to transport.

(3) Electron tubes, mercury vapor tubes and similar tubes must be packaged as follows:

(i) Tubes which are packed in strong outer packagings with all seams and joints sealed with self-adhesive, pressure-sensitive tape which will prevent the escape of mercury from the package, are authorized up to a total net quantity of 450 g (15.9 ounces) of mercury per package;

(ii) Tubes with more than 450 g (15.9 ounces) of mercury are authorized only when packed in strong outer packagings, having sealed inner liners or bags of strong leakproof and puncture-resistant material impervious to mercury which will prevent

escape of mercury from the package irrespective of its position;
(iii) Tubes which do not contain more than 5 g (0.2 ounce) of mercury each and which are packed in the manufacturer's original packagings, are authorized up to a total net quantity of 30 g (1.1 ounces) of mercury per package;
(iv) Tubes which are completely jacketed in sealed leakproof metal cases are authorized in the manufacturer's original packagings.
(4) A person offering for transportation electron tubes, mercury vapor tubes, and similar tubes shall indicate the quantity of mercury therein on the shipping paper.
(5) Mercurial barometers conforming to paragraph (c)(1) of this section, which are loaded and unloaded from an aircraft under the supervision of, and accompanied in flight by, a National Weather Service official or similar United States agency official, are excepted from any other requirements of this subchapter.
(d) For transportation by other than aircraft, mercury must be packaged-
(1) In any packaging which meets the requirements of part 178 of this subchapter at the Packing Group III performance level; or
(2) In non-specification reusable metal packagings.
(e) Except for a hazardous substance or a hazardous waste or for transportation by aircraft or vessel, packages containing less than 0.45 kg (1.0 pound) net weight of mercury are not subject to the requirements of this subchapter.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-241, 59 FR 67509, Dec. 29, 1994; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; 64 FR 10777, 10778, Mar. 5, 1999]

§173.166 Air bag inflators, air bag modules and seat-belt pretensioners.
(a) *Definitions. An air bag inflator (consisting of a casing containing an igniter, a booster material, a gas generant and, in some cases, a pressure vessel (cylinder)) is a gas generator used to inflate an air bag in a supplemental restraint system in a motor vehicle. An air bag module is the air bag inflator plus an inflatable bag assembly. A seat-belt pre-tensioner contains similar hazardous materials and is used in the operation of a seat-belt restraining system in a motor vehicle.*
(b) Classification. An air bag inflator, air bag module, or seat-belt pre-tensioner may be classed as Class 9 (UN3268) or Division 2.2 (UN3353) if it meets the following requirements-
(1) The manufacturer has submitted each design type air bag inflator or seat-belt pre-tensioner to a person approved by the Associate Administrator for Hazardous Materials Safety for examination and testing. The submission must contain a detailed description of the inflator or pre-tensioner (or, if more than a single inflator or pre-tensioner is involved, the maximum parameters of each particular inflator or pre-tensioner design type for which approval is sought) and details on the complete package.
(2) Samples of the inflator or pre-tensioner, packaged as for transport, have been subjected to test series 6(c) of the UN Recommendations on the Transport of

Dangerous Goods, Manual of Tests and Criteria, with no explosion of the device, no fragmentation of device casings, and no projection hazard or thermal effect which would significantly hinder fire-fighting or other emergency response efforts in the immediate vicinity.

(3) The manufacturer submits an application, including-

(i) The test results and report recommending the shipping description and classification for each device or design type; or

(ii) An approved classification issued by the competent authority of a foreign government, to the Associate Administrator for Hazardous Materials Safety, and is notified in writing by the Associate Administrator that the device has been classed as Class 9 or Division 2.2 and approved for transportation.

(4) No approval applications are required for air bag modules containing an approved air bag inflator.

(5) Air bag inflators or seat belt pre-tensioners previously reclassed from Class 1 to Division 4.1 under the terms of an exemption may be reclassed as Class 9 materials without further testing.

(c) *EX numbers. When offered for transportation, the shipping paper must contain the EX number or product code for each approved inflator or pre-tensioner in association with the basic description required by §172.202(a) of this subchapter. Product codes must be traceable to the specific EX number assigned to the inflator, module or pre-tensioner by the Associate Administrator for Hazardous Materials Safety. Marking the EX number or product code on the outside package is not required.*

(d) Exceptions. (1) An air bag module or seat-belt pretensioner that has been approved by the Associate Administrator for Hazardous Materials Safety and is installed in a motor vehicle or in completed vehicle components, such as steering columns or door panels, is not subject to the requirements of this subchapter.

(2) An air bag module, containing an inflator that has previously been examined and approved for transportation as a Division 4.1 material, is not required to be submitted for examination or approval.

(e) *Packagings. The following packagings are authorized:*

(1) 1A2, 1B2, 1G or 1H2 drums.

(2) 3A2 or 3H2 jerricans.

(3) 4C1, 4C2, 4D, 4F, 4G or 4H2 boxes.

(4) Reusable high strength plastic or metal containers or dedicated handling devices are authorized for shipment of air bag inflators, air bag modules, and seat-belt pretensioners from a manufacturing facility to the assembly facility, subject to the following conditions:

(i) The gross weight of the container or handling device may not exceed 1000 kg (2205 pounds). The container or handling device structure must provide adequate support to allow them to be stacked at least three high with no damage to the containers or devices.

(ii) If not completely enclosed by design, the container or handling device must be covered with plastic, fiberboard, or metal. The covering must be secured to the container by banding or other comparable methods.

(iii) Internal dunnage must be sufficient to prevent movement of the devices within the container.

(f) *Labeling. Notwithstanding the provisions of §172.402 of this subchapter, each package or handling device must display a CLASS 9 or NON-FLAMMABLE GAS label. Additional labeling is not required when the package contains no hazardous materials other than the devices.*

[Amdt. 173-230, 57 FR 1878, Jan. 16, 1992, as amended by Amdt. 173-241, 59 FR 67509, Dec. 29, 1994; Amdt. 173-261, 62 FR 24733, May 6, 1997; 62 FR 51560, Oct. 1, 1997; 64 FR 10778, Mar. 5, 1999]

§173.170 Black powder for small arms.

Black powder for small arms that has been classed in Division 1.1 may be reclassed as a Division 4.1 material, for domestic transportation by motor vehicle, rail freight, and cargo vessel only, subject to the following conditions:

(a) The powder must be examined and approved for Division 1.1 and Division 4.1 classification in accordance with §§173.56 and 173.58;

(b) The total quantity of black powder in one motor vehicle, rail car, or freight container may not exceed 45.4 kg (100 pounds) net mass, and no more than four freight containers may be on board one cargo vessel;

(c) The black powder must be packed in inner metal or heavy wall conductive plastic receptacles not over 454 g (16 ounces) net capacity each, with no more than 25 cans in one outer UN 4G fiberboard box. The inner packagings must be arranged and protected so as to prevent simultaneous ignition of the contents. The complete package must be of the same type which has been examined as required in §173.56;

(d) Each completed package must be marked "BLACK POWDER FOR SMALL ARMS" and "NA 0027"; and

(e) Each package must bear the FLAMMABLE SOLID label.

[Amdt. 173-255, 61 FR 50626, Sept. 26, 1996, as amended at Amdt. 173-255, 62 FR 14338, Mar. 26, 1997]

§173.171 Smokeless powder for small arms.

Smokeless powder for small arms which has been classed in Division 1.3 may be reclassed in Division 4.1, for transportation by motor vehicle, rail car, vessel, or cargo-only aircraft, subject to the following conditions:

(a) The powder must be examined and approved for a Division 1.3 and Division 4.1 classification in accordance with §§173.56 and 173.58 of this part.

(b) The total quantity of smokeless powder may not exceed 45.4 kg (100 pounds) net mass in:

(1) One rail car, motor vehicle, or cargo-only aircraft; or

(2) One freight container on a vessel, not to exceed four freight containers per vessel.

(c) Only combination packagings with inner packagings not exceeding 3.6 kg (8 pounds) net mass are authorized. Inner packagings must be arranged and protected so as to prevent simultaneous ignition of the contents. The complete package must be of the same type which has been examined as required in §173.56 of this part.

(d) Inside packages that have been examined and approved by the Associate Administrator for Hazardous Materials Safety may be packaged in UN 4G fiberboard boxes meeting the Packing Group I performance level, provided all inside containers are packed to prevent movement and the net weight of smokeless powder in any one box does not exceed 7.3 kg (16 pounds).

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-241, 59 FR 67509, Dec. 29, 1994; Amdt. 173-253, 61 FR 27174, May 30, 1996]

§173.172 Aircraft hydraulic power unit fuel tank.

Aircraft hydraulic power unit fuel tanks containing a mixture of anhydrous hydrazine and monomethyl hydrazine (M86 fuel) and designed for installation as complete units in aircraft are excepted from the specification packaging requirements of this subchapter when they conform to either of the following conditions:

(a) The unit must consist of an aluminum pressure vessel made from tubing and having welded heads. Primary containment of the fuel within this vessel must consist of a welded aluminum bladder having a maximum internal volume of 46 L (12 gallons). The outer vessel must have a minimum design gauge pressure of 1.275 kPa (185 psi) and a minimum burst gauge pressure of 2,755 kPa (400 psi). Each vessel must be leak-checked during manufacture and before shipment and must be found leakproof. The complete inner unit must be securely packed in non-combustible cushioning material, such as vermiculite, in a strong outer tightly closed metal packaging which will adequately protect all fittings. Maximum quantity of fuel per unit and package is 42 L (11 gallons); or

(b) The unit must consist of an aluminum pressure vessel. Primary containment of the fuel within this vessel must consist of a welded hermetically sealed fuel compartment with an elastomeric bladder having a maximum internal volume of 46 L (12 gallons). The pressure vessel must have a minimum design gauge pressure of 5,170 kPa (750 psi). Each vessel must be leak-checked during manufacture and before shipment and must be securely packed in non-combustible cushioning material, such as vermiculite, in a strong outer tightly closed metal packaging which will adequately protect all fittings. Maximum quantity of fuel per unit and package is 42 L (11 gallons).

§173.173 Paint, paint-related material, adhesives, ink and resins.

(a) When the §172.101 table specifies that a hazardous material be packaged under this section, the following requirements apply. Except as otherwise provided in this part, the description "Paint" is the proper shipping name for paint, lacquer, enamel, stain, shellac, varnish, liquid aluminum, liquid bronze, liquid gold, liquid wood filler, and liquid lacquer base. The description "Paint-related material" is the proper shipping name for a paint thinning, drying, reducing or removing compound. However, if a more specific description is listed in the §172.101 table of this subchapter, that description must be used.

(b) Paint, paint-related material, adhesives, ink and resins must be packaged as follows:

(1) As prescribed in §173.202 of this part if it is a Packing Group II material or §173.203 of this part if it is a Packing Group III material; or

(2) In inner glass packagings of not over 1 L (0.3 gallon) capacity each or inner metal packagings of not over 5 L (1 gallon) each, packed in a strong outer packaging. Packages must conform to the packaging requirements of subpart B of this part but need not conform to the requirements of part 178 of this subchapter.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991; Amdt. 173-241, 59 FR 67509, Dec. 29, 1994]

§173.174 Refrigerating machines.

A refrigerating machine assembled for shipment and containing 7 kg (15 pounds) or less of a flammable liquid for its operation in a strong, tight receptacle is excepted from labeling (except when offered for transportation or transported by air) and the specification packaging requirements of this subchapter. In addition. shipments are not subject to subpart F of part 172 of this subchapter (Placarding), to part 174 of this subchapter (Carriage by rail) except §174.24 (Shipping papers) and to part 177 (Carriage by highway) of this subchapter except §177.817 (Shipping papers).

§173.181 Pyrophoric materials (liquids).

When the §172.101 table specifies that a hazardous material be packaged under this section, only the following non-bulk packagings are authorized:

(a) Specification steel or nickel cylinders prescribed for any compressed gas except acetylene having a minimum design pressure of 1206 kPa (175 psi). Cylinders with valves must be:

(1) Equipped with steel valve protection caps or collars, unless overpacked; or

(2) Overpacked in a wooden box (4C1, 4C2, 4D or 4F); fiberboard box (4G), or plastic box (4H1 or 4H2). Cylinders must be secured to prevent movement in the box and, when offered for transportation or transported, must be so loaded that pressure relief

devices remain in the vapor space of the cylinder. (See §§173.34(d)(7), 174.430 and 177.838(h) of this subchapter.)
(b) Wooden boxes (4C1, 4C2, 4D, or 4F) or fiberboard boxes (4G) enclosing not more than four strong, tight metal cans with inner receptacles of glass or metal, not over 1 L (0.3 gallon) capacity each, having positive screwcap closures adequately gasketed. Inner packagings must be cushioned on all sides with dry, absorbent, incombustible material in a quantity sufficient to absorb the entire contents. The strong, tight metal cans must be closed by positive means, not by friction.
(c) Steel drums (1A2) or fiber drums (1G) not exceeding 220 L (58 gallons) capacity each with strong tight inner metal cans not over 4.0 L (1 gallon) capacity each, closed by positive means, not friction.
(1) Inner packagings must have no opening exceeding 25 mm (1 inch) diameter and must be surrounded with noncombustible cushioning material.
(2) Net quantity of pyrophoric liquids may not exceed two-thirds of the rated capacity of the outer drum. For example, a 220 L (58 gallons) outer drum may contain no more than 147 L (39 gallons) of pyrophoric liquids.
(3) Each layer of inner containers must be separated by a metal plate separator in addition to cushioning material.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66270, Dec. 20, 1991]

§173.182 Barium azide-50 percent or more water wet.

Barium azide-50 percent or more water wet, must be packed in wooden boxes (4C1, 4C2, 4D, or 4F) or fiber drums (1G) with inner glass packagings not over 0.5 kg (1.1 pounds) capacity each. Packagings must have rubber stoppers wire tied for securement. If transportation is to take place when and where freezing weather is possible, a suitable antifreeze solution must be used to prevent freezing. Each packaging must conform to the requirements of part 178 of this subchapter at the Packing Group I performance level.

§173.183 Nitrocellulose base film.

Films, nitrocellulose base, must be packaged in packagings conforming to the requirements of part 178 of this subchapter at the Packing Group III performance level, as follows:
(a) In steel drums (1A2), aluminum drums (1B2), steel jerricans (3A2), wooden (4C1, 4C2), plywood (4D) or reconstituted wood (4F) boxes or plywood drums (1D) with each reel in a tightly closed metal can, polypropylene canister, or strong cardboard or fiberboard inner packaging with cover held in place by adhesive tape or paper; or
(b) In fiberboard (4G) boxes or fiber drums (1G) with a single tightly closed metal can,

polypropylene canister, or strong cardboard or fiberboard inner packaging with cover held in place by adhesive tape or paper; authorized only for not over 600 m (1969 feet) of film.

[Amdt. 173-224, 55 FR 52643 Dec. 21, 1990, as amended by Amdt. 173-255, 61 FR 50627, Sept. 26, 1996]

§173.184 Highway or rail fusee.

(a) A fusee is a device designed to burn at a controlled rate and to produce visual effects for signaling purposes. The composition of the fusee must be such that the fusee will not ignite spontaneously or undergo marked decomposition when subjected to a temperature of 75 ^{o}C (167 ^{o}F) for 48 consecutive hours.

(b) Fusees (highway and railway) must be packaged in steel drums (1A2), steel jerricans (3A2), wooden (4C1, 4C2), plywood (4D) or reconstituted wood (4F) boxes or in fiberboard boxes (4G), plywood (1D) or fiber (1G) drums. If the fusees are equipped with spikes packagings must have reinforced ends to prevent penetration of spikes through the outer packagings; packages must be capable of passing drop test requirements (§178.603 of this subchapter), including at least one drop with spike in a downward position, and other requirements of part 178 of this subchapter, at the Packing Group II performance level.

§173.185 Lithium batteries and cells.

(a) Except as otherwise provided in this subpart, a lithium cell or battery is authorized for transportation only if it conforms to the provisions of this section.

(b) *Exceptions. Cells and batteries are not subject to the requirements of this subchapter if they meet the following requirements:*

(1) Each cell with a liquid cathode may contain no more than 0.5 g of lithium or lithium alloy, and each cell with a solid cathode may contain no more than 1.0 g lithium or lithium alloy;

(2) Each battery with a liquid cathode may contain an aggregate quantity of no more than 1.0 g lithium or lithium alloy, and each battery with a solid cathode may contain an aggregate quantity of no more than 2.0 g of lithium or lithium alloy;

(3) Each cell or battery containing a liquid cathode must be hermetically sealed;

(4) Cells and batteries must be packed in such a way so as to prevent short circuits and must be packed in strong packagings, except when installed in equipment; and

(5) If a liquid cathode battery contains more than 0.5 g of lithium or lithium alloy or a solid cathode battery contains more than 1.0 g lithium or lithium alloy, it may not contain a liquid or gas that is a hazardous material according to this subchapter unless the liquid or gas, if free, would be completely absorbed or neutralized by other materials in the battery.

(c) Cells and batteries also are not subject to this subchapter if they meet the following requirements:
(1) Each cell contains not more than 5 g of lithium or lithium alloy;
(2) Each battery contains not more than 25 g of lithium or lithium alloy;
(3) Each cell or battery is of the type proven to be non-dangerous by testing in accordance with tests in the UN Manual of Tests and Criteria, such testing must be carried out on each type prior to the initial transport of that type; and
(4) Cells and batteries are designed or packed in such a way as to prevent short circuits under conditions normally encountered in transportation.
(d) Cells and batteries and equipment containing cells and batteries which were first transported prior to January 1, 1995, and were assigned to Class 9 on the basis of the requirements of this subchapter in effect on October 1, 1993, may continue to be transported in accordance with the applicable requirements in effect on October 1, 1993.
(e) Cells and batteries may be transported as items of Class 9 if they meet the requirements in paragraphs (e)(1) through (e)(9) of this section:
(1) Cells must not contain more than 12 g of lithium or lithium alloy.
(2) Batteries must not contain more than 500 g of lithium or lithium alloy.
(3) Each cell and battery must be equipped with an effective means of preventing external short circuits.
(4) Each cell and battery must incorporate a safety venting device or be designed in a manner that will preclude a violent rupture under conditions normally incident to transportation.
(5) Batteries containing cells or series of cells connected in parallel must be equipped with diodes to prevent reverse current flow.
(6) Cells and batteries must be packed in strong inner packagings containing not more than 500 g of lithium or lithium alloy per inner packaging.
(7) Cells and batteries must be packed in inner packagings in such a manner as to effectively prevent short circuits and to prevent movement which could lead to short circuits.
(8) Cells and batteries must be packaged in packagings conforming to the requirements of part 178 of this subchapter at the Packing Group II performance level: Inner packagings must be packed within metal boxes (4A or 4B), wooden boxes (4C1, 4C2, 4D,or 4F), fiberboard boxes (4G), solid plastic boxes (4H2), fiber drums (1G), metal drums (1A2 or 1B2), plywood drums (1D), plastic jerricans (3H2), or metal jerricans (3A2 or 3B2).
(9) Each cell or battery must be of the type proven to meet the criteria of Class 9 by testing in accordance with tests in the UN Manual of Tests and Criteria.
(10) Except as provided in paragraph (h) of this section, cells or batteries may not be offered for transportation or transported if any cell has been discharged to the extent that the open circuit voltage is less than two volts or is less than $^{2/3}$ of the voltage of the fully charged cell, whichever is less.
(f) Equipment containing or packed with cells and batteries meeting the requirements of paragraph (b) or (c) of this section is excepted from all other requirements of this

subchapter.
(g) Equipment containing or packed with cells and batteries may be transported as items of Class 9 if the batteries and cells meet all the requirements of paragraph (e) of this section and are packaged as follows:
(1) Equipment containing cells and batteries must be packed in a strong outer packaging that is waterproof or is made waterproof through the use of a liner unless the equipment is made waterproof by nature of its construction. The equipment must be secured within the outer packaging and be packed as to effectively prevent movement, short circuits, and accidental operation during transport; and
(2) Cells and batteries packed with equipment must be packed in inner packagings conforming to paragraph (e)(8) of this section in such a manner as to effectively prevent movement and short circuits. The quantity of lithium contained in any piece of equipment must not exceed 12 g per cell and 500 g per battery. Not more than 5 kg of cells and batteries may be packed with each item of equipment.
(h) Cells and batteries, for disposal, may be offered for transportation or transported to a permitted storage facility and disposal site by motor vehicle when they meet the following requirements:
(1) Cells, when new, may not contain more than 12 g and batteries may not contain more than 500 g of lithium or lithium alloy;
(2) Be equipped with an effective means of preventing external short circuits; and
(3) Be packed in a strong outer packaging conforming to the requirements of §§173.24 and 173.24a. The packaging need not conform to performance requirements of part 178 of this subchapter.
(i) Cells and batteries and equipment containing or packed with cells and batteries which do not comply with the provisions of this section may be transported only if they are approved by the Associate Administrator for Hazardous Materials Safety.
(j) For testing purposes, when not contained in equipment, cells containing not more than 12 g of lithium or lithium alloy and batteries containing not more than 500 g of lithium or lithium alloy may be offered for transportation or transported by highway only as items of Class 9. Packaging must conform with paragraph (e)(8) of this section with not more than 100 cells per package.

[Amdt. 173-261, 62 FR 24733, May 6, 1997]

§173.186 Matches.

(a) Matches must be of a type which will not ignite spontaneously or undergo marked decomposition when subjected for 8 consecutive hours to a temperature of 93 ^{o}C (200 ^{o}F).

(b) *Definitions. (1) Fusee matches are matches the heads of which are prepared with a friction-sensitive igniter composition and a pyrotechnic composition which burns with little or no flame, but with intense heat.*

(2) Safety matches are matches combined with or attached to the box, book or card

that can be ignited by friction only on a prepared surface.

(3) Strike anywhere matches are matches that can be ignited by friction on a solid surface.

(4) Wax "Vesta" matches are matches that can be ignited by friction either on a prepared surface or on a solid surface.

(c) Safety matches and wax "Vesta" matches must be tightly packed in securely closed inner packagings to prevent accidental ignition under conditions normally incident to transportation, and further packed in outer fiberboard, wooden, or other equivalent-type packagings. These matches in outer packagings not exceeding 23 kg (50 pounds) gross weight are not subject to any other requirement (except marking) of this subchapter. These matches may be packed in the same outer packaging with materials not subject to this subchapter.

(d) Strike-anywhere matches may not be packed in the same outer packaging with any material other than safety matches or wax "Vesta" matches, which must be packed in separate inner packagings.

(e) Packagings. Strike-anywhere matches must be tightly packed in securely closed chipboard, fiberboard, wooden, or metal inner packagings to prevent accidental ignition under conditions normally incident to transportation. Each inner packaging may contain no more than 700 strike-anywhere matches and must be packed in outer steel drums (1A2), aluminum drums (1B2), steel jerricans (3A2), wooden (4C1, 4C2), plywood (4D), reconstituted wood (4F) or fiberboard (4G) boxes, plywood (1D) or fiber (1G) drums. Gross weight of fiberboard boxes (4G) must not exceed 27 kg (60 pounds). Gross weight of other outer packagings must not exceed 45 kg (100 pounds).

§173.187 Pyrophoric solids, metals or alloys, n.o.s.

Packagings for pyrophoric solids, metals, or alloys, n.o.s. must conform to the requirements of part 178 of this subchapter at the packing group performance level specified in the §172.101 table. These materials must be packaged as follows:

(a) In wooden boxes (4C1, 4C2, 4D, or 4F) with inner metal receptacles which have a positive (not friction) means of closure and contain not more than 15 kg (33 pounds) each.

(b) In steel drums (1A1 or 1A2) with a gross mass not exceeding 150 kg (331 pounds) per drum.

(c) In fiberboard boxes (4G) with inner metal receptacles which have a positive (not friction) means of closure and contain not more than 7.5 kg (17 pounds) each.

(d) In fiber drums (1G) with inner metal receptacles which have a positive (not friction) means of closure and contain not more than 15 kg (33 pounds) each.

(e) In plywood drums (1D) with inner metal receptacles which have a positive (not friction) means of closure and contain not more than 15 kg (33 pounds) each.

§173.188 White or yellow phosphorus.

Phosphorus, white or yellow, when offered for transportation or transported by rail, highway, or water, must be packaged in water or dry in packagings conforming to the requirements of part 178 of this subchapter at the Packing Group I performance level, as follows:

(a) When placed in water, it must be packaged in specification packagings as follows:

(1) Wooden boxes (4C1, 4C2, 4D, or 4F) with:

(i) Inner hermetically sealed (soldered) metal cans, enclosed in other hermetically sealed (soldered) metal cans, or

(ii) Inner water-tight metal cans containing not over 0.5 kg (1 pound) of phosphorus with screw-top closures; or

(2) Steel drums (1A1) not over 250 L (66 gallons) capacity each or steel drums (1A2) not over 115 L (30 gallons) capacity each.

(b) When dry, it must be cast solid and shipped in packagings as follows:

(1) Steel drums (1A2) not over 115 L (30 gallons) capacity each, or

(2) In projectiles or bombs when shipped by, for, or to the Departments of the Army, Navy, or Air Force of the United States Government, without bursting elements.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20, 1991]

§173.189 Batteries containing sodium or cells containing sodium.

(a) Batteries and cells may not contain any hazardous material other than sodium, sulfur or polysulfides. Cells not forming a component of a completed battery may not be offered for transportation at a temperature at which any liquid sodium is present in the cell. Batteries may only be offered for transportation, or transported, at a temperature at which any liquid sodium present in the battery conforms to the conditions prescribed in paragraph (d) of this section.

(b) Cells must consist of hermetically sealed metal casings which fully enclose the hazardous materials and which are so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport. Cells must be placed in suitable outer packagings with sufficient cushioning material to prevent contact between cells and between cells and the internal surfaces of the outer packaging, and to ensure that no dangerous movement of the cells within the outer packaging occurs in transport. Cells must be packaged in 1A2, 1B2, 1D, 1G, 1H2, 4C1, 4C2, 4D, 4F, 4G or 4H2 outer packagings which meet the requirements of part 178 of this subchapter at the Packing Group II performance level.

(c) Batteries must consist of cells secured within, and fully enclosed by a metal casing so constructed and closed as to prevent the release of the hazardous materials under normal conditions of transport. Batteries may be offered for transportation, and transported, unpacked or in protective packagings that are not subject to the requirements of part 178 of this subchapter.

(d) Batteries containing any liquid sodium may not be offered for transportation, or transported, by aircraft. Batteries containing liquid sodium may be transported by motor vehicle, rail car or vessel under the following conditions:

(1) Batteries must be equipped with an effective means of preventing external short circuits, such as by providing complete electrical insulation of battery terminals or other external electrical connectors. Battery terminals or other electrical connectors penetrating the heat insulation fitted in battery casings must be provided with thermal insulation sufficient to prevent the temperature of the exposed surfaces of such devices from exceeding 55 ^{o}C (130 ^{o}F).

(2) No battery may be offered for transportation if the temperature at any point on the external surface of the battery exceeds 55 ^{o}C (130 ^{o}F).

(3) If any external source of heating is used during transportation to maintain sodium in batteries in a molten state, means must be provided to ensure that the internal temperature of the battery does not reach or exceed 400 ^{o}C (752 ^{o}F).

(4) When loaded in a transport vehicle or freight container:

(i) Batteries must be secured so as to prevent significant movement within the transport vehicle or freight container under conditions normally incident to transportation;

(ii) Adequate ventilation and/or separation between batteries must be provided to ensure that the temperature at any point on the external surface of the battery casing will not exceed 240 ^{o}C (464 ^{o}F) during transportation; and

(iii) No other hazardous materials, with the exception of cells containing sodium, may be loaded in the same transport vehicle or freight container. Batteries must be separated from all other freight by a distance of not less than 0.5 meters (1.6 feet).

(e) Batteries containing sodium or cells containing sodium, when installed as part of a motor vehicle, are not subject to the requirements of this subchapter.

[Amdt. 173-241, 59 FR 67511, Dec. 29, 1994, as amended by Amdt. 173-256, 61 FR 51338, Oct. 1, 1996]

§173.192 Packaging for certain Packing Group I poisonous materials.

When §172.101 of this subchapter specifies that a poisonous material be packaged under this section, only specification cylinders are authorized, as follows:

(a) Specification 3A1800, 3AA1800, 3AL1800, 3D, 3E1800, or 33 cylinders, under the following conditions:

(1) Specification 3A, 3AA and 3AL cylinders may not exceed 57 kg (125 pounds) water capacity (nominal).

(2) Specification 3D and 33 cylinders may not exceed 57 kg (125 pounds) water capacity (nominal).

(3) Specification 3AL cylinders containing arsine or phosphine may only be offered for transportation or transported by highway and rail.

(b) Packagings must conform to the requirements of §173.40 of this part.

(c) For cylinders used for phosgene,
(1) The filling density may not exceed 125 percent;
(2) A cylinder may not contain more than 68 kg (150 pounds) of phosgene; and
(3) Each filled cylinder must be tested for leakage before it is offered for transportation or transported and must show absolutely no leakage; this test must consist of immersing the cylinder and valve, without the protection cap attached, in a bath of water at a temperature of approximately 66 ^{o}C (150 ^{o}F) for at least 30 minutes, during which time frequent examinations must be made to note any escape of gas. The valve of the cylinder must not be loosened after this test and before the cylinder is offered for transportation or transported.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20, 1991]

§173.193 Bromoacetone, methyl bromide, chloropicrin and methyl bromide or methyl chloride mixtures, etc.

(a) Bromoacetone must be packaged as follows in wooden boxes (4C1, 4C2, 4D or 4F) with inner glass receptacles or tubes in hermetically sealed metal receptacles in corrugated fiberboard cartons. Bottles may not contain over 500 g (17.6 ounces) of liquid each and must be cushioned in cans with at least 12.7 mm (0.5 inch) of absorbent material. Total amount of liquid in the outer box must not exceed 11 kg (24 pounds). Packagings must conform to the requirements of part 178 of this subchapter at the Packing Group I performance level.

(b) Bromoacetone, methyl bromide, chloropicrin and methyl bromide mixtures, chloropicrin and methyl chloride mixtures, and chloropicrin mixtures charged with non-flammable, non-liquefied compressed gas must be packed in Specification 3A, 3AA, 3B, 3C, 3E, 4A, 4B, 4BA, 4BW, or 4C cylinders having not over 113 kg (250 pounds) water capacity (nominal). This capacity does not apply to shipments of methyl bromide.

(c) Methyl bromide mixtures containing up to 2% chloropicrin must be packaged in 4G fiberboard boxes with inside metal cans containing not over one pound each, or inside metal cans with a minimum wall thickness of 0.007 inch containing not over $1^{3/4}$ pounds each. The one-pound can must be capable of withstanding an internal pressure of 130 psig without leakage or permanent distortion. Vapor pressure of the contents must not exceed 130 psig at 55 ^{o}C (130 ^{o}F). The $1^{3/4}$-pound can must be capable of withstanding an internal pressure of 140 psig without leakage or permanent distortion. Vapor pressure of the contents must not exceed 140 psig at 55 ^{o}C (130 ^{o}F). Cans must not be liquid full at 130 ^{o}F. Cans must be constructed of tinplate or lined with suitable material and must have concave or pressure ends.

(d) Cylinders, except those containing methyl bromide, must conform to §173.40 of this part.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20,

1991; 57 FR 45463, Oct. 1, 1992]

§173.194 Gas identification sets.

Gas identification sets containing poisonous material must be packaged in packagings conforming to the requirements of part 178 of this subchapter at the Packing Group I performance level, as follows:

(a) In glass inner receptacles, hermetically sealed, of not over 40 ml (1.4 fluid ounces) each. Each glass inner receptacle must in turn be placed in a sealed fiberboard receptacle, cushioned with absorbent material. Not more than 12 fiberboard receptacles must in turn be placed in a 4G fiberboard box. No more than four boxes, well-cushioned, may in turn be placed in a steel cylinder. The cylinder must have a wall thickness of at least 3.7 mm (0.146 inch) and must have a hermetically sealed steel closure.

(b) When the poisonous material is absorbed in a medium such as activated charcoal or silical gel, gas identification sets may be shipped as follows:

(1) If the poisonous material does not exceed 5 ml (0.2 fluid ounce) if a liquid or 5 g (0.2 ounce) if a solid, it may be packed in glass inner receptacles of not over 120 ml (4.1 fluid ounces) each. Each glass receptacle, cushioned with absorbent material must be packed in a hermetically sealed metal can of not less than 0.30-mm (0.012 inch) wall thickness. Metal cans, surrounded on all sides by at least 25 mm (1 inch) of dry sawdust, must be packed in 4C1, 4C2, 4D or 4F wooden boxes. Not more than 100 ml (3.4 fluid ounces) or 100 g (3.5 ounces) of poisonous materials may be packed in one outer wooden box.

(2) If the poisonous material does not exceed 5 ml (0.2 fluid ounce) if a liquid or 20 g (0.7 ounce) if a solid, it may be packed in glass inner receptacles with screw-top closures of not less than 60 ml (2 ounces), hermetically sealed. Twelve bottles containing poisonous material, not to exceed 100 ml (3.4 ounces) or 100 g (3.5 ounces), or both, may be placed in a plastic carrying case, each glass receptacle surrounded by absorbent cushioning and each separated from the other by sponge rubber partitions. The plastic carrying case must be placed in a tightly fitting fiberboard box which in turn must be placed in a tightly fitting 4C1, 4C2, 4D or 4F wooden box.

§173.195 Hydrogen cyanide, anhydrous, stabilized (hydrocyanic acid, aqueous solution).

(a) Hydrogen cyanide, anhydrous, stabilized, must be packed in specification cylinders as follows:

(1) As prescribed in §173.192, or

(2) Specification 3A480, 3A480X, 3AA480, or 3A1800 metal cylinders of not over 126 kg (278 pounds) water capacity (nominal). Shipments in 3AL cylinders are authorized only when transported by highway and rail.

(b) Cylinders may not be charged with more than 0.27 kg (0.6 pound) of liquid per 0.45 kg (1 pound) water capacity of cylinder. Each filled cylinder must be tested for leakage before being offered for transportation or transported and must show absolutely no leakage; this test must consist of passing a piece of Guignard's sodium picrate paper over the closure of the cylinder, without the protection cap attached, to detect any escape of hydrogen cyanide from the cylinder. Other equally efficient test methods may be used in place of sodium picrate paper.
(c) Packagings for hydrogen cyanide must conform to §173.40.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20, 1991]

§173.196 Infectious substances (etiologic agents).

(a) Authorized packagings and components are as follows:

(1) Inner packagings comprising:

(i) A watertight primary receptacle;

(ii) A watertight secondary packaging; and

(iii) When the primary receptacle contains liquids, an absorbent material must be placed between the primary receptacle and the secondary packaging. If multiple-primary receptacles are placed in a single secondary packaging they must be wrapped individually to ensure that contact between them is prevented. The absorbent material, such as cotton wool, must be sufficient to absorb the entire contents of all primary receptacles.

(2) An outer packaging must be of adequate strength for its capacity, mass and intended use.

(b) Each package for infectious substances must be capable of passing the tests specified in §178.609 of this subchapter.

(c) Packages consigned as freight must be at least 100 mm (3.9 inches) in the smallest overall external dimensions.

(d) For all packages containing infectious substances, an itemized list of contents must be enclosed between the secondary packaging and the outer packaging.

(e) Although exceptional cases, such as whole organs, may require special packaging, the great majority of infectious substances can and must be packaged according to the following guidelines.

(1) *Lypholized substances. Primary receptacles include flame-sealed glass ampoules or rubber-stopped glass vials fitted with metal seals.*

(2) Liquid or solid substances-(i) Substances shipped at ambient temperatures or higher. Primary receptacles include those of glass, metal or plastic. Positive means of ensuring a leakproof seal, such as heat seal, skirted stopper or metal crimp seal must be provided. If screw caps are used, they must be reinforced with adhesive tape.

(ii) Substances shipped refrigerated or frozen (ice, pre-frozen packs, dry ice). Ice or dry ice must be placed outside the secondary packagings. Interior supports must be provided to secure the secondary packagings in the original position after the ice or dry ice has dissipated. If ice is used, the packaging must be leakproof. If dry ice is used, the outer packaging must permit the release of carbon dioxide gas.

(iii) Substances shipped in liquid nitrogen. Plastic primary receptacles capable of withstanding very low temperatures must be used. Secondary packaging must also withstand very low temperatures and in most cases will need to be fitted over individual primary receptacles. Requirements for shipment of liquid nitrogen must also be observed.

(f) Whatever the intended temperature of shipment, the primary receptacle or secondary packaging used for infectious substances must be capable of withstanding, without leakage, an internal pressure which produces a pressure differential of not less than 95 kPa (14 psi) and temperatures in the range of -40 ^{o}C to +55 ^{o}C (-40 ^{o}F to +131 ^{o}F).

(g) The requirements of this section supplement the requirements of the Department of Health and Human Services contained in 42 CFR part 72.

(h) *Exceptions. The following substances are not subject to any requirements of this subchapter if the items as packaged do not contain any material otherwise subject to the requirements of this subchapter.*

(1) Diagnostic specimens.

(2) Biological products.

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-241, 59 FR 67511, Dec. 29, 1994; 64 FR 10778, Mar. 5, 1999]

§173.197 Regulated medical waste.

Regulated medical waste must be packaged in packagings conforming to the requirements of part 178 of this subchapter at the Packing Group II performance level. The packagings must be:

(a) Rigid;

(b) Leak resistant;

(c) Impervious to moisture;

(d) Of sufficient strength to prevent tearing or bursting under normal conditions of use and handling;

(e) Sealed to prevent leakage during transport;

(f) Puncture resistant for sharps and sharps with residual fluids; and

(g) Break-resistant and tightly lidded or stoppered for fluids in quantities greater than 20 cubic centimeters.

[Amdt. 173-224, 56 FR 66271, Dec. 20, 1991, as amended at 64 FR 51919, Sept. 27, 1999]

§173.198 Nickel carbonyl.

(a) Nickel carbonyl must be packed in specification steel or nickel cylinders as prescribed for any compressed gas except acetylene. A cylinder used exclusively for nickel carbonyl may be given a complete external visual inspection in lieu of the interior hydrostatic pressure test required by §173.34(e). Visual inspection must be in accordance with CGA Pamphlet C-6.

(b) Packagings for nickel carbonyl must conform to §173.40.

§173.201 Non-bulk packagings for liquid hazardous materials in Packing Group I.

(a) When §172.101 of this subchapter specifies that a liquid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I performance level, and to the requirements of the special provisions of column 7 of the §172.101 table.

(b) The following combination packagings are authorized:

Outer packagings:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H1
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles

Glass ampoules

(c) Except for transportation by passenger aircraft, the following single packagings are authorized:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel, or aluminum: 1N1 or 1N2
Plastic drum: 1H1 or 1H2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Plastic receptacle in steel, aluminum, fiber or plastic drum: 6HA1, 6HB1, 6HG1, 6HH1
Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum or fiber drum: 6PA1, 6PB1 or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2, 6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in solid or expanded plastic packaging: 6PH1 or 6PH2
Cylinders, specification, as prescribed for any compressed gas, except for Specifications 8 and 3HT

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-241, 59 FR 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997]

§173.202 Non-bulk packagings for liquid hazardous materials in Packing Group II.

(a) When §172.101 of this subchapter specifies that a liquid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I or II performance level (unless otherwise excepted), and to the particular requirements of the special provisions of column 7 of the §172.101 table.

(b) The following combination packagings are authorized:

Outer packagings:
Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2

Wooden barrel: 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H1
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles
Glass ampoules

(c) Except for transportation by passenger aircraft, the following single packagings are authorized:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plastic drum: 1H1 or 1H2
Fiber drum: 1G (with liner)
Wooden barrel: 2C1
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Plastic receptacle in steel, aluminum, fiber or plastic drum: 6HA1, 6HB1, 6HG1 or 6HH1
Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum or fiber drum: 6PA1, 6PB1 or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2, 6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in solid or expanded plastic packaging: 6PH1 or 6PH2
Plastic receptacle in plywood drum: 6HD1
Glass, porcelain or stoneware in plywood drum or wickerwork hamper: 6PDl or 6PD2
Cylinders, specification, as prescribed for any compressed gas, except for Specifications 8 and 3HT

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20,

1991; Amdt 173-241, 59 FR 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997; 62 FR 51560, Oct. 1, 1997]

§173.203 Non-bulk packagings for liquid hazardous materials in Packing Group III.

(a) When §172.101 of this subchapter specifies that a liquid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I, II or III performance level, and to the requirements of the special provisions of column 7 of the §172.101 table.

(b) The following combination packagings are authorized:

Outer packagings:
Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Wooden barrel: 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H1
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles
Glass ampoules

(c) The following single packagings are authorized:

Steel drum: 1A1 or 1A2

Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1
Plastic drum: 1H1 or 1H2
Fiber drum: 1G (with liner)
Wooden barrel: 2C1
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Plastic receptacle in steel, aluminum, fiber or plastic drum: 6HA1, 6HB1, 6HG1 or 6HH1
Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum or fiber drum: 6PA1, 6PB1, or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2, 6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in solid or expanded plastic packaging: 6PH1 or 6PH2
Plastic receptacle in plywood drum: 6HD1
Glass, porcelain or stoneware in plywood drum or wickerwork hamper: 6PD1 or 6PD2
Cylinders, as prescribed for any compressed gas, except for Specifications 8 and 3HT

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20, 1991; Amdt. 173-241, 59 FR 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997]

§173.204 Non-bulk, non-specification packagings for certain hazardous materials.

When §172.101 of this subchapter specifies that a liquid or solid hazardous material be packaged under this section, any appropriate non-bulk packaging which conforms to the general packaging requirements of subpart B of part 173 may be used for its transportation. Packagings need not conform to the requirements of part 178 of this subchapter.

§173.205 Specification cylinders for liquid hazardous materials.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, any specification cylinder, except those specified for acetylene, is authorized. Cylinders used for poisonous materials (Division 6.1 or 2.3) must conform to the requirements of §173.40.

§173.211 Non-bulk packagings for solid hazardous materials in Packing Group I.

(a) When §172.101 of this subchapter specifies that a solid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each package must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I performance level, and to the requirements of the special provisions of column 7 of the §172.101 table.
(b) The following combination packagings are authorized:

Outer packagings:
Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Wooden barrel: 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles
Glass ampoules

(c) Except for transportation by passenger aircraft, the following single packagings are authorized:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plastic drum: 1H1 or 1H2
Fiber drum: 1G
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2

Steel box with liner: 4A
Aluminum box with liner: 4B
Natural wood box, sift proof: 4C2
Plastic receptacle in steel, aluminum, plywood, fiber or plastic drum: 6HA1, 6HB1, 6HD1, 6HG1 or 6HH1
Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum, plywood or fiber drum: 6PA1, 6PB1, 6PD1 or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2, 6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in expanded or solid plastic packaging: 6PH1 or 6PH2

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66271, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-241, 59 FR 67511, 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997]

§173.212 Non-bulk packagings for solid hazardous materials in Packing Group II.

(a) When §172.101 of this subchapter specifies that a solid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each package must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I or II performance level, and to the requirements of the special provisions of column 7 of the §172.101 table.

(b) The following combination packagings are authorized:

Outer packagings:
Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Wooden barrel: 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F

Fiberboard box: 4G
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles
Glass ampoules

(c) Except for transportation by passenger aircraft, the following single packagings are authorized:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Plywood drum: 1D
Plastic drum: 1H1 or 1H2
Fiber drum: 1G
Metal drum other than steel or aluminum: 1N1 or 1N2
Wooden barrel: 2C1 or 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Steel box with liner: 4A
Aluminum box: 4B
Aluminum box with liner: 4B
Natural wood box: 4C1
Natural wood box, sift proof: 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H1
Solid plastic box: 4H2
Bag, woven plastic: 5H1, 5H2 or 5H3
Bag, plastic film: 5H4
Bag, textile: 5L1, 5L2 or 5L3
Bag, paper, multiwall, water resistant: 5M2
Plastic receptacle in steel, aluminum, plywood fiber or plastic drum: 6HA1, 6HB1, 6HD1, 6HG1 or 6HH1
Plastic receptacle in steel aluminum, wood, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum, plywood or fiber drum: 6PA1, 6PB1, 6PD1 or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2,

6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in expanded or solid plastic packaging: 6PH1 or 6PH2

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-241, 59 FR 67511, 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997]

§173.213 Non-bulk packagings for solid hazardous materials in Packing Group III.

(a) When §172.101 of this subchapter specifies that a solid hazardous material be packaged under this section, only non-bulk packagings prescribed in this section may be used for its transportation. Each package must conform to the general packaging requirements of subpart B of part 173, to the requirements of part 178 of this subchapter at the Packing Group I, II or III performance level, and to the requirements of the special provisions of column 7 of the §172.101 table.

(b) The following combination packagings are authorized:

Outer packagings:
Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Metal drum other than steel or aluminum: 1N1 or 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Wooden barrel: 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Solid plastic box: 4H2

Inner packagings:
Glass or earthenware receptacles
Plastic receptacles
Metal receptacles
Glass ampoules

(c) The following single packagings are authorized:

Steel drum: 1A1 or 1A2
Aluminum drum: 1B1 or 1B2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H1 or 1H2
Metal drum other than steel or aluminum: 1N1 or 1N2
Wooden barrel: 2C1 or 2C2
Steel jerrican: 3A1 or 3A2
Plastic jerrican: 3H1 or 3H2
Aluminum jerrican: 3B1 or 3B2
Steel box with liner: 4A
Steel box: 4A
Aluminum box with liner: 4B
Natural wood box: 4C1
Natural wood box, sift proof: 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H1
Solid plastic box: 4H2
Bag, woven plastic: 5H1, 5H2 or 5H3
Bag, plastic film: 5H4
Bag, textile: 5L1, 5L2 or 5L3
Bag, paper, multiwall, water resistant: 5M2
Plastic receptacle in steel, aluminum, plywood, fiber or plastic drum: 6HA1, 6HB1, 6HD1, 6HG1 or 6HH1
Plastic receptacle in steel, aluminum, wooden, plywood or fiberboard box: 6HA2, 6HB2, 6HC, 6HD2 or 6HG2
Glass, porcelain or stoneware in steel, aluminum, plywood or fiber drum: 6PA1, 6PB1, 6PD1 or 6PG1
Glass, porcelain or stoneware in steel, aluminum, wooden or fiberboard box: 6PA2, 6PB2, 6PC or 6PG2
Glass, porcelain or stoneware in expanded or solid plastic packaging: 6PH1 or 6PH2

[Amdt. 173-224, 55 FR 52634, Dec. 21, 1990, as amended by Amdt. 173-241, 59 FR 67511, 67518, Dec. 29, 1994; Amdt. 173-261, 62 FR 24734, May 6, 1997]

§173.214 Packagings which require approval by the Associate Administrator for Hazardous Materials Safety.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, packagings and method of shipment must be approved by the Associate Administrator for Hazardous Materials Safety prior to the first shipment.

§173.216 Asbestos, blue, brown or white.
(a) Asbestos, blue, brown or white, includes each of the following hydrated mineral silicates: chrysolite, crocidolite, amosite, anthophyllite asbestos, tremolite asbestos, actinolite asbestos, and every product containing any of these materials.
(b) Asbestos which is immersed or fixed in a natural or artificial binder material (such as cement, plastic, asphalt, resins or mineral ore), and manufactured products containing asbestos are not subject to the requirements of this subchapter.
(c) Packagings for asbestos must conform to the general packaging requirements of subpart B of this part but need not conform to the requirements of part 178 of this subchapter. Asbestos must be offered for transportation and transported in-
(1) Rigid, leaktight packagings, such as metal, plastic or fiber drums, portable tanks, hopper-type rail cars, or hopper-type motor vehicles;
(2) Bags or other non-rigid packagings in closed freight containers, motor vehicles, or rail cars that are loaded by and for the exclusive use of the consignor and unloaded by the consignee;
(3) Bags or other non-rigid packagings which are dust and sift-proof. When transported by other than private carrier by highway, such packagings containing asbestos must be palletized and unitized by methods such as shrink-wrapping in plastic film or wrapping in fiberboard secured by strapping. Pallets need not be used during transportation by vessel for loads with slings that are unitized by methods such as shrink-wrapping, if the slings adequately and evenly support the loads and the unitizing method prevents shifting of the bags or other non-rigid packagings during conditions normally incident to transportation; or
(4) Bags or other non-rigid packagings which are dust and sift-proof in strong outside fiberboard or wooden boxes.

§173.217 Carbon dioxide, solid (dry ice).
(a) Carbon dioxide, solid (dry ice), when offered for transportation or transported by aircraft or water, must be packed in packagings designed and constructed to permit the release of carbon dioxide gas to prevent a build-up of pressure that could rupture the packagings. Packagings must conform to the general packaging requirements of subpart B of this part but need not conform to the requirements of part 178 of this subchapter. For each shipment by air exceeding 2.3 kg (5 lbs) per package, advance arrangements must be made between the shipper and each carrier.
(b) Railroad cars and motor vehicles containing solid carbon dioxide, when accepted for transportation on board ocean vessels, must be conspicuously marked on two sides "WARNING CO_2 SOLID (DRY ICE)."
(c) Other packagings containing solid carbon dioxide, when offered or accepted for transportation on board ocean vessels, must be marked "CARBON DIOXIDE, SOLID-

DO NOT STOW BELOW DECKS."
(d) Not more than 200 kg (441 pounds) of solid carbon dioxide may be transported in any one cargo compartment or bin on any aircraft except by specific and special written arrangement between the shipper and the aircraft operator.
(e) Carbon dioxide, solid (dry ice) is excepted from the shipping paper and certification requirements of this subchapter if the requirements of paragraphs (a) and (d) of this section are complied with and the package is marked "Carbon dioxide, solid" or "Dry ice" and marked with an indication that the material being refrigerated is used for diagnostic or treatment purposes (e.g., frozen medical specimens).

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended by Amdt. 173-138, 59 FR 49133, Sept. 26, 1994]

§173.218 Fish meal or fish scrap.

(a) Except as provided in paragraph (b) of this section, fish meal or fish scrap, containing at least 6 percent but not more than 12 percent water, is authorized for transportation by water only when packaged as follows:
(1) Burlap (jute) bag;
(2) Multi-wall paper bag;
(3) Polyethylene-lined burlap or paper bag;
(4) Cargo tank;
(5) Portable tank;
(6) Rail car; or
(7) Freight container.
(b) Fish meal or fish scrap may not be offered for transportation if the temperature of the material exceeds 49 ^{o}C (120 ^{o}F).
(c) When fish scrap or fish meal is offered for transportation by vessel in bulk in freight containers, the fish meal must contain at least 100 ppm of anti-oxident (ethoxyquin) at the time of shipment.

§173.219 Life-saving appliances.

(a) A life-saving appliance, self-inflating or non-self-inflating, containing small quantities of hazardous materials which are required as part of the life-saving appliance must conform to the requirements of this section. Packagings must conform to the general packaging requirements of subpart B of this part but need not conform to the requirements of part 178 of this subchapter.
(b) Hazardous materials therein must be packaged as follows:
(1) Nonflammable compressed gases must be packaged in cylinders in accordance with the requirements of this subchapter;
(2) Smoke and illumination signal flares must be in plastic or fiberboard receptacles;

(3) Strike-anywhere matches must be cushioned to prevent movement or friction in a cylindrical metal or composition receptacle with a screw-type closure;
(4) Flammable liquids must be in strong inner packagings in a repair kit; and
(5) Limited quantities of other hazardous materials are permitted if packaged in accordance with the requirements of this subchapter.
(c) Materials therein not subject to the requirements of this subchapter which are an integral part of the life-saving appliance must be packaged in a strong fiberglass kit case which is overpacked in a waterproof fiberboard packaging, or be packaged in other strong outer packagings.

§173.220 Internal combustion engines, self-propelled vehicles, mechanical equipment containing internal combustion engines, and battery powered vehicles or equipment.
(a) *Applicability. An internal combustion engine, self-propelled vehicle, mechanized equipment containing an internal combustion engine, or a battery powered vehicle or equipment is subject to the requirements of this subchapter when transported as cargo on a transport vehicle, vessel, or aircraft if-*
(1) The engine or fuel tank contains a liquid or gaseous fuel. An engine may be considered as not containing fuel when the fuel tank, engine components, and fuel lines have been completely drained, sufficiently cleaned of residue, and purged of vapors to remove any potential hazard and the engine when held in any orientation will not release any liquid fuel;
(2) It is equipped with a wet electric storage battery other than a non-spillable battery; or
(3) Except as provided in paragraph (d)(1) of this section, it contains other hazardous materials subject to the requirements of this subchapter.
(b) *Requirements. Unless otherwise excepted in paragraph (b)(4) of this section, vehicles, engines and equipment are subject to the following requirements:*
(1) Flammable liquid fuel. A fuel tank containing a flammable liquid fuel must be drained and securely closed, except that up to 500 ml (17 ounces) of residual fuel may remain in the tank, engine components, or fuel lines provided they are securely closed to prevent leakage of fuel during transportation. Self-propelled vehicles containing diesel fuel are excepted from the requirement to drain the fuel tanks, provided that sufficient ullage space has been left inside the tank to allow fuel expansion without leakage, and the tank caps are securely closed.
(2) Flammable liquefied or compressed gas fuel. Fuel tanks and fuel systems containing flammable liquefied or compressed gas fuel must be securely closed. For transportation by water, the requirements of §176.78(k) and 176.905 of this subchapter apply. For transportation by air, the fuel tank and fuel system must be emptied and securely closed or must be removed, packaged and transported in accordance the requirements of this subchapter.
(3) Truck bodies or trailers on flat cars-flammable liquid or gas powered. Truck bodies or trailers with automatic heating or refrigerating equipment of the flammable liquid type

may be shipped with fuel tanks filled and equipment operating or inoperative, when used for the transportation of other freight and loaded on flat cars as part of a joint rail and highway movement, provided the equipment and fuel supply conform to the requirements of §177.834(l) of this subchapter.
(4) Modal exceptions. Quantities of flammable liquid fuel greater than 500 ml (17 ounces) may remain in self-propelled vehicles and mechanical equipment only under the following conditions:
(i) For transportation by motor vehicle or rail car, the fuel tanks must be securely closed.
(ii) For transportation by vessel, the shipment must conform to §176.905 of this subchapter.
(iii) For transportation by aircraft designed or modified for vehicle ferry operations, the shipment must conform to §175.305 of this subchapter.
(c) *Wet battery powered or installed. Wet batteries must be securely installed and fastened in an upright position. Batteries must be protected against short circuits and leakage or removed and packaged separately under §173.159. Battery powered vehicles, machinery or equipment including battery powered wheelchairs and mobility aids are excepted from the requirements of this subchapter when transported by rail, highway or vessel.*
(d) Other hazardous materials. (1) Items of equipment containing hazardous materials, fire extinguishers, compressed gas accumulators, safety devices and other hazardous materials which are integral components of the motor vehicle, engine or mechanical equipment and are necessary for the operation of the vehicle, engine or equipment, or for the safety of its operator or passengers must be securely installed in the motor vehicle, engine or mechanical equipment. Such items are not otherwise subject to the requirements of this subchapter.
(2) Other hazardous materials must be packaged and transported in accordance with the requirements of this subchapter.
(e) *Exceptions. Except as provided in paragraph (d)(2) of this section, shipments made under the provisions of this section-*
(1) Are not subject to any other requirements of this subchapter, for transportation by motor vehicle or rail car; and
(2) Are not subject to the requirements of subparts D, E and F (marking, labeling and placarding, respectively) of part 172 of this subchapter or §172.604 of this subchapter (emergency response telephone number) for transportation by vessel or aircraft. For transportation by aircraft, all other applicable requirements of this subchapter, including shipping papers, emergency response information, notification of pilot-in-command, general packaging requirements, and the requirements specified in §173.27 must be met. For transportation by vessel, additional exceptions are specified in §176.905 of this subchapter.

[64 FR 10778, Mar. 5, 1999]

§173.221 Polymeric beads, expandable and Plastic molding compound.

(a) Non-bulk shipments of Polymeric beads (or granules), expandable, *evolving flammable vapor and Plastic molding compound in dough, sheet or extruded rope form, evolving flammable vapor must be packed in: wooden (4C1 or 4C2), plywood (4D), fiberboard (4G), reconstituted wood (4F) boxes, plywood drums (1D) or fiber drums (1G) with sealed inner plastic liners; in vapor tight metal or plastic drums (1A1, 1A2, 1B1, 1B2, 1H1 or 1H2); or packed in non-specification packagings when transported in dedicated vehicles or freight containers. The packagings need not conform to the requirements for package testing in part 178 of this subchapter, but must be capable of containing any evolving gases from the contents during normal conditions of transportation.*

(b) Bulk shipments of Polymeric beads (or granules), expandable, evolving flammable vapor or Plastic molding compounds in dough, sheet or extruded rope, evolving flammable vapor may be packed in non-specification bulk packagings. Except for transportation by highway and rail, bulk packagings must be capable of containing any gases evolving from the contents during normal conditions of transportation.

[64 FR 10779, Mar. 5, 1999]

§173.222 Dangerous goods in equipment, machinery or apparatus.

Hazardous materials in machinery or apparatus are excepted from the specification packaging requirements of this subchapter when packaged according to this section. Hazardous materials in machinery or apparatus must be packaged in strong outer packagings, unless the receptacles containing the hazardous materials are afforded adequate protection by the construction of the machinery or apparatus. Each package must conform to the packaging requirements of subpart B of this part, except for the requirements in §§173.24(a)(1) and 173.27(e), and the following requirements:

(a) If the equipment, machinery or apparatus contains more than one hazardous material, the materials must not be capable of reacting dangerously together.

(b) The nature of the containment must be as follows-

(1) Damage to the receptacles containing the hazardous materials during transport is unlikely. However, in the event of damage to the receptacles containing the hazardous materials, no leakage of the hazardous materials from the equipment, machinery or apparatus is possible. A leakproof liner may be used to satisfy this requirement.

(2) Receptacles containing hazardous materials must be secured and cushioned so as to prevent their breakage or leakage and so as to control their movement within the equipment, machinery or apparatus during normal conditions of transportation. Cushioning material must not react dangerously with the content of the receptacles. Any leakage of the contents must not substantially impair the protective properties of the cushioning material.

(3) Receptacles for gases, their contents and filling densities must conform to the applicable requirements of this subchapter, unless otherwise approved by the Associate

Administrator for Hazardous Materials Safety.

(c) The total net quantity of hazardous materials contained in one item of equipment, machinery or apparatus must not exceed the following:

(1) 1 kg (2.2 pounds) in the case of solids;

(2) 0.5 L (0.3 gallons) in the case of liquids;

(3) 0.5 kg (1.1 pounds) in the case of Division 2.2 gases; and

(4) A total quantity of not more than the aggregate of that permitted in paragraphs (c)(1) through (c)(3) of this section, for each category of material in the package, when a package contains hazardous materials in two or more of the categories in paragraphs (c)(1) through (c)(3) of this section.

(d) When a package contains hazardous materials in two or more of the categories listed in paragraphs (c)(1) through (c)(3) of this section, the total quantity required by §172.202(c) of this subchapter to be entered on the shipping paper, must be the aggregate quantity of all hazardous materials, expressed as net mass.

[64 FR 10779, Mar. 5, 1999, as amended at 64 FR 44428, Aug. 16, 1999]

§173.224 Packaging and control and emergency temperatures for self-reactive materials.

(a) *General. When the §172.101 table of this subchapter specifies that a Division 4.1 material be packaged in accordance with this section, only packagings which conform to the provisions of this section may be used. Each packaging must conform to the general packaging requirements of subpart B of this part and the applicable requirements of part 178 of this subchapter. Non-bulk packagings must meet Packing Group II performance levels. To avoid unnecessary confinement, metallic non-bulk packagings meeting Packing Group I are not authorized. Self-reactive materials which require temperature control are subject to the provisions of §173.21(f). Packagings required to bear a Class 1 subsidiary label must conform to §§173.60 through 173.62.*

(b) Self-Reactive Materials Table. The Self-Reactive Materials Table specifies, by technical name, those self-reactive materials that are authorized for transportation and not subject to the approval provisions of §173.124(a)(2)(iii). A self-reactive material identified by technical name in the following table is authorized for transportation only if it conforms to all applicable provisions of the table. The column headings of the Self-Reactive Materials Table are as follows:

(1) Technical name. Column 1 specifies the technical name.

(2) ID number. Column 2 specifies the identification number which is used to identify the proper shipping name in the §172.101 table.

(3) Concentration of self-reactive material. Column 3 specifies the concentration (percent) limitations, if any, in mixtures or solutions for the self-reactive material. Limitations are given as minimums, maximums, or a range, as appropriate. A range includes the lower and upper limits (i.e., "53-100" means from, and including, 53 percent to, and including 100 percent).

(4) Packing method. Column 4 specifies the highest packing method which is authorized for the self-reactive material. A packing method corresponding to a smaller package size may be used, but a packing method corresponding to a larger package size may not be used. The Table of Packing Methods in §173.225(d) defines the packing methods. Additional bulk packagings are authorized in paragraph (d) of this section for Type F self-reactive materials.

(5) Control temperature. Column 5 specifies the control temperature in °C. Temperatures are specified only when temperature controls are required (see §173.21(f)).

(6) Emergency temperature. Column 6 specifies the emergency temperature in °C. Temperatures are specified only when temperature controls are required (see §173.21(f)).

(7) Notes. Column 7 specifies other applicable provisions, as set forth in notes following the table.

Self-Reactive Substances

Self-reactive substance	Identification No.	Concentration-(%)	Packing method	Control temperature-(C)	Emergency temperature	Notes
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Azodicarbonamide formulation type B, temperature controlled	3232	<100	OP5	-	-	1
Azodicarbonamide formulation type C	3224	<100	OP6	-	-	-
Azodicarbonamide formulation type C, temperature controlled	3234	<100	OP6	-	-	1
Azodicarbonamide formulation type D	3226	<100	OP7	-	-	-
Azodicarbonamide formulation type D, temperature controlled	3236	<100	OP7	-	-	1
2,2'-Azodi(2,4-dimethyl-4-methoxyvaleronitrile)	3236	100	OP7	-5	+5	-
2,2'-Azodi(2,4-dimethylvaleronitrile)	3236	100	OP7	+10	+15	-
2,2'-Azodi(ethyl 2-methylpropionate)	3235	100	OP7	+20	+25	-
1,1-Azodi(hexahydrobenzonitrile)	3226	100	OP7	-	-	-
2,2-Azodi(isobutyronitrile)	3234	100	OP6	+40	+45	-
2,2-Azodi(2-methylbutyronitrile)	3236	100	OP7	+35	+40	-
Benzene-1,3-disulphohydrazide, as a paste	3226	52	OP7	-	-	-
Benzene sulphohydrazide	3226	100	OP7	-	-	-
4-(Benzyl(ethyl)amino)-3-ethoxybenzenediazonium zinc chloride	3226	100	OP7	-	-	-
4-(Benzyl(methyl)amino)-3-ethoxybenzenediazonium zinc chloride	3236	100	OP7	+40	+45	-
3-Chloro-4-diethylaminobenzenediazonium zinc chloride	3226	100	OP7	-	-	-
2-Diazo-1-Naphthol-4-sulphochloride	3222	100	OP5	-	-	-
2-Diazo-1-Naphthol-5-sulphochloride	3222	100	OP5	-	-	-
2,5-Diethoxy-4-morpholinobenzenediazonium zinc chloride	3236	67-100	OP7	+35	+40	-
2,5-Diethoxy-4-morpholinobenzenediazonium zinc chloride	3236	66	OP7	+40	+45	-
2,5-Diethoxy-4-morpholinobenzenediazonium tetrafluoroborate	3236	100	OP7	+30	+35	-
2,5-Diethoxy-4-(phenylsulphonyl)benzenediazonium zinc chloride	3236	67	OP7	+40	+45	-
Diethylene glycol bis(allyl carbonate) + Diisopropylperoxydicarbonate	3237	"88+ >12	OP8	-10	0	-
2,5-Dimethoxy-4-(4-methylphenylsulphony)benzenediazonium zinc chloride	3236	79	OP7	+40	+45	-

4-Dimethylamino-6-(2-dimethylaminoethoxy)toluene-2-diazonium zinc chloride	3236	100	OP7	+40	+45	-
N,N'-Dinitroso-N, N'-dimethyl-terephthalamide, as a paste	3224	72	OP6	-	-	-
N,N'-Dinitrosopentamethylenetetramine	3224	82	OP6	-	-	2
Diphenyloxide-4,4'-disulphohydrazide	3226	100	OP7	-	-	-
4-Dipropylaminobenzenediazonium zinc chloride	3226	100	OP7	-	-	-
2-(N,N-Ethoxycarbonylphenylamino)-3-methoxy-4-(N-methyl-N-cyclohexylamino)benzenediazonium zinc chloride	3236	63-92	OP7	+40	+45	-
2-(N,N-Ethoxycarbonylphenylamino)-3-methoxy-4-(N-methyl-N-cyclohexylamino)benzenediazonium zinc chloride	3236	62	OP7	+35	+40	-
N-Formyl-2-(nitromethylene)-1,3-perhydrothiazine	3236	100	OP7	+45	+50	-
2-(2-Hydroxyethoxy)-1-(pyrrolidin-1-yl)benzene-4-diazonium zinc chloride	3236	100	OP7	+45	+50	-
3-(2-Hydroxyethoxy)-4-(pyrrolidin-1-yl)benzenediazonium zinc chloride	3236	100	OP7	+40	+45	-
2-(N,N-Methylaminoethylcarbonyl)-4-(3,4-dimethyl-phenylsulphonyl)benzene diazonium zinc chloride	3236	96	OP7	+45	+50	-
4-Methylbenzenesulphonylhydrazide	3226	100	OP7	-	-	-
3-Methyl-4-(pyrrolidin-1-yl)benzenediazonium tetrafluoroborate	3234	95	OP6	+45	+50	-
4-Nitrosophenol	3236	100	OP7	+35	+40	-
Self-reactive liquid, sample	3223	-	OP2	-	-	3
Self-reactive liquid, sample, temperature control	3233	-	OP2	-	-	3
Self-reactive solid, sample	3224	-	OP2	-	-	3
Self-reactive solid, sample, temperature control	3234	-	OP2	-	-	3
Sodium 2-diazo-1-naphthol-4-sulphonate	3226	100	OP7	-	-	-
Sodium 2-diazo-1-naphthol-5-sulphonate	3226	100	OP7	-	-	-
Tetramine palladium (II) nitrate	3234	100	OP6	+30	+35	-

NOTES:

1. THE EMERGENCY AND CONTROL TEMPERATURES MUST BE DETERMINED IN ACCORDANCE WITH §173.21(F).

2. WITH A COMPATIBLE DILUENT HAVING A BOILING POINT OF NOT LESS THAN 150 C.

3. SAMPLES MAY ONLY BE OFFERED FOR TRANSPORTATION UNDER THE PROVISIONS OF PARAGRAPH(C)(4) OF THIS SECTION.

(c) *New self-reactive materials, formulations and samples. (1) Except as provided for samples in paragraph (c)(3) of this section, no person may offer, accept for transportation, or transport a self-reactive material which is not identified by technical name in the Self-Reactive Materials Table of this section, or a formulation of one or more self-reactive materials which are identified by technical name in the table, unless the self-reactive material is assigned a generic type and shipping description and is approved by the Associate Administrator for Hazardous Materials Safety under the provisions of §173.124(a)(2)(iii).*

(2) Except as provided by an approval issued under §173.124(a)(2)(iii), intermediate bulk and bulk packagings are not authorized.

(3) *Samples. Samples of new self-reactive materials or new formulations of self-reactive materials identified in the Self-Reactive Materials Table in paragraph (b) of this section, for which complete test data are not available, and which are to be transported*

for further testing or product evaluation, may be assigned an appropriate shipping description for Self-reactive materials Type C, packaged and offered for transportation under the following conditions:

(i) Data available to the person offering the material for transportation must indicate that the sample would pose a level of hazard no greater than that of a self-reactive material Type B and that the control temperature, if any, is sufficiently low to prevent any dangerous decomposition and sufficiently high to prevent any dangerous phase separation;

(ii) The sample must be packaged in accordance with packing method OP2;

(iii) Packages of the self-reactive material may be offered for transportation and transported in a quantity not to exceed 10 kg (22 pounds) per transport vehicle; and

(iv) One of the following shipping descriptions must be assigned:

(A) Self-reactive, liquid, type C, 4.1, UN3223.

(B) Self-reactive, solid, type C, 4.1, UN3224.

(C) Self-reactive, liquid, type C, temperature controlled, 4.1, UN3233.

(D) Self-reactive, solid, type C, temperature controlled, 4.1, UN3234.

(d) Self-reactive substances of Type F may not be transported in bulk or intermediate bulk containers except as approved, in writing, by the Associate Administrator for Hazardous Materials Safety.

[Amdt. 173-241, 59 FR 67511, Dec. 29, 1994, as amended by Amdt. 173-242, 60 FR 26806, May 18, 1995; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; Amdt. 173-256, 61 FR 51338, Oct. 1, 1996; Amdt. 173-261, 62 FR 24734, 24735, May 6, 1997; 62 FR 45702, Aug. 28, 1997; 64 FR 10779, Mar. 5, 1999]

§173.225 Packaging requirements and other provisions for organic peroxides.

(a) *General. When the §172.101 table specifies that an organic peroxide be packaged under this section, the organic peroxide must be packaged and offered for transportation in accordance with the provisions of this section. Each packaging must conform to the general requirements of subpart B of part 173 and to the applicable requirements of part 178 of this subchapter. Non-bulk packagings must meet Packing Group II performance levels. To avoid unnecessary confinement, metallic non-bulk packagings meeting Packing Group I are not authorized. No used material, other than production residues or regrind from the same production process, may be used in plastic packagings. Organic peroxides which require temperature control are subject to the provisions of §173.21(f).*

(b) Organic peroxides table. The following Organic Peroxides Table specifies, by technical name, those organic peroxides that are authorized for transportation and not subject to the approval provisions of §173.128 of this part. An organic peroxide identified by technical name in the following table is authorized for transportation only if it conforms to all applicable provisions of the table. For an organic peroxide not identified in the table by technical name or a formulation of identified organic peroxides, the provisions of paragraph (c) of §173.128 apply. The column headings of the Organic Peroxides table are as follows:

(1) Technical name. The first column specifies the technical name.

(2) ID number. The second column specifies the identification (ID) number which is used to identify the proper shipping name in the §172.101 table. The word "EXEMPT" appearing in the column denotes that the material is not regulated as an organic peroxide.

(3) Concentration of organic peroxide. The third column specifies concentration (mass percent) limitations, if any, in mixtures or solutions for the organic peroxide. Limitations are given as minimums, maximums, or a range, as appropriate. A range includes the lower and upper limits (i.e., "53-100" means from, and including, 53 percent to, and including 100 percent).

(4) Concentration of diluents. The fourth column specifies the type and concentration (mass percent) of diluent or inert solid, when required. Other types and concentrations of diluents may be authorized if approved by the Associate Administrator for Hazardous Materials Safety.

(i) The required mass percent of "Diluent type A" is specified in column 4a. A diluent type A is an organic liquid that does not detrimentally affect the thermal stability or increase the hazard of the organic peroxide and with a boiling point not less than 150 ^{o}C at atmospheric pressure. Type A diluents may be used for desensitizing all organic peroxides.

(ii) The required mass percent of "Diluent type B" is specified in column 4b. A diluent type B is an organic liquid which is compatible with the organic peroxide and which has a boiling point, at atmospheric pressure, of less than 150 ^{o}C (302 ^{o}F) but at least 60 ^{o}C (140 ^{o}F), and a flash point greater than 5 ^{o}C (41 ^{o}F). Type B diluents may be used for desensitizing all organic peroxides provided that the boiling point is at least 60 ^{o}C (140 ^{o}F) above the SADT of the peroxide in a 50 kg (110 lbs) package. A type A diluent may be used to replace a type B diluent in equal concentration.

(iii) The required mass percent of "Inert solid" is specified in column 4c. An inert solid is a solid that does not detrimentally affect the thermal stability or increase the hazard of the organic peroxide.

(5) *Concentration of water. Column 5 specifies, in mass percent, the minimum amount of water, if any, which must be in formulation.*

(6) Packing method. Column 6 specifies the highest packing method (largest packaging capacity) authorized for the organic peroxide. Lower numbered packing methods (smaller packaging capacities) are also authorized. For example, if OP3 is specified, then OP2 and OP1 are also authorized. When an IBC or bulk packaging is authorized and meets the requirements of paragraph (e) of this section, lower control temperatures than those specified for non-bulk packagings are required. The Table of Packing Methods in paragraph (d) of this section defines the non-bulk packing methods.

(7) Temperatures. Column 7a specifies the control temperature. Column 7b specifies the emergency temperature. Temperatures are specified only when temperature controls are required. (See §173.21(f)).

(8) Notes. Column 8 specifies other applicable provisions, as set forth in notes

following the table.

Organic Peroxide Table

Technical name	ID number	Concentration (mass %)	Diluent (mass %)			Water (mass %)	Packing method	Temperature (C)		Notes
-	-	-	A	B	I	-	-	Control	Emergency	-
(1)	(2)	(3)	(4a)	(4b)	(4c)	(5)	(6)	(7a)	(7b)	(8)
Acetyl acetone peroxide	UN3105	>42	"48	-	-	"8	OP7	-	-	2
Acetyl acetone peroxide [as a paste]	UN3106	>32	-	-	-	-	OP7	-	-	21
Acetyl benzoyl peroxide	UN3105	>45	"55	-	-	-	OP7	-	-	-
Acetyl cyclohexanesulfonyl peroxide	UN3112	>82	-	-	-	"12	OP4	-10	0	-
Acetyl cyclohexanesulfonyl peroxide	UN3115	>32	-	"68	-	-	OP7	-10	0	-
tert-Amyl hydroperoxide	UN3107	>88	"6	-	-	"6	OP8	-	-	-
tert-Amyl peroxyacetate	UN3107	>62	"38	-	-	-	OP8	-	-	-
tert-Amyl peroxybenzoate	UN3105	>96	"4	-	-	-	OP7	-	-	-
tert-Amyl peroxy-2-ethylhexanoate	UN3115	>100	-	-	-	-	OP7	+20	+25	-
tert-Amyl peroxy-2-ethylhexyl carbonate	UN3105	>100	-	-	-	-	OP7	-	-	-
tert-Amyl peroxyneodecanoate	UN3115	>77	-	"23	-	-	OP7	0	+10	-
tert-Amyl peroxypivalate	UN3113	>77	-	"23	-	-	OP5	+10	+15	-
tert-Amylperoxy-3,5,5-trimethylhexanoate	UN3101	>100	-	-	-	-	OP5	-	-	-
tert-Butyl cumyl peroxide	UN3105	>42-100	-	-	-	-	OP7	-	-	1, 9
tert-Butyl cumyl peroxide	UN3106	>42	-	-	"58	-	OP7	-	-	1, 9
n-Butyl-4,4-di-(tert- butylperoxy)valerate	UN3103	>52-100	-	-	-	-	OP5	-	-	-
n-Butyl-4,4-di-(tert- butylperoxy)valerate	UN3106	>52	-	-	"48	-	OP7	-	-	-
n-Butyl-4,4-di-(tert- butylperoxy)valerate	UN3108	>42	-	-	"58	-	OP8	-	-	-
tert-Butyl hydroperoxide	UN3103	>79-90	-	-	-	"10	OP5	-	-	13
tert-Butyl hydroperoxide	UN31	>80	"20	-	-	-	OP7	-	-	4, 13

	05									
tert-Butyl hydroperoxide	UN3107	>79	-	-	-	>14	OP8	-	-	13, 16
tert-Butyl hydroperoxide	UN3109	>72	-	-	-	"28	OP8	-	-	7, 13
tert-Butyl hydroperoxide [and] Di- tert-butylperoxide	UN3103	<82+>9	-	-	-	"7	OP5	-	-	13
tert-Butyl monoperoxymaleate	UN3102	>52-100	-	-	-	-	OP5	-	-	-
tert-Butyl monoperoxymaleate	UN3103	>52	"48	-	-	-	OP6	-	-	-
tert-Butyl monoperoxymaleate	UN3108	>52	-	-	"48	-	OP8	-	-	-
tert-Butyl monoperoxymaleate [as a paste]	UN3108	>52	-	-	-	-	OP8	-	-	-
tert-Butyl monoperoxymaleate [as a paste]	UN3110	>42	-	-	-	-	OP8	-	-	7
tert-Butyl monoperoxyphthalate	UN3102	>100	-	-	-	-	OP5	-	-	-
tert-Butyl peroxyacetate	UN3101	>52-77	"23	-	-	-	OP5	-	-	-
tert-Butyl peroxyacetate	UN3103	>32-52	"48	-	-	-	OP6	-	-	-
tert-Butyl peroxyacetate	UN3109	>32	"68	-	-	-	OP8	-	-	10
tert-Butyl peroxyacetate	UN3119	>32	-	"68	-	-	Bulk	+30	+35	7
tert-Butyl peroxyacetate	UN3109	>22	-	"78	-	-	OP8	-	-	14
tert-Butyl peroxybenzoate	UN3103	>77-100	>23	-	-	-	OP5	-	-	-
tert-Butyl peroxybenzoate	UN3105	>52-77	"23	-	-	-	OP7	-	-	1
tert-Butyl peroxybenzoate	UN3106	>52	-	-	>48	-	OP7	-	-	-
tert-Butyl peroxybutyl fumarate	UN3105	>52	"48	-	-	-	OP7	-	-	-
tert-Butyl peroxycrotonate	UN3105	>77	"23	-	-	-	OP7	-	-	-
tert-Butyl peroxydiethylacetate	UN3113	>100	-	-	-	-	OP5	+20	+25	-
tert-Butyl peroxydiethylacetate [and] tert-Butyl peroxybenzoate	UN3105	>33+>33	"33	-	-	-	OP7	-	-	-
tert-Butyl peroxy-2-ethylhexanoate	UN3113	>52-100	-	-	-	-	OP6	+20	+25	-
tert-Butyl peroxy-2-ethylhexanoate	UN3117	>32-52	-	"48	-	-	OP8	+30	+35	-
tert-Butyl peroxy-2-ethylhexanoate	UN3118	>52	-	-	"48	-	OP8	+20	+25	-
tert-Butyl peroxy-2-ethylhexanoate	UN3119	>32	-	"68	-	-	OP8	+40	+45	-
tert-Butyl peroxy-2-ethylhexanoate	UN3119	>32	-	"68	-	-	IBC	+30	+35	10
tert-Butyl peroxy-2-ethylhexanoate	UN3119	>32	-	"68	-	-	Bulk	+10	+15	14
tert-Butyl peroxy-2-ethylhexanoate [and] 2,2-di-	UN31	>31+>	-	"33	-	-	OP7	+3	+4	-

(tert-Butylperoxy)butane	15	36						5	0	
tert-Butyl peroxy-2-ethylhexanoate [and] 2,2-di-(tert-Butylperoxy)butane	UN3106	>12+>14	"14	-	"60	-	OP7	-	-	-
tert-Butyl peroxy-2- ethylhexylcarbonate	UN3105	>100	-	-	-	-	OP7	-	-	-
tert-Butyl peroxyisobutyrate	UN3111	>52-77	-	"23	-	-	OP5	+15	+20	-
tert-Butyl peroxyisobutyrate	UN3115	>52	-	"48	-	-	OP7	+15	+20	-
tert-Butylperoxy isopropylcarbonate	UN3103	>77	"23	-	-	-	OP5	-	-	-
1-(2-	-	-	-	-	-	-	-	-	-	-
tert-Butylperoxy isopropyl)-3-isopropenylbenzene	UN3105	>77	"23	-	-	-	OP7	-	-	-
1-(2-	-	-	-	-	-	-	-	-	-	-
tert-Butylperoxy isopropyl)-3-isopropenylbenzene	UN3108	>42	-	-	"58	-	OP8	-	-	-
tert-Butyl peroxy-2-methylbenzoate	UN3103	>100	-	-	-	-	OP5	-	-	-
tert-Butyl peroxyneodecanoate	UN3115	>77-100	-	-	-	-	OP7	-5	+5	-
tert-Butyl peroxyneodecanoate	UN3115	>77	-	"23	-	-	OP7	0	+10	-
tert-Butyl peroxyneodecanoate [as a stable dispersion in water]	UN3117	>42	-	-	-	-	OP8	0	+10	-
tert-Butyl peroxyneodecanoate [as a stable dispersion in water (frozen)]	UN3118	>42	-	-	-	-	OP8	0	+10	-
tert-Butyl peroxyneoheptanoate	UN3115	>77	"23	-	-	-	OP7	+10	+15	-
3-tert-Butylperoxy-3-phenylphthalide	UN3106	>100	-	-	-	-	OP7	-	-	-
tert-Butyl peroxypivalate	UN3113	>67-77	"23	-	-	-	OP5	0	+10	-
tert-Butyl peroxypivalate	UN3115	>67	-	"33	-	-	OP7	0	+10	-
tert-Butyl peroxypivalate	UN3119	>27	-	"73	-	-	OP8	+30	+35	-
tert-Butyl peroxypivalate	UN3119	>27	-	"73	-	-	IBC	+10	+15	10
tert-Butyl peroxypivalate	UN3119	>27	-	"73	-	-	Bulk	-5	+5	14
tert-Butylperoxy stearylcarbonate	UN3106	>100	-	-	-	-	OP7	-	-	-
tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3105	>32-100	-	-	-	-	OP7	-	-	-
tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3109	>32	"68	-	-	-	OP8	-	-	10
tert-Butyl peroxy-3,5,5-trimethylhexanoate	UN3119	>32	-	"68	-	-	Bulk	+35	+40	14
3-Chloroperoxybenzoic acid	UN3102	>57-86	-	-	"14	-	OP1	-	-	-
3-Chloroperoxybenzoic acid	UN3106	>77	-	-	"6	"17	OP7	-	-	-
3-Chloroperoxybenzoic acid	UN3106	>57	-	-	"3	"40	OP7	-	-	-
Cumyl hydroperoxide	UN31	>90-	>1	-	-	-	OP8	-	-	13

	07	98	0								
Cumyl hydroperoxide	UN31 09	>90	"10	-	-	-	OP8	-	-	7, 13, 15
Cumyl peroxyneodecanoate	UN31 15	>77	-	"23	-	-	OP7	-10	0	-
Cumyl peroxyneodecanoate [as a stable dispersion in water]	UN31 19	>52	-	-	-	-	OP8	-10	0	-
Cumyl peroxyneoheptanoate	UN31 15	>77	"23	-	-	-	OP7	0	+1 0	-
Cumyl peroxypivalate	UN31 15	>77	-	"23	-	-	OP7	-5	+5	-
Cyclohexanone peroxide(s)	UN31 04	>91	-	-	-	"9	OP6	-	-	13
Cyclohexanone peroxide(s)	UN31 05	>72	-	"28	-	-	OP7	-	-	5
Cyclohexanone peroxide(s) [as a paste]	UN31 06	>72	-	-	-	-	OP7	-	-	5, 21
Cyclohexanone peroxide(s)	Exem pt	>32	-	-	"68	-	Exem pt	-	-	-
Diacetone alcohol peroxides	UN31 15	>57	-	"26	-	"8	OP7	+4 0	+4 5	5
Diacetyl peroxide	UN31 15	>27	-	"73	-	-	OP7	+2 0	+2 5	8,13
Di-tert-amyl peroxide	UN31 07	>100	-	-	-	-	OP8	-	-	-
1,1-Di-(tert-amylperoxy)cyclohexane	UN31 03	>82	"18	-	-	-	OP6	-	-	-
Dibenzoyl peroxide	UN31 02	>51- 100	-	-	>4 8	-	OP2	-	-	3
Dibenzoyl peroxide	UN31 02	>77- 94	-	-	-	"6	OP4	-	-	3
Dibenzoyl peroxide	UN31 04	>77	-	-	-	"23	OP6	-	-	-
Dibenzoyl peroxide	UN31 06	>62	-	-	"28	"10	OP7	-	-	-
Dibenzoyl peroxide [as a paste]	UN31 06	>52- 62	-	-	-	-	OP7	-	-	21
Dibenzoyl peroxide [as a paste]	UN31 08	>56.5	-	-	-	"15	OP8	-	-	-
Dibenzoyl peroxide	UN31 06	>35- 52	-	-	"48	-	OP7	-	-	-
Dibenzoyl peroxide [as a paste]	UN31 08	>52	-	-	-	-	OP8	-	-	21
Dibenzoyl peroxide	UN31 07	>36- 42	"18	-	-	>40	OP8	-	-	-
Dibenzoyl peroxide	UN31 07	>36- 42	"58	-	-	-	OP8	-	-	-
Dibenzoyl peroxide [as a stable dispersion in water]	UN31 09	>42	-	-	-	-	OP8	-	-	10
Dibenzoyl peroxide	Exem pt	>35	-	-	"65	-	Exem pt	-	-	-
Dibenzyl peroxydicarbonate	UN31 12	>87	-	-	-	"13	OP5	+2 5	+3 0	-
Di-(4-tert- butylcyclohexyl)peroxydicarbonate	UN31 14	>100	-	-	-	-	OP6	+3 0	+3 5	-
Di-(4-tert- butylcyclohexyl)peroxydicarbonate [as	UN31	>42	-	-	-	-	OP8	+3	+3	10

a stable dispersion in water]	19							0	5	
Di-tert-butyl peroxide	UN3107	>32-100	-	-	-	-	OP8	-	-	-
Di-tert-butyl peroxide	UN3109	>52	-	"48	-	-	OP8	-	-	7, 24
Di-tert-butyl peroxyazelate	UN3105	>52	"48	-	-	-	OP7	-	-	-
2,2-Di-(tert-butylperoxy)butane	UN3103	>52	"48	-	-	-	OP6	-	-	-
1,1-Di-(tert-butylperoxy)cyclohexane	UN3101	>80-100	-	-	-	-	OP5	-	-	-
1,1-Di-(tert-butylperoxy)cyclohexane	UN3103	>52-80	"20	-	-	-	OP5	-	-	-
1,1-Di-(tert-butylperoxy)cyclohexane	UN3105	>52	"48	-	-	-	OP7	-	-	-
1,1-Di-(tert-butylperoxy)cyclohexane	UN3106	>42	"13	-	"45	-	OP7	-	-	-
1,1-Di-(tert-butylperoxy)cyclohexane	UN3109	>42	"58	-	-	-	OP8	-	-	10
1,1-Di-(tert-butylperoxy)cyclohexane	UN3107	>27	"36	-	-	-	OP8	-	-	22
1,1-Di-(tert-butylperoxy)cyclohexane	UN3109	>25	"25	"50	-	-	OP8	-	-	7
1,1-Di-(tert-butylperoxy)cyclohexane	UN3109	>13	"13	"74	-	-	OP8	-	-	7
Di-n-butyl peroxydicarbonate	UN3115	>27-52	-	"48	-	-	OP7	-15	-5	-
Di-n-butyl peroxydicarbonate [as a stable dispersion in water (frozen)]	UN3118	>42	-	-	-	-	OP8	-15	-5	-
Di-n-butyl peroxydicarbonate	UN3117	>27	-	"73	-	-	OP8	-10	0	-
Di-sec-butyl peroxydicarbonate	UN3113	>52-100	-	-	-	-	OP4	-20	-10	6
Di-sec-butyl peroxydicarbonate	UN3115	>52	-	"48	-	-	OP7	-15	-5	-
Di-(2-tert-butylperoxyisopropyl)benzene(s)	UN3106	>42-100	-	-	>57	-	OP7	-	-	1, 9
Di-(2-tert-butylperoxyisopropyl)benzene(s)	Exempt	>42	-	-	"58	-	Exempt	-	-	-
Di-(tert-butylperoxy)phthalate	UN3105	>42-52	"48	-	-	-	OP7	-	-	-
Di-(tert-butylperoxy)phthalate [as a paste]	UN3106	>52	-	-	-	-	OP7	-	-	21
Di-(tert-butylperoxy)phthalate	UN3107	>42	"58	-	-	-	OP8	-	-	-
2,2-Di-(tert-butylperoxy)propane	UN3105	>52	"48	-	-	-	OP7	-	-	-
2,2-Di-(tert-butylperoxy)propane	UN3106	>42	"13	-	"45	-	OP7	-	-	-
1,1-Di-(tert-butylperoxy)-3,5,5-trimethylcyclohexane	UN3101	>90-100	-	-	-	-	OP5	-	-	-
1,1-Di-(tert-butylperoxy)-3,5,5-trimethylcyclohexane	UN3103	>57-90	"10	-	-	-	OP5	-	-	-
1,1-Di-(tert-butylperoxy)-3,5,5-trimethylcyclohexane	UN3106	>57	-	-	"43	-	OP7	-	-	-
1,1-Di-(tert-butylperoxy)-3,5,5-	UN31	>57	"43	-	-	-	OP8	-	-	-

trimethylcyclohexane	07									
1,1-Di-(tert-butylperoxy)-3,5,5-trimethylcyclohexane	UN3107	>32	"26	"42	-	-	OP8	-	-	-
Dicetyl peroxydicarbonate	UN3116	>100	-	-	-	-	OP7	+30	+35	-
Dicetyl peroxydicarbonate [as a stable dispersion in water]	UN3119	>42	-	-	-	-	OP8	+30	+35	10
Di-4-chlorobenzoyl peroxide	UN3102	>77	-	-	-	"23	OP5	-	-	-
Di-4-chlorobenzoyl peroxide [as a paste]	UN3106	>52	-	-	-	-	OP7	-	-	21
Di-4-chlorobenzoyl peroxide	Exempt	>32	-	-	"68	-	Exempt	-	-	-
Dicumyl peroxide	UN3109	>52-100	-	>48	-	-	OP8	-	-	7, 9, 11
Dicumyl peroxide	UN3110	>52-100	-	-	>48	-	OP8	-	-	7, 9, 11
Dicumyl peroxide	Exempt	>52	"48	-	-	-	Exempt	-	-	-
Dicumyl peroxide	Exempt	>52	-	-	"48	-	Exempt	-	-	-
Dicyclohexyl peroxydicarbonate	UN3112	>91-100	-	-	-	-	OP3	+5	+10	-
Dicyclohexyl peroxydicarbonate	UN3114	>91	-	-	-	"9	OP5	+5	+10	-
Didecanoyl peroxide	UN3114	>100	-	-	-	-	OP6	+30	+35	-
2,2-Di-(4,4-di(tert-butylperoxy)cyclohexyl)propane	UN3106	>42	-	-	"58	-	OP7	-	-	-
2,2-Di-(4,4-di(tert-butylperoxy)cyclohexyl)propane	UN3107	>25	-	"75	-	-	OP8	-	-	-
Di-2,4-dichlorobenzoyl peroxide	UN3102	>77	-	-	-	"23	OP5	-	-	-
Di-2,4-dichlorobenzoyl peroxide [as a paste with silicone oil]	UN3106	>52	-	-	-	-	OP7	-	-	-
Di-(2-ethylhexyl) peroxydicarbonate	UN3113	>77-100	-	-	-	-	OP5	-20	-10	-
Di-(2-ethylhexyl) peroxydicarbonate	UN3115	>77	-	-	-	-	OP7	-15	-5	-
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water]	UN3119	>52	-	-	-	-	OP8	-15	-5	-
Di-(2-ethylhexyl) peroxydicarbonate [as a stable dispersion in water (frozen)]	UN3118	>42	-	-	-	-	OP8	-15	-5	-
Diethyl peroxydicarbonate	UN3115	>27	"73	-	-	-	OP7	-10	0	-
2,2-Dihydroperoxypropane	UN3102	>27	-	-	"73	-	OP5	-	-	-
Di-(1-hydroxycyclohexyl)peroxide	UN3106	>100	-	-	-	-	OP7	-	-	-
Diisobutyryl peroxide	UN3111	>32-52	-	"48	-	-	OP5	-20	-10	-
Diisobutyryl peroxide	UN3115	>32	-	"68	-	-	OP7	-20	-10	-
Diisopropylbenzene dihydroperoxide	UN3106	>82	"5	-	-	"5	OP7	-	-	17
Diisopropyl peroxydicarbonate	UN31	>52-	-	-	-	-	OP2	-15	-5	-

	12	100								
Diisopropyl peroxydicarbonate	UN3115	>52	-	"48	-	-	OP7	-10	0	-
Diisotridecyl peroxydicarbonate	UN3115	>100	-	-	-	-	OP7	-10	0	-
Dilauroyl peroxide	UN3106	>100	-	-	-	-	OP7	-	-	-
Dilauroyl peroxide [as a stable dispersion in water]	UN3109	>42	-	-	-	-	OP8	-	-	10
Di-(2-methylbenzoyl)peroxide	UN3112	>87	-	-	-	"13	OP5	+30	+35	-
Di-(4-methylbenzoyl)peroxide [as a paste with silicone oil]	UN3106	>52	-	-	-	-	OP7	-	-	-
2,5-Dimethyl-2,5-di- (benzoylperoxy)hexane	UN3102	>82-100	-	-	-	-	OP5	-	-	-
2,5-Dimethyl-2,5-di- (benzoylperoxy)hexane	UN3104	>82	-	-	-	"18	OP5	-	-	-
2,5-Dimethyl-2,5-di-(benzoylperoxy)hexane	UN3106	>82	-	-	"18	-	OP7	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3105	>52-100	-	-	-	-	OP7	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3101	>87-100	-	-	-	-	OP5	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3103	>52-86	"14	-	-	-	OP5	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3106	>52	-	-	"48	-	OP7	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane	UN3109	>52	"48	-	-	-	OP8	-	-	7
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexyne-3	UN3106	>52	-	-	"48	-	OP7	-	-	-
2,5-Dimethyl-2,5-di-(tert- butylperoxy)hexane [as a paste]	UN3108	>47	-	-	-	-	OP8	-	-	-
2,5-Dimethyl-2,5-di-(2-ethylhexanoylperoxy)hexane	UN3115	>100	-	-	-	-	OP7	+20	+25	-
2,5-Dimethyl-2,5-dihydroperoxyhexane	UN3104	>82	-	-	-	"18	OP7	-	-	-
2,5-Dimethyl-2,5-di-(3,5,5-trimethylhexanoylperoxy)hexane	UN3105	>77	"23	-	-	-	OP7	-	-	-
1,1-Dimethyl-3-hydroxybutylperoxyneoheptanoate	UN3117	>52	"48;	-	-	-	OP8	+0	+10	-
Dimyristyl peroxydicarbonate	UN3116	>100	-	-	-	-	OP7	+20	+25	-
Dimyristyl peroxydicarbonate [as a stable dispersion in water]	UN3119	>42	-	-	-	-	OP8	+20	+25	-
Dimyristyl peroxydicarbonate [as a stable dispersion in water]	UN3119	>42	-	-	-	-	IBC	+15	+25	10
Di-(2-neodecanoylperoxyisopropyl)benzene	UN3115	>52	"48	-	-	-	OP7	-10	0	-
Di-n-nonanoyl peroxide	UN3116	>100	-	-	-	-	OP7	0	+10	-
Di-n-octanoyl peroxide	UN3114	>100	-	-	-	-	OP5	+10	+15	-
Diperoxy azelaic acid	UN3116	>27	-	-	"73	-	OP7	+35	+40	-
Diperoxy dodecane diacid	UN31	>13-	-	-	"58	-	OP7	+4	+4	-

	16	42						0	5	
Diperoxy dodecane diacid	Exempt	>13	-	-	"87	-	Exempt	-	-	-
Di-(2-phenoxyethyl)peroxydicarbonate	UN3102	>85-100	-	-	-	-	OP5	-	-	-
Di-(2-phenoxyethyl)peroxydicarbonate	UN3106	>85	-	-	-	"15	OP7	-	-	-
Dipropionyl peroxide	UN3117	>27	-	"73	-	-	OP8	+15	+20	-
Di-n-propyl peroxydicarbonate	UN3113	>100	-	-	-	-	OP4	-25	-15	-
Distearyl peroxydicarbonate	UN3106	>87	-	-	"13	-	OP7	-	-	-
Disuccinic acid peroxide	UN3102	>72-100	-	-	-	-	OP4	-	-	18
Disuccinic acid peroxide	UN3116	>72	-	-	-	"28	OP7	+10	+15	-
Di-(3,5,5-trimethyl-1,2-dioxolanyl- 3)peroxide [as a paste]	UN3116	>52	-	-	-	-	OP7	+30	+35	21
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3115	>38-82	"18	-	-	-	OP7	0	+10	-
Di-(3,5,5-trimethylhexanoyl)peroxide [as a stable dispersion in water]	UN3117	>52	-	-	-	-	OP8	+10	+15	-
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3119	>38	"62	-	-	-	OP8	+20	+25	-
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3119	>38	"62	-	-	-	IBC	+10	+15	10
Di-(3,5,5-trimethylhexanoyl)peroxide	UN3119	>38	"62	-	-	-	Bulk	-10	0	14
Ethyl 3,3-di-(tert-amylperoxy)butyrate	UN3105	>67	"33	-	-	-	OP7	-	-	-
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3103	>77 - 100	-	-	-	-	OP5	-	-	-
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3105	>77	"23	-	-	-	OP7	-	-	-
Ethyl 3,3-di-(tert-butylperoxy)butyrate	UN3106	>52	-	-	"48	-	OP7	-	-	-
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3102	>52 - 100	-	-	-	-	OP4	-	-	-
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3105	>52	"48	-	-	-	OP7	-	-	-
3,3,6,6,9,9-Hexamethyl-1,2,4,5-tetraoxacyclononane	UN3106	>52	-	-	"48	-	OP7	-	-	-
Isopropyl sec-butyl peroxydicarbonate + di-sec-butyl peroxydicarbonate + di-isopropyl peroxydicarbonate	UN3111	>52 + >28 + >22	-	-	-	-	OP5	-20	-10	-
Isopropyl sec-butyl peroxydicarbonate [and] Di-sec-butyl peroxydi-carbonate [and] Di-isopropyl peroxydicarbonate	UN3115	>32 + >15-18 + >12-15	"38	-	-	-	OP7	-20	-10	-
Isopropylcumyl hydroperoxide	UN3109	>72	"28	-	-	-	OP8	-	-	7, 13ROW>
p-Menthyl hydroperoxide	UN3105	> 72 - 100	-	-	-	-	OP7	-	-	13

p-Menthyl hydroperoxide	UN3109	>72	"28	-	-	-	OP8	-	-	7,25
Methylcyclohexanone peroxide(s)	UN3115	>67	-	"33	-	-	OP7	+35	+40	-
Methyl ethyl ketone peroxide(s)	UN3101	>52	"48	-	-	-	OP5	-	-	5, 13
Methyl ethyl ketone peroxide(s)	UN3105	>45	"55	-	-	-	OP7	-	-	5
Methyl ethyl ketone peroxide(s)	UN3107	>40	"60	-	-	-	OP8	-	-	5
Methyl isobutyl ketone peroxide(s)	UN3105	>62	"19	-	-	-	OP7	-	-	5, 23
Organic peroxide, liquid, sample	UN3103	-	-	-	-	-	OP2	-	-	12
Organic peroxide, liquid, sample, temperature controlled	UN3113	-	-	-	-	-	OP2	-	-	12
Organic peroxide, solid, sample	UN3104	-	-	-	-	-	OP2	-	-	12
Organic peroxide, solid, sample, temperature controlled	UN3114	-	-	-	-	-	OP2	-	-	12
Peracetic acid with not more than 20% hydrogen peroxide	Exempt	>6	-	-	-	"60	Exempt	-	-	-
Peracetic acid with not more than 26% hydrogen peroxide	UN3109	>17	-	-	-	"27	OP8	-	-	10, 13
Peracetic acid with 7% hydrogen peroxide	UN3107	>36	-	-	-	"15	OP8	-	-	13
Peroxyacetic acid, type D, stabilized	UN3105	>43	-	-	-	-	OP7	-	-	13, 20
Peroxyacetic acid, type E, stabilized	UN3107	>43	-	-	-	-	OP8	-	-	13, 20
Peroxyacetic acid, type F, stabilized	UN3109	>43	-	-	-	-	OP8	-	-	7, 13, 20
Pinanyl hydroperoxide	UN3105	56-100	-	-	-	-	OP7	-	-	13
Pinanyl hydroperoxide	UN3109	<56	>44	-	-	-	OP8	-	-	7
Tetrahydronaphthyl hydroperoxide	UN3106	>100	-	-	-	-	OP7	-	-	-
1,1,3,3-Tetramethylbutyl hydroperoxide	UN3105	>100	-	-	-	-	OP7	-	-	-
1,1,3,3-Tetramethylbutylperoxy-2-ethylhexanoate	UN3115	>100	-	-	-	-	OP7	+20	+25	-
2,4,4-Trimethylpentyl-2-peroxyneodecanoate	UN3115	>72	-	"28	-	-	OP7	-5	+5	-
2,4,4-Trimethylpentyl-2-peroxyneodecanoate [as a stable dispersion in water]	UN3119	>52	-	-	-	-	OP8	-5	+5	-
2,4,4-Trimethylpentyl-2-peroxy phenoxyacetate	UN3115	>37	-	"63	-	-	OP7	-10	0	-

NOTES:
1. FOR DOMESTIC SHIPMENTS, OP8 IS AUTHORIZED.
2. AVAILABLE OXYGEN MUST BE <4.7 PERCENT.
3. FOR CONCENTRATIONS <80 PERCENT OP5 IS ALLOWED. FOR

CONCENTRATIONS OF AT LEAST 80 PERCENT BUT <85 PERCENT, OP4 IS ALLOWED. FOR CONCENTRATIONS OF AT LEAST 85 PERCENT, MAXIMUM PACKAGE SIZE IS OP2.

4. THE DILUENT MAY BE REPLACED BY DI-TERT-BUTYL PEROXIDE.

5. AVAILABLE OXYGEN MUST BE >9 PERCENT.

6. FOR DOMESTIC SHIPMENTS, OP5 IS AUTHORIZED.

7. THIS MATERIAL MAY BE TRANSPORTED IN INTERMEDIATE BULK CONTAINERS AND BULK PACKAGINGS UNDER THE PROVISIONS OF PARAGRAPH (E) OF THIS SECTION.

8. ONLY NON-METALLIC PACKAGINGS ARE AUTHORIZED.

9. FOR DOMESTIC SHIPMENTS, THIS MATERIAL MAY BE TRANSPORTED IN BULK PACKAGINGS UNDER THE PROVISIONS OF PARAGRAPH (E)(3)(II) OF THIS SECTION.

10. THIS MATERIAL MAY BE TRANSPORTED IN INTERMEDIATE BULK CONTAINERS UNDER THE PROVISIONS OF PARAGRAPH (E) OF THIS SECTION.

11. UP TO 2000 KG PER CONTAINER AUTHORIZED.

12. SAMPLES MAY ONLY BE OFFERED FOR TRANSPORTATION UNDER THE PROVISIONS OF PARAGRAPH (C)(4) OF THIS SECTION.

13. "CORROSIVE" SUBSIDIARY RISK LABEL IS REQUIRED.

14. THIS MATERIAL MAY BE TRANSPORTED IN BULK PACKAGINGS UNDER THE PROVISIONS OF PARAGRAPH (E) OF THIS SECTION.

15. NO "CORROSIVE" SUBSIDIARY RISK LABEL IS REQUIRED FOR CONCENTRATIONS BELOW 80%.

16. WITH <6% DI-TERT-BUTYL PEROXIDE.

17. WITH "8% 1-ISOPROPYLHYDROPEROXY-4-ISOPROPYLHYDROXYBENZENE.

18. ADDITION OF WATER TO THIS ORGANIC PEROXIDE WILL DECREASE ITS THERMAL STABILITY.

19. [RESERVED]

20. MIXTURES WITH HYDROGEN PEROXIDE, WATER AND ACID(S).

21. WITH DILUENT TYPE A, WITH OR WITHOUT WATER.

22. WITH >36 PERCENT, BY MASS, ETHYLBENZENE.

23. WITH >19 PERCENT, BY MASS, METHYL ISOBUTYL KETONE.

24. DILUENT TYPE B WITH BOILING POINT >100 C.

25. NO "CORROSIVE" SUBSIDIARY RISK LABEL IS REQUIRED FOR CONCENTRATIONS BELOW 56%.

(c) *New organic peroxides, formulations and samples. (1) Except as provided for samples in paragraph (c)(2) of this section, no person may offer for transportation an organic peroxide which is not identified by technical name in the Organic Peroxides Table of this section, or a formulation of one or more organic peroxides which are identified by technical name in that table, unless the organic peroxide is assigned a generic type and shipping description and is approved by the Associate Administrator for Hazardous Materials Safety under the provisions of §173.128(c) of this subchapter.*

(2) Samples. Samples of new organic peroxides or new formulations of organic

peroxides identified in the Organic Peroxides Table in paragraph (b) of this section, for which complete test data are not available, and which are to be transported for further testing or product evaluation, may be assigned an appropriate shipping description for organic peroxide Type C, packaged and offered for transportation, under the following conditions:

(i) Data available to the person offering the material for transportation must indicate that the sample would pose a level of hazard no greater than that of an organic peroxide Type B and that the control temperature, if any, is sufficiently low to prevent any dangerous decomposition and sufficiently high to prevent any dangerous phase separation;

(ii) The sample must be packaged in accordance with packing method OP2, for a liquid or solid, respectively;

(iii) Packages of the organic peroxide may be offered for transportation and transported in a quantity not to exceed 10 kg (22 pounds) per transport vehicle; and

(iv) One of the following shipping descriptions must be assigned:

(A) Organic peroxide Type C, liquid, 5.2, UN 3103;

(B) Organic peroxide Type C, solid, 5.2, UN 3104;

(C) Organic peroxide Type C, liquid, temperature controlled, 5.2, UN 3113; or

(D) Organic peroxide Type C, solid, temperature controlled, 5.2, UN 3114.

(3) *Mixtures. Mixtures of organic peroxides individually identified in the Organic Peroxides Table in paragraph (b) of this section may be classified as the same type of organic peroxide as that of the most dangerous component and be transported under the conditions for transportation given for this type. If the stable components form a thermally less stable mixture, the SADT of the mixture must be determined and the new control and emergency temperature derived under the provisions of §173.21(f).*

(d) Packing Method Table. Packagings for organic peroxides and self-reactive substances are listed in the Maximum Quantity per Packing Method Table. The packing methods are designated OP1 to OP8. The quantities specified for each packing method represent the maximum that is authorized.

(1) The following types of packagings are authorized:

(i) Drums: 1A1, 1A2, 1B1, 1B2, 1D, 1G, 1H1, 1H2;

(ii) Jerricans: 3A1, 3A2, 3B1, 3B2, 3H1, 3H2;

(iii) Boxes: 4C1, 4C2, 4D, 4F, 4G, 4H1, 4H2, 4A, 4B; or

(iv) Composite packagings with a plastic inner receptacle: 6HA1, 6HA2, 6HB1, 6HB2, 6HC, 6HD1, 6HD2, 6HG1, 6HG2, 6HH1, 6HH2.

(2) Metal packaging (including inner packagings of combination packagings and outer packagings of combination or composite packagings) are used only for packing methods OP7 and OP8.

(3) In combination packagings, glass receptacles are used only as inner packagings with a maximum content of 0.5 kg or 0.5 liter.

(4) The maximum quantity per packaging or package for Packing Methods OP1-OP8 must be as follows:

Maximum Quantity Per Packaging/Package for Packing Methods OP1 to OP8

Maximum quantity	Packing method							
-	OP1	OP2	OP3	OP4	OP5	OP6	OP7	OP8
Solids and combination packagings (liquid and solid) (kg)	0.5	0.5/10	5	5/25	25	50	50	[2]200
Liquids (L)	0.5	-	5	-	30	60	60	[3]225

[1]If two values are given, the first applies to the maximum net mass per inner packaging and the second to the maximum net mass of the complete package.

[2]60 kg for jerricans and 100 kg for boxes.

[3]60 L for jerricans.

(e) *Bulk packagings for organic peroxides. When bulk packagings are authorized under the provisions of the Organic Peroxides Table in paragraph (b) of this section, only the following packagings are authorized:*

(1) Rail cars. Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 fusion-weld tank car tank are authorized. DOT 103W, 111A60F1 and 111A60W1 tank car tanks must have bottom outlets effectively sealed from inside. Gauging devices are required on DOT 103W tank car tanks. Riveted tank car tanks are not authorized.

(2) Cargo tanks. Specification MC 307, MC 310, MC 311, MC 312, DOT 407, and DOT 412 cargo tank motor vehicles with a tank design pressure of at least 172 kPa (25 psig) are authorized.

(3) Portable tanks.

(i) Specification IM 101 intermodal portable tanks are authorized as follows:

(A) Each tank must have a minimum design pressure of 267 kPa (39 psig), a minimum shell thickness of 6.35 mm (0.250 inch) mild steel.

(B) Each tank must be equipped with at least two self-reclosing pressure relief devices of at least 7.6 cm (3.0 inches) diameter. The pressure relief devices must be set at a pressure that is determined by the following formula:

Pressure relief valve setting = 1.2 x [Vapor pressure of lading at 46 ^{o}C (115 ^{o}F)+Static head of lading+Pressure of gas padding, if any]

(ii) Specification 57 metal portable tanks are authorized only for tert-butyl cumyl peroxide, di-(2-tert-butylperoxyisopropyl-benzene(s), dicumyl peroxide and mixtures of two or more of these peroxides.

(4) For tertiary butyl hydroperoxide (TBHP), each tank car, cargo tank or portable tank must contain 7.6 cm (3.0 inches) low density polyethylene (PE) saddles having a melt index of at least 0.2 grams per 10 minutes (ASTM D1238, condition E) as part of the lading, with a ratio of PE to TBHP over a range of 0.008 to 0.012 by mass. Alternatively, plastic or metal containers equipped with fusible plugs having a melting point between 69 ^{o}C (156 ^{o}F) and 71 ^{o}C (160 ^{o}F) and filled with a sufficient quantity of water to dilute the TBHP to 65 percent or less by mass may be used. The PE saddles must be visually inspected after each trip and, at a minimum, once every 12 months,

and replaced when discoloration, fracture, severe deformation, or other indication of change is noted.

(5) *Intermediate bulk containers. Intermediate bulk containers that are tested at the Packing Group II performance level in accordance with subpart O of part 178 of this subchapter are authorized as follows:*

(i) Composite: 31HA1;

(ii) Rigid plastic: 31H1; and

(iii) Metal: 31A.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.225, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.226 Materials poisonous by inhalation, Division 6.1, Packing Group I, Hazard Zone A.

Division 6.1, Packing Group I, materials that are poisonous by inhalation and that fall within the boundaries of Hazard Zone A in the graph found in §173.133 must be packed in non-bulk packagings in accordance with the following paragraphs:

(a) In specification cylinders, as authorized in §173.40.

(b) In 1A1, 1B1, 1H1, 1N1, or 6HA1 drums further packed in a 1A2 or 1H2 drum. Both inner and outer drums must conform to the performance test requirements of subpart M of part 178 of this subchapter at the Packing Group I performance level. The outer drum must have a minimum thickness of 1.35 mm (0.053 inch) for a 1A2 outer drum or 6.30 mm (0.248 inch) for a 1H2 outer drum. Outer 1A2 and 1H2 drums must withstand a hydrostatic test pressure of 100 kPa (15 psi). Capacity of the inner drum may not exceed 220 L (58 gallons). In addition, the inner drum must-

(1) Be capable of satisfactorily withstanding the hydrostatic pressure test in §178.605 of this subchapter at a test pressure of 550 kPa (80 psig);

(2) Satisfactorily withstand the leakproofness test in §178.604 of this subchapter using an internal air pressure of at least twice the vapor pressure at 55 ^{o}C (131 ^{o}F) of the material to be packaged;

(3) Have screw-type closures that are-

(i) Closed and tightened to a torque prescribed by the closure manufacturer, using a device that is capable of measuring torque;

(ii) Physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during transportation; and

(iii) Provided with a cap seal that is properly applied in accordance with the cap seal manufacturer's recommendations and is capable of withstanding an internal pressure of at least 100 kPa (15 psig).

(4) Have a minimum thickness as follows:

(i) If the capacity of the inner drum is less than or equal to 120 L (32 gallons), the minimum thickness of the inner drum is-
(A) For a 1A1 or 1N1 drum, 1.3 mm (0.051 inch);
(B) For a 1B1 drum, 3.9 mm (0.154 inch);
(C) For a 1H1 drum, 3.16 mm (0.124 inch); and
(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0622 inch) and the outer steel drum shall be 0.96 mm (0.0378 inch).
(ii) If the capacity of the inner drum is greater than 120 L (32 gallons), the thickness of the inner drum is-
(A) For a 1A1 or 1N1 drum, 1.7 mm (0.067 inch);
(B) For a 1B1 drum, 4.7 mm (0.185 inch);
(C) For a 1H1 drum, 3.16 mm (0.124 inch); and
(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0622 inch) and the outer steel drum shall be 1.08 mm (0.043 inch); and
(5) Be isolated from the outer drum by a shock-mitigating, non-reactive material.
(c) In combination packagings, consisting of an inner packaging system and an outer packaging, as follows:
(1) *Outer packagings:*

Steel drum: 1A2
Aluminum drum: 1B2
Metal drum, other than steel or aluminum: 1N2
Plywood drum: 1D
Fiber drum: 1G
Plastic drum: 1H2
Wooden barrel: 2C2
Steel jerrican: 3A2
Plastic jerrican: 3H2
Aluminum jerrican: 3B2
Steel box: 4A
Aluminum box: 4B
Natural wood box: 4C1 or 4C2
Plywood box: 4D
Reconstituted wood box: 4F
Fiberboard box: 4G
Expanded plastic box: 4H2
Solid plastic box: 4H2

(2) *Inner packaging system. The inner packaging system consists of two packagings: an impact-resistant receptacle of glass, earthenware, plastic or metal securely cushioned with a non-reactive, absorbent material and packed within a leak-tight packaging of metal or plastic. This combination packaging in turn is packed within the outer packaging. Capacity of each inner receptacle may not exceed 4 L (1 gallon). An inner receptacle that has a closure must have a closure which is physically held in place*

by any means capable of preventing back-off or loosening of the closure by impact or vibration during transportation. Both the inner packaging system and the outer packaging must conform to the performance test requirements of subpart M of part 178 of this subchapter, at the Packaging Group I performance level. The inner packaging system must meet these tests without the benefit of the outer packaging. The total amount of liquid contained in the outer packaging may not exceed 16 L (4 gallons).

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66274, Dec. 20, 1991; Amdt. 173-236, 58 FR 50236, Sept. 24, 1993; Amdt. 173-138, 59 FR 49134, Sept. 26, 1994; Amdt. 173-241, 59 FR 67517, Dec. 29, 1994; Amdt 173-261, 62 FR 24741, May 6, 1997]

§173.227 Materials poisonous by inhalation. Division 6.1, Packing Group I, Hazard Zone B.

Division 6.1, Packing Group I, materials that are poisonous by inhalation and that fall within the boundaries of Hazard Zone B in the graph found in §173.133 shall be packed in non-bulk packagings which conform to the performance test requirements of subpart M of part 178 of this subchapter, at the Packing Group I performance level. The following packagings are authorized:

(a) Packagings as authorized in §173.226.

(b) 1A1, 1B1, 1N1 or 1H1 drum or 6HA1 composite further packed in a 1A2 or 1H2 drum. Both the inner and outer drums must conform to the performance test requirements of subpart M of part 178 of this subchapter at the Packing Group I performance level. The outer drum must have a minimum thickness of 1.35 mm (0.053 inches) for a 1A2 outer drum or 6.30 mm (0.248 inches) for a 1H2 outer drum. Outer 1A2 and 1H2 drums must withstand a hydrostatic test pressure of 100 kPa (15 psi). In addition, the inner drum must-

(1) Satisfactorily withstand the leakproofness test in §178.604 of this subchapter using an internal air pressure of at least two times the vapor pressure at 55 ^{o}C (131 ^{o}F) of the material to be packaged;

(2) Have screw closures that are-

(i) Closed and tightened to a torque prescribed by the closure manufacturer, using a device that is capable of measuring torque;

(ii) Physically held in place by any means capable of preventing back-off or loosening of the closure by impact or vibration during transportation; and

(iii) Provided with a cap seal that is properly applied in accordance with the cap seal manufacturer's recommendations and is capable of withstanding an internal pressure of at least 100 kPa (15 psig).

(3) Have a minimum thickness as follows:

(i) If the capacity of the inner drum is less than or equal to 30 L (7.9 gallons), the minimum thickness of the inner drum is:

(A) For a 1A1 drum, 0.69 mm (0.027 inch);

(B) For a 1B1 drum, 2.79 mm (0.110 inch);
(C) For a 1H1 drum, 1.14 mm (0.045 inch); and
(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0625 inch), the outer steel drum shall be 0.70 mm (0.027 inch).
(ii) If the capacity of the inner drum is greater than 30 L (7.9 gallons) but less than or equal to 120 L (32 gallons), the minimum thickness of the inner drum is-
(A) For a 1A1 drum, 1.08 mm (.043 inch);
(B) For a 1B1 drum, 3.9 mm (0.154 inch);
(C) For a 1H1 drum, 3.16 mm (0.124 inch); and
(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0625 inch) and the outer steel drum shall be 0.96 mm (0.0378 inches).
(iii) If the capacity of the inner drum is greater than 120 L (31.7 gallons), the thickness of the inner drum is-
(A) For a 1A1 or 1N1 drum, 1.35 mm (0.053 inches);
(B) For a 1B1 drum, 4.7 mm (0.185 inches);
(C) For a 1H1 drum, 3.16 mm (0.124 inches); and
(D) For a 6HA1 drum, the plastic inner container shall be 1.58 mm (0.0625 inch) and the outer steel drum shall be 1.08 mm (0.043 inch).
(4) Be isolated from the outer drum by a shock-mitigating, non-reactive material; and
(5) Have a capacity not greater than 220 L (58 gallons).
(c) 1A1, 1B1, 1H1, 1N1 or 6HA1 drums described in paragraph (b) of this section may be used without being further packed in a 1A2 or 1H2 drum if the shipper loads the material, blocks and braces the drums within the transport vehicle and seals the transport vehicle used. Drums may not be stacked (double decked) within the transport vehicle. Shipments must be from one origin to one destination only without any intermediate pickup or delivery.

[Amdt. 173-224, 55 FR 52643, Dec. 21, 1990, as amended at 56 FR 66274, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-236, 58 FR 50236, Sept. 24, 1993; Amdt. 173-138, 59 FR 49134, Sept. 26, 1994]

§173.228 Bromine pentafluoride or bromine trifluoride.
(a) When the §172.101 table specifies that a hazardous material be packaged under this section, only non-bulk packagings prescribed in paragraph (b) of this section are authorized for its transportation. Each packaging must conform to the general packaging requirements of subpart B of this part, to the specification requirements of part 178 of this subchapter and to the requirements of the special provisions of column 7 of the §172.101 table.
(b) Specification 3A150, 3AA150, 3B240, 3BN150, 4B240, 4BA240, 4BW240 and 3E1800 cylinders are authorized. Each valve outlet must be sealed by a threaded cap or threaded plug. Cylinder valves must be protected as specified for corrosive gases in §173.301(g). No cylinder may be equipped with any pressure relief device. Specification

3E1800 cylinders must be packaged in accordance with the requirements of §173.301(k).

§173.229 Chloric acid solution or chlorine dioxide hydrate, frozen.
When the §172.101 table specifies that a hazardous material be packaged in accordance with this section, only 4G fiberboard boxes, with inner packagings of polyethylene or other suitable material, are authorized. Fiberboard boxes must be reinforced and insulated and sufficient dry ice must be used to maintain the hydrate or acid in a frozen state during transportation. Each packaging must conform to the general packaging requirements of subpart B of part 173, and to the requirements of part 178 of this subchapter at the Packing Group I performance level. Transportation is authorized only by private or contract carrier by motor vehicle.

[CFR] PART 173 SUBPART F - Bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART F]

Subpart F - Bulk Packaging for Hazardous Materials Other Than Class 1 and Class 7

§173.240 Bulk packaging for certain low hazard solid materials.
When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) *Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 tank car tanks; Class 106 or 110 multi-unit tank car tanks; and metal non-DOT specification, sift-proof tank car tanks and sift-proof closed cars.*

(b) Motor vehicles: Specification MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, MC 312, MC 330, MC 331, DOT 406, DOT 407, and DOT 412 cargo tank motor vehicles; non-DOT specification, sift-proof cargo tank motor vehicles; and sift-proof closed vehicles.

(c) Portable tanks and closed bulk bins: DOT 51, 52, 53, 56, 57 and 60 portable tanks; IMO type 1, 2 and 5, and IM 101 and IM 102 portable tanks; marine portable tanks conforming to 46 CFR part 64; and sift-proof non-DOT specification portable tanks and closed bulk bins.

(d) Intermediate bulk containers. Intermediate bulk containers are authorized subject to the conditions and limitations of this paragraph and paragraph (d)(2) of this section provided they conform to the requirements in subpart O of part 178 of this subchapter at the Packing Group performance level specified in column 5 of the §172.101 table of this subchapter for the material being transported.

(1) The following are authorized:

(i) Composite: 11HZ1, 11HZ2, 21HZ1, 21HZ2, 31HZ1, or 31HZ2. For composite intermediate bulk containers, the letter "Z" must be replaced with a capital letter which indicates the material of construction of the outer packaging. For example 21HA1 is a composite intermediate bulk container with a metal outer packaging (see §178.702 of this subchapter);

(ii) Fiberboard: 11G;

(iii) Flexible: 13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, or 13M2;

(iv) Metal: 11A, 11B, 11N, 21A, 21B, 21N, 31A, 31B, or 31N;

(v) Rigid plastic: 11H1, 11H2, 21H1, 21H2, 31H1, or 31H2; or

(vi) Wooden intermediate bulk containers: 11C, 11D, or 11F.

(2) The following conditions and limitations apply to the use of intermediate bulk containers:

(i) Flexible, fiberboard and wooden intermediate bulk containers are intended for the transport of solids only and may not be used for liquids or materials that may become liquid during transportation; or

(ii) Flexible, fiberboard, or wooden intermediate bulk containers containing materials in Packing Group II must be packed in a closed freight container or a closed transport vehicle.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66274, Dec. 20, 1991; Amdt. 173-238, 59 FR 38067, July 26, 1994; Amdt. 173-252, 61 FR 28676, June 5, 1996]

§173.241 Bulk packagings for certain low hazard liquid and solid materials.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) *Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 tank car tanks; Class 106 or 110 multi-unit tank car tanks and AAR Class 203W, 206W, and 211W tank car tanks.*

(b) Cargo tanks: DOT specification MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, MC 312, MC 330, MC 331, DOT 406, DOT 407, and DOT 412 cargo tank motor vehicles; and non-DOT specification cargo tank motor vehicles suitable for transport of liquids.

(c) Portable tanks: DOT 51, 52, 56, 57 and 60 portable tanks; IMO type 1, 2 and 5, and IM 101 and IM 102 portable tanks; marine portable tanks conforming to 46 CFR part 64; and non-DOT specification portable tanks suitable for transport of liquids.

(d) Intermediate bulk containers. (1) Intermediate bulk containers are authorized subject to the conditions and limitations of this paragraph and paragraph (d)(2) of this section provided they conform to the requirements in subpart O of part 178 of this subchapter at the Packing Group performance level specified in column 5 of the §172.101 table of this subchapter for the material being transported.

(i) The following are authorized for liquids or solids:

(A) Composite: 31HZ1 or 31HZ2; For each composite intermediate bulk container, the letter "Z" must be replaced with a capital letter which indicates the material of construction of the outer packaging. For example, 31HA1 is a composite intermediate bulk container with a metal outer packaging (see §178.702 of this subchapter);

(B) Metal: 31A, 31B, or 31N; or

(C) Rigid plastic: 31H1 or 31H2.

(ii) The following are authorized for solids only:

(A) Composite: 11HZ1, 11HZ2, 21HZ1, or 21HZ2. For each composite intermediate bulk container, the letter "Z" must be replaced with a capital letter which indicates the material of construction of the outer packaging. For example, 21HA1 is a composite intermediate bulk container with a metal outer packaging (see §178.702 of this subchapter);

(B) Fiberboard: 11G;

(C) Flexible: 13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, or 13M2;

(D) Metal: 11A, 11B, 11N, 21A, 21B, or 21N;

(E) Rigid plastic: 11H1, 11H2, 21H1, or 21H2; or

(F) Wooden: 11C, 11D, or 11F.

(2) The following conditions and limitations apply to the use of intermediate bulk containers:

(i) Flexible, fiberboard and wooden intermediate bulk containers are intended for the transport of solids only and may not be used for liquids or materials that may become liquid during transportation;

(ii) Only liquids with a vapor pressure less than or equal to 110 kPa (16 psig) at 50 ^{o}C (122 ^{o}F), or 130 kPa (18.9 psig) at 55 ^{o}C (131 ^{o}F), are authorized in metal intermediate bulk containers; or

(iii) Flexible, fiberboard, or wooden intermediate bulk containers containing materials in Packing Group II must be packed in a closed freight container or a closed transport vehicle.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991; Amdt. 173-238, 59 FR 38067, July 26, 1994; Amdt. 173-252, 61 FR 28676, June 5, 1996]

§173.242 Bulk packagings for certain medium hazard liquids and solids, including solids with dual hazards.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) *Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 tank car tanks; Class 106 or 110 multi-unit tank car tanks and AAR Class 206W tank car tanks.*

(b) Cargo tanks: Specification MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, MC 312, MC 330, MC 331, DOT 406, DOT 407, and DOT 412 cargo tank motor vehicles. Cargo tanks used to transport Class 3, Packing Group I or II, or Packing Group III with a flash point of less than 38 ^{o}C (100 ^{o}F); Class 6, Packing Group I or II; and Class 8, Packing Group I or II materials must conform to the following special requirements:

(1) Pressure relief system: Except as provided by §173.33(d), each cargo tank must be equipped with a pressure relief system meeting the requirements of §178.346-3 or §178.347-4 of this subchapter. However, pressure relief devices on MC 310, MC 311 and MC 312 cargo tanks must meet the requirements for a Specification MC 307 cargo tank (except for Class 8, Packing Group I and II). Pressure relief devices on MC 330 and MC 331 cargo tanks must meet the requirement in §178.337-9 of this subchapter.

(2) Bottom outlets: DOT 406, DOT 407 and DOT 412 must be equipped with stop-valves meeting the requirements of §178.345-11 of this subchapter; MC 304, MC 307, MC 310, MC 311, and MC 312 cargo tanks must be equipped with stop-valves capable of being remotely closed within 30 seconds of actuation by manual or mechanic means and (except for Class 8, Packing Group I and II) by a closure activated at a temperature not over 121 ^{o}C (250 ^{o}F); MC 330 and MC 331 cargo tanks must be equipped with internal self-closing stop-valves meeting the requirements in §178.337-11 of this subchapter.

(c) *Portable tanks: DOT 51, 52, 53, 56, 57 and 60 portable tanks; and marine portable tanks conforming to 46 CFR part 64. DOT 57 portable tanks used for the transportation by vessel of Class 3, Packing Group II, materials must conform to the following:*

(1) Each tank must have a minimum design pressure of 62 kPa (9 psig) and be equipped in accordance with §178.253-4 of this subchapter, except that frangible devices are not authorized; and

(2) No pressure relief device may open at less than 34.4 kPa (5 psig).

(d) *Intermediate bulk containers. (1) Intermediate bulk containers are authorized subject to the conditions and limitations of this paragraph and paragraph (d)(2) of this section provided they conform to the requirements in subpart O of part 178 of this subchapter at the Packing Group performance level specified in column 5 of the §172.101 table of this subchapter for the material being transported.*

(i) The following are authorized for liquids or solids:

(A) Composite intermediate bulk containers: 31HZ1 or 31HZ2; for each composite intermediate bulk container, the letter "Z" must be replaced with a capital letter which indicates the material of construction of the outer packaging. For example, 21HA1 is a composite intermediate bulk container with a metal outer packaging (see §178.702 of this subchapter);

(B) Metal: 31A, 31B, or 31N; or

(C) Rigid plastic: 31H1 or 31H2;

(ii) The following are authorized for solids only:

(A) Composite: 11HZ1, 11HZ2, 21HZ1, or 21HZ2. For each composite intermediate bulk container, the letter "Z" must be replaced with a capital letter which indicates the material of construction of the outer packaging. For example, 21HA1 is a composite intermediate bulk container with a metal outer packaging (see §178.702 of this subchapter);

(B) Fiberboard: 11G;

(C) Flexible: 13H1, 13H2, 13H3, 13H4, 13H5, 13L1, 13L2, 13L3, 13L4, or 13M2;

(D) Metal: 11A, 11B, 11N, 21A, 21B, or 21N;

(E) Rigid plastic: 11H1, 11H2, 21H1, or 21H2; or

(F) Wooden intermediate bulk containers: 11C, 11D, or 11F.

(2) Intermediate bulk containers are authorized subject to the following conditions and limitations:

(i) No Packing Group I liquids or materials classified as Division 4.2 Packing Group I are authorized in intermediate bulk containers. Packing Group I solids are only authorized in metal intermediate bulk containers with capacities up to 3 cubic meters (106 cubic feet) and in rigid plastic, composite, flexible, fiberboard and wooden intermediate bulk containers with capacities of up to 1.5 cubic meters (53 cubic feet);

(ii) Flexible, fiberboard and wooden intermediate bulk containers are intended for the transport of solids only and may not be used for liquids or materials that may become liquid during transportation;

(iii) Only liquids with a vapor pressure less than or equal to 110 kPa (16 psig) at 50 ^{o}C (122 ^{o}F), or 130 kPa (18.9 psig) at 55 ^{o}C (131 ^{o}F), are authorized in metal intermediate bulk containers; or

(iv) Flexible, fiberboard, or wooden intermediate bulk containers and composite intermediate bulk containers, with a fiberboard outer body, containing materials in Packing Group I must be packed in a closed freight container or a closed transport vehicle. Flexible, fiberboard, or wooden intermediate bulk containers containing materials in Packing Group II must be packed in a closed freight container or a closed transport vehicle.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991; Amdt. 173-238, 59 FR 38067, July 26, 1994; Amdt. 173-243, 60 FR 40038, Aug. 4, 1995; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; Amdt. 173-252, 61 FR 28676, June 5, 1996; 62 FR 51560, Oct. 1, 1997]

§173.243 Bulk packaging for certain high hazard liquids and dual hazard

materials which pose a moderate hazard.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) *Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 fusion-welded tank car tanks; and Class 106 or 110 multi-unit tank car tanks.*

(b) Cargo tanks. Specification MC 304, MC 307, MC 330, MC 331 cargo tank motor vehicles; and MC 310, MC 311, MC 312, DOT 407, and DOT 412 cargo tank motor vehicles with tank design pressure of at least 172.4 kPa (25 psig). Cargo tanks used to transport Class 3 or Division 6.1 materials, or Class 8, Packing Group I or II materials must conform to the following special requirements:

(1) Pressure relief system: Except as provided by §173.33(d), each cargo tank must be equipped with a pressure relief system meeting the requirements of §178.346-3 or 178.347-4 of this subchapter. However, pressure relief devices on MC 310, MC 311 and MC 312 cargo tanks must meet the requirements for a Specification MC 307 cargo tank (except for Class 8, Packing Group I and II). Pressure relief devices on MC 330 and MC 331 cargo tanks must meet the requirement in §178.337-9 of this subchapter.

(2) Bottom outlets: DOT 407 and DOT 412 cargo tanks must be equipped with stop-valves meeting the requirements of §178.345-11 of this subchapter; MC 304, MC 307, MC 310, MC 311, and MC 312 cargo tanks must be equipped with stop-valves capable of being remotely closed within 30 seconds of actuation by manual or mechanic means and (except for Class 8, Packing Group I and II) by a closure activated at a temperature not over 121 ^{o}C (250 ^{o}F); MC 330 and MC 331 cargo tanks must be equipped with internal self-closing stop-valves meeting the requirements in §178.337-11 of this subchapter.

(c) *Portable tanks: DOT 51 and DOT 60 portable tanks; and marine portable tanks conforming to 46 CFR part 64 with design pressure of at least 172.4 kPa (25 psig).*

(d) Intermediate bulk containers. (1) Metal intermediate bulk containers (31A, 31B, 31N) are authorized subject to the conditions and limitations of paragraph (d)(2) of this section provided they conform to the requirements in subpart O of part 178 of this subchapter at the Packing Group performance level specified in column 5 of the §172.101 table of this subchapter for the material being transported.

(2) Intermediate bulk containers are authorized subject to the following conditions and limitations:

(i) No Packing Group I liquids or materials classified as Division 4.2 Packing Group I are authorized in intermediate bulk containers.

(ii) Packing Group I solids are authorized only in metal intermediate bulk containers with capacities up to three cubic meters (106 cubic feet); and

(iii) Liquids with a vapor pressure greater than 110 kPa (16 psig) at 50 ^{o}C (122 ^{o}F), or 130 kPa (18.9 psig) at 55 ^{o}C (131 ^{o}F), are not authorized in metal intermediate bulk containers.

(e) A dual hazard material may be packaged in accordance with §173.242 if:

(1) The subsidiary hazard is Class 3 with a flash point greater than 38 ^{o}C (100 ^{o}F); or

(2) The subsidiary hazard is Division 6.1, Packing Group III; or
(3) The subsidiary hazard is Class 8, Packaging Group, III.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991; Amdt. 173-138, 59 FR 49134, Sept. 26, 1994; Amdt. 173-238, 59 FR 38068, July 26, 1994; Amdt. 173-243, 60 FR 40038, Aug. 4, 1995; Amdt. 173-246, 60 FR 49110, Sept. 21, 1995; Amdt. 173-252, 61 FR 28676, June 5, 1996; 62 FR 51560, Oct. 1, 1997; 64 FR 10780, Mar. 5, 1999]

§173.244 Bulk packaging for certain pyrophoric liquids (Division 4.2), dangerous when wet (Division 4.3) materials, and poisonous liquids with inhalation hazards (Division 6.1).

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) *Rail cars: Class DOT 105, 109, 112, 114, or 120 fusion-welded tank car tanks; and Class 106 or 110 multi-unit tank car tanks.*

(b) Cargo tanks: Specifications MC 330 and MC 331 cargo tank motor vehicles and, except for Division 4.2 materials, MC 312 and DOT 412 cargo tank motor vehicles.

(c) Portable tanks: DOT 51 portable tanks.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991; 57 FR 45463, Oct. 1, 1992; Amdt. 173-252, 61 FR 28676, June 5, 1996]

§173.245 Bulk packaging for extremely hazardous materials such as poisonous gases (Division 2.3).

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) Tank car tanks and multi-unit tank car tanks, when approved by the Associate Administrator for Hazardous Materials Safety.

(b) Cargo tank motor vehicles and portable tanks, when approved by the Associate Administrator for Hazardous Materials Safety.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991]

§173.247 Bulk packaging for certain elevated temperature materials (Class 9) and certain flammable elevated temperature materials (Class 3).

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions in column 7 of the §172.101 table. On or after October 1, 1993, authorized packagings must meet all requirements in paragraph (g) of this section, unless otherwise excepted.

(a) *Rail cars: Class DOT 103, 104, 105, 109, 111, 112, 114, 115, or 120 tank car tanks; Class DOT 106, 110 multi-unit tank car tanks; AAR Class 203W, 206W, 211W tank car tanks; and non-DOT specification tank car tanks equivalent in structural design and accident damage resistance to specification packagings.*

(b) Cargo tanks: Specification MC 300, MC 301, MC 302, MC 303, MC 304, MC 305, MC 306, MC 307, MC 310, MC 311, MC 312, MC 330, MC 331 cargo tank motor vehicles; DOT 406, DOT 407, DOT 412 cargo tank motor vehicles; and non-DOT specification cargo tank motor vehicles equivalent in structural design and accident damage resistance to specification packagings. A non-DOT specification cargo tank motor vehicle constructed of carbon steel which is in elevated temperature material service is excepted from §178.345-7(d)(5) of this subchapter.

(c) Portable tanks: Specification 51, 52, 53, 56, 57, 60 portable tanks; IM 101, 102 portable tanks; marine portable tanks conforming to 46 CFR part 64; and non-specification portable tanks equivalent in structural design and accident damage resistance to specification packagings.

(d) Crucibles: Nonspecification crucibles designed and constructed such that the stress in the packaging does not exceed one fourth (0.25) of the ultimate strength of the packaging material at any temperature within the design temperature range. Stress is determined under a load equal to the sum of the static or working pressure in combination with the loads developed from accelerations and decelerations incident to normal transportation. For highway transportation, these forces are assumed to be "1.7g" vertical, "0.75g" longitudinal, and "0.4g" transverse, in reference to the axes of the transport vehicle. Each accelerative or decelerative load may be considered separately.

(e) Kettles: A kettle, for the purpose of this section, is a bulk packaging (portable tank or cargo tank) having a capacity not greater than 5678 L (1500 gallons) with an integral heating apparatus used for melting various bituminous products such as asphalt. Kettles used for the transport of asphalt or bitumen are subject to the following requirements:

(1) Low stability kettles. Kettles with a ratio of track-width to fully loaded center of gravity (CG) height less than 2.5 must meet all requirements of paragraph (g) of this section (track-width is the distance measured between the outer edge of the kettle tires; CG height is measured perpendicular from the road surface).

(2) High stability kettles. (i) Kettles with a total capacity of less than 2650 L (700 gallons) and a ratio of track-width to fully loaded CG height of 2.5 or more are excepted

from all requirements of paragraph (g)(2) of this section and the rollover protection requirements of paragraph (g)(6) of this section, if closures meet the requirements of paragraph (e)(2)(iii) of this section.

(ii) Kettles with a total capacity of 2650 L (700 gallons) or more and a ratio of track-width to fully loaded CG height of 2.5 or more are excepted from the "substantially leak tight" requirements of paragraph (g)(2) of this section and the rollover protection requirements of paragraph (g)(6) of this section if closures meet the requirements of paragraph (e)(2)(iii) of this section.

(iii) Closures must be securely closed during transportation. Closures also must be designed to prevent opening and the expulsion of lading in a rollover accident.

(f) *Other bulk packagings: Bulk packagings, other than those specified in paragraphs (a) through (e) of this section, which are used for the transport of elevated temperature materials, must conform to all requirements of paragraph (g) of this section on or after October 1, 1993.*

(g) General requirements. Bulk packagings authorized or used for transport of elevated temperature materials must conform to the following requirements:

(1) Pressure and vacuum control equipment. When pressure or vacuum control equipment is required on a packaging authorized in this section, such equipment must be of a self-reclosing design, must prevent package rupture or collapse due to pressure, must prevent significant release of lading due to packaging overturn or splashing or surging during normal transport conditions, and may be external to the packaging.

(i) Pressure control equipment is not required if pressure in the packaging would increase less than 10 percent as a result of heating the lading from the lowest design operating temperature to a temperature likely to be encountered if the packaging were engulfed in a fire. When pressure control equipment is required, it must prevent rupture of the packaging from heating, including fire engulfment.

(ii) Vacuum control equipment is not required if the packaging is designed to withstand an external pressure of 100 kPa (14.5 psig) or if pressure in the packaging would decrease less than 10 percent as a result of the lading cooling from the highest design operating temperature to the lowest temperature incurred in transport. When vacuum control equipment is required, it must prevent collapse of the packaging from a cooling-induced pressure differential.

(iii) When the regulations require a reclosing pressure relief device, the lading must not render the devices inoperable (i.e. from clogging, freezing, or fouling). If the lading affects the proper operation of the device, the packaging must have:

(A) A safety relief device incorporating a frangible disc or a permanent opening, each having a maximum effective area of 22 cm^2 (3.4 $in.^2$), for transportation by highway;

(B) For transportation of asphalt by highway, a safety relief device incorporating a frangible disc or a permanent opening, each having a maximum effective area of 48 cm^2 (7.4 in^2); or

(C) For transportation by rail, a safety relief device incorporating a frangible disc, meeting the requirements of §179.15 of this subchapter.

(iv) Reclosing pressure relief devices, frangible discs or permanent openings must not allow the release of lading during normal transportation conditions (i.e., due to splashing or surging).

(2) *Closures. All openings, except permanent vent openings authorized in paragraph (g)(1)(iii) of this section, must be securely closed during transportation. Packagings must be substantially leak-tight so as not to allow any more than dripping or trickling of a non-continuous flow when overturned. Closures must be designed and constructed to withstand, without exceeding the yield strength of the packaging, twice the static loading produced by the lading in any packaging orientation and at all operating temperatures.*

(3) Strength. Each packaging must be designed and constructed to withstand, without exceeding the yield strength of the packaging, twice the static loading produced by the lading in any orientation and at all operating temperatures.

(4) Compatibility. The packaging and lading must be compatible over the entire operating temperature range.

(5) Markings. In addition to any other markings required by this subchapter, each packaging must be durably marked in a place readily accessible for inspection in characters at least 4.8 mm (3/16 inch) with the manufacturer's name, date of manufacture, design temperature range, and maximum product weight (or "load limit" for tank cars) or volumetric capacity.

(6) Accident damage protection. For transportation by highway, external loading and unloading valves and closures must be protected from impact damage resulting from collision or overturn. Spraying equipment and the road oil application portion of a packaging are excepted from this requirement.

(7) New construction. Specification packagings that are being manufactured for the transport of elevated temperature materials must be authorized for current construction.

(h) Exceptions-(1) General. Packagings manufactured for elevated temperature materials service prior to October 1, 1993, which are not in full compliance with the requirements in paragraph (g) of this section, may continue in service if they meet the applicable requirements of subparts A and B of this part and meet the closure requirements in paragraph (g)(2) of this section by March 30, 1995.

(2) Kettles. Kettles in service prior to October 1, 1993, which are used to transport asphalt or bitumen, are excepted from specific provisions of this section as follows:

(i) Kettles with a total capacity of less than 2650 L (700 gallons), which are not in full compliance with the requirements of paragraph (g) of this section, may continue in elevated temperature material service if they meet the applicable requirements of subparts A and B of this part and if, after March 30, 1995, closures are secured during transport to resist opening in an overturn.

(ii) Kettles with a total capacity of 2650 L (700 gallons) or more, which are not in full compliance with the requirements of paragraph (g) of this section, may continue in elevated temperature material service if they meet the applicable requirements of subparts A and B of this part and if, after March 30, 1995, closures are secured during transport to resist opening in an overturn and no opening exceeds 46 cm^2 (7.1 in^2).

(3) *Molten metals and molten glass. This section does not apply to packagings used for transportation of molten metals and molten glass by rail when movement is restricted to operating speeds less than 15 miles per hour. (See §172.203(g)(3) of this subchapter for shipping paper requirements.)*

(4) Solid elevated temperature materials. A material which meets the definition of a solid elevated temperature material is excepted from all requirements of this subchapter except §172.325 of this subchapter.

[Amdt. 173-227, 58 FR 3349, Jan. 8, 1993, as amended by Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; 173-237, 59 FR 28493, June 2, 1994; 62 FR 51560, Oct. 1, 1997; 63 FR 52849, Oct. 1, 1998]

§173.249 Bromine.

When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of part 173 of this subchapter and the special provisions specified in column 7 of the §172.101 table.

(a) Class DOT 105A300W or 105A500W tank cars. Class 105A500W tank cars may be equipped with manway cover plates, pressure relief valves, vent valves, and loading/unloading valves that are required on Class 105A-300W tank cars. Tank cars must conform with paragraphs (d) through (f) of this section.

(b) Specification MC 310, MC 311, MC 312 or DOT 412 cargo tank motor vehicles conforming with paragraphs (d) through (f) of this section. The total quantity in one tank may not be less than 88 percent nor more than 96 percent of the volume of the tank. Cargo tanks in bromine service built prior to August 31, 1991 may continue in service under the requirements contained in §173.252(a)(4) of this part in effect on September 30, 1991.

(c) Specification IM 101 portable tanks conforming with paragraphs (d) through (f) of this section. The total quantity in one tank may not be less than 88 percent nor more than 92 percent of the volume of the tank.

(d) The tank must be made from nickel-clad or lead-lined steel plate. Nickel cladding or lead lining must be on the inside of the tank. Nickel cladding must comprise at least 20 percent of the required minimum total thickness. Nickel cladding must conform to ASTM Specification B162-69. Lead lining must be at least 4.763 mm (0.188 inch) thick. All tank equipment and appurtenances in contact with the lading must be lined or made from metal not subject to deterioration by contact with lading.

(e) Maximum filling density is 300 percent of the tank's water capacity. Minimum filling density is 287 percent of the tank's water capacity. Maximum water capacity is 9,253 kg (20,400 pounds) for DOT 105A300W tank cars. Maximum quantity of lading in DOT 105A300W tank cars is 27,216 kg (60,000 pounds). Maximum water capacity is 16,964 kg (37,400 pounds) for DOT 105A500W tank cars and DOT 105A500W tank cars equipped as described in paragraph (a) of this section. Maximum quantity of lading in DOT 105A500W tank cars is 49,895 kg (110,000 pounds).

(f) Tank shell and head thickness for cargo tank motor vehicles and portable tanks must be at least 9.5 mm (0.375 inch) excluding lead lining.

[Amdt. 173-224, 55 FR 52663, Dec. 21, 1990, as amended at 56 FR 66275, Dec. 20, 1991]

[CFR] PART 173 SUBPART G - Gases; Preparation and Packaging

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART G]

Subpart G - Gases; Preparation and Packaging

§173.300 [Reserved]

§173.300a Approval of independent inspection agency.

(a) Any person who (1) does not manufacture cylinders for use in the transportation of hazardous materials and (2) is not directly or indirectly controlled by any person or firm which manufactures cylinders for use in the transportation of hazardous materials, may apply to the Department of Transportation for approval as an independent inspection agency for the purpose of performing cylinder inspections and verifications required by part 178 of this subchapter.

(b) Each application filed under this section for approval as an independent inspection agency must:

(1) Be submitted in writing to: Associate Administrator for Hazardous Materials Safety, U.S. Department of Transportation, Washington, DC 20590-0001;

(2) State the name, address, principal business activity, and telephone number of the applicant and the name and address of each facility where tests and inspections are to be performed;

(3) State the name, address and principal business activity of each person having any direct or indirect ownership interest in the applicant greater than three percent and of each subsidiary or division of the applicant;

(4) If the applicant is not a permanent resident of the United States, include a designation of a permanent resident of the United States as his agent for service of process in accordance with §107.7 of this title;

(5) Set forth a detailed description of the inspection and testing facilities to be used by the applicant and the applicant's capability to perform the inspections and verify the tests required by part 178 of this subchapter;

(6) Identify by name each individual whom the applicant proposes to employ as an inspector responsible for certifying inspection and test results and a statement of that

person's qualifications; and

(7) Specify the identification or qualification number assigned to each inspector who is supervised by a certifying inspector identified in §173.300a(b)(6).

(c) Upon the request of the Associate Administrator for Hazardous Materials Safety the applicant shall allow the Associate Administrator or his or her representative to inspect the applicant's inspection and testing facilities. In the case of inspection and testing facilities located outside the United States, the applicant shall bear the cost of the inspection.

(d) If, on the basis of information submitted in the application and his own investigation, the Associate Administrator for Hazardous Materials Safety finds that the applicant is qualified to perform the inspections and verifications required by part 178 of this subchapter for cylinders to be used in the transportation of hazardous materials, he issues an approval subject to such terms and conditions as he considers necessary. After approval, the Associate Administrator for Hazardous Materials Safety, may authorize, upon request, the independent inspection agency to perform other inspections and functions for which the Associate Administrator for Hazardous Materials Safety, finds the applicant to be qualified. Such additional authorizations will be noted on each inspector's approval documents.

(e) The Associate Administrator for Hazardous Materials Safety will issue an approval as an independent inspection agency for the purpose of performing inspections and verifications within the United States to any competent and disinterested inspector of cylinders so designated by the Bureau of Explosives before May 1, 1976, who submits a copy of that designation by July 15, 1976, together with the name, the assigned identification or qualification number, and a statement of the qualifications of each person employed as an inspector under that designation to: Associate Administrator for Hazardous Materials Safety, U.S. Department of Transportation, Washington, DC 20590-0001.

(f) Notwithstanding any requirement of this subchapter to the contrary, between May 30, 1976, and August 15, 1976, inspections and verifications required by part 178 of this subchapter may be performed within the United States by any competent and disinterested inspector so designated by the Bureau of Explosives prior to May 1, 1976.

(g) An approval issued under this section is not transferable and is effective until surrendered or withdrawn or otherwise terminated by the Associate Administrator for Hazardous Materials Safety.

(h) The holder of an approval issued under this section shall notify the Associate Administrator for Hazardous Materials Safety within 20 days after the date there is any change in the information submitted in the application for the approval.

(i) Upon the request of the Associate Administrator for Hazardous Materials Safety the holder of an approval issued under this section shall allow the Director to inspect the holder's inspection and testing facilities and shall make available for inspection the holder's records pertaining to inspections and verifications required by part 178 of this subchapter. In the case of inspection and testing facilities located outside the United States and records made available for inspection outside the United States, the holder shall bear the costs of inspection.

[Amdt. 173-97, 41 FR 18414, May 4, 1976, as amended by Amdt. 173-142, 45 FR 81572, Dec. 11, 1980; Amdt. 173-158, 47 FR 43065, Sept. 30, 1982; Amdt. 173-194 50 FR 46056, Nov. 6, 1985; Amdt. 173-223, 55 FR 39981, Oct. 1, 1990; Amdt. 173-224, 56 FR 66279, Dec. 20, 1991; Amdt. 173-256, 61 FR 51338, Oct. 1, 1996]

§173.300b Approval of non-domestic chemical analyses and tests.

(a) Any person who manufactures cylinders outside the United States may apply to the Department for approval to have the chemical analyses and tests of those cylinders required by part 178 of this subchapter performed outside the United States for the purpose of qualifying them for use in the transportation of hazardous materials to, from or within the United States.

(b) Each application filed under this section for approval to perform chemical analyses and tests of cylinders outside the United States must:

(1) Be submitted in writing to: Associate Administrator for Hazardous Materials Safety, U.S. Department of Transportation, Washington, DC 20590-0001;

(2) State the name, address, and telephone number of the applicant and the name, address and a description of each facility at which cylinders are to be manufactured and chemical analyses and tests are to be performed;

(3) If the applicant is not a resident of the United States, include a designation of a permanent resident of the United States as his agent for service of process in accordance with §107.7 of this title;

(4) Set forth complete details concerning the dimension, materials of construction, wall thickness, water capacity, shape, type of joints, location and size of openings and other pertinent physical characteristics of each specification cylinder for which approval is being requested, including calculations for cylinder wall stress and wall thickness which may be shown on a drawing or on separate sheets attached to a descriptive drawing. If units of weights and measures are expressed in the metric system, they must also be stated in the English system equivalents; and

(5) Identify the independent inspection agency to be used.

(c) Upon the request of the Associate Administrator for Hazardous Materials Safety the applicant shall allow the Director to inspect the applicant's cylinder manufacturing and testing facilities and shall provide such materials and cylinders for analyses and tests as the Director may specify. The applicant shall bear the cost of the inspections, analyses, and tests.

(d) If, on the basis of the information submitted in the application and his own investigation, the Associate Administrator for Hazardous Materials Safety finds that the applicant has the proper manufacturing equipment and facilities and is otherwise capable of insuring the proper performance of the chemical analyses and tests required by part 178 of this subchapter for cylinders to be used in the transportation of hazardous materials, he issues an approval, subject to such terms and conditions as he considers necessary.

(e) An approval issued under this section is not transferable and is effective until surrendered or withdrawn or otherwise terminated by the Associate Administrator for Hazardous Materials Safety.

(f) The holder of an approval issued under this section shall notify the Associate Administrator for Hazardous Materials Safety within 20 days after the date there is any change in the information submitted in the application for the approval.

(g) Upon the request of the Associate Administrator for Hazardous Materials Safety the holder of an approval issued under this section shall allow the Director to inspect the holder's cylinder manufacturing and testing facilities, any cylinder manufactured under that approval, the holder's inspection and test records, and technical data files pertaining to any cylinder manufactured under that approval. In the case of facilities located outside the United States, or cylinders, records or files made available for inspection outside the United States, the holder shall bear the costs of inspection.

[Amdt. 173-97, 41 FR 18415, May 4, 1976, as amended by Amdt. 173-142, 45 FR 81572, Dec. 11, 1980; Amdt. 173-158, 47 FR 43065, Sept. 30, 1982; Amdt. 173-223, 55 FR 39981, Oct. 1, 1990; Amdt. 173-224, 56 FR 66279, Dec. 20, 1991]

§173.300c Termination of approval.

(a) The Associate Administrator for Hazardous Materials Safety may terminate an approval issued under §173.300a or §173.300b of this subpart if he determines:

(1) That information upon which approval was based is fraudulent or substantially erroneous;

(2) That the holder has not complied with subchapter C of this chapter;

(3) That, in the case of an independent inspection agency, the agency or an employee thereof is or appears to be controlled or improperly influenced by cylinder manufacturing interests;

(4) That the holder is subject to an outstanding final judgment of a Federal court which concerns the enforcement of subchapter C of this chapter and which has not been satisfied within a reasonable period of time; or

(5) That continuation of the approval is not consistent with the requirements of transportation safety.

(b) The Associate Administrator for Hazardous Materials Safety, before he terminates an approval issued under §173.300a or §173.300b of this subpart, notifies the holder in writing of the reasons therefor and provides the holder an opportunity to show why the approval should not be terminated.

[Amdt. 173-97, 41 FR 18415, May 4, 1976, as amended by Amdt. 173-142, 45 FR 81572, Dec. 11, 1980; Amdt. 173-224, 56 FR 66279, Dec. 20, 1991]

§173.301 General requirements for shipment of compressed gases in cylinders and spherical pressure vessels.

(a) *Gases capable of combining chemically. A cylinder charged with compressed gas must not contain gases or materials that are capable of combining chemically with each other or with the cylinder material so as to endanger its serviceability. See §173.34(e)(17) regarding the requalification of a cylinder that previously contained a corrosive liquid.*

(b) Ownership of container. A container charged with a compressed gas must not be shipped unless it was charged by or with the consent of the owner of the container.

(c) Retest of container. A container for which prescribed periodic retest has become due must not be charged and shipped until such retest has been properly made.

(d) Manifolding containers in transportation. No means of interconnecting such as manifolding of individual containers may be employed for the transportation of compressed gases, except as hereinafter authorized. Containers so manifolded shall be supported and held together as a unit by structurally adequate means. Safety relief devices on manifolded horizontal containers charged with flammable compressed gas shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the containers.

(1) Manifolding is authorized for containers of the following gases: argon, air, carbon dioxide, helium, neon, nitrogen, nitrous oxide, oxygen or sulfur hexafluoride provided that each container is individually equipped with pressure relief devices as required by §173.34(d) or §173.315(i).

(2) Manifolding is authorized for specification cylinders containing the following nonliquefied gases: boron trifluoride, carbon monoxide, ethylene, hydrogen, hydrocarbon gases, methane, nitrogen trifluoride, and tetrafluoroethylene, inhibited, except that aluminum cylinders are not authorized for boron trifluoride or nitrogen trifluoride service. Individual cylinders must be equipped with approved pressure relief devices as required by §173.34(d) or §173.315(i) of this part. Each cylinder must be equipped with an individual shutoff valve that must be tightly closed while in transit. Manifold branch lines of these individual shutoff valves must be sufficiently flexible to prevent damage to the valves which otherwise might result from the use of rigid branch lines. A temperature measuring device may be inserted in one cylinder of a manifold installation in place of the shutoff valve.

(3) Manifolding is authorized for specification cylinders containing the following gases: 1,1-Difluoroethylene, ethane, ethylene, hydrogen chloride, liquefied hydrocarbon gas, liquefied petroleum gas and propylene, except that aluminum cylinders are not authorized for hydrogen chloride service, provided each cylinder is equipped with approved pressure relief devices as required by §173.34(d) or §173.315(i) of this part: *and provided further, that each cylinder is equipped with an individual shutoff valve that must be tightly closed while in transit. Each cylinder must be separately charged and means must be provided to insure that no interchange of cylinder contents can occur during transportation. Manifold branch lines to these individual shutoff valves must be sufficiently flexible to prevent injury to the valves which otherwise might result from the use of rigid branch lines.*

(4) Manifolding is authorized for containers of acetylene, provided that each container is individually equipped with approved safety relief devices as required by §173.34(d): And further provided, That each container is equipped with an individual shutoff valve, or valves, which shall be tightly closed while in transit. Manifold branch lines to these individual shutoff valves shall be sufficiently flexible to prevent injury to the valves which otherwise might result from the use of rigid branch lines. All manifold containers shall be transported in a vertical position. For the checking of tare weights or for replacement of solvent the container shall be removed from the manifold. This requirement is not intended to prohibit the charging of the acetylene cylinders while manifolded.

(5) Manifolding is authorized for cargo tanks of the following gas provided individual cargo tanks are equipped with the safety relief valves and gaging devices, as required by §173.315(h) and (i): And further provided, That each cargo tank is equipped with individual valve, or valves, which shall be tightly closed while in transit and that each such container must be separately charged: Anhydrous ammonia.

(e) Container pressure. The pressure in the container at 70 ^{o}F. must not exceed the service pressure for which the container is marked or designated, except as provided in §173.302(c).

Note 1: In certain cases with liquefied gases the pressure at 70 ^{o}F. must be lower than the marked service pressure to avoid having a greater pressure at a temperature of 130 ^{o}F. than is permitted.

(1) For authorized containers not marked with a service pressure, the service pressure is designated as follows:

Specification marking	Service pressure-psig
DOT 3	1,800
3E	1,800
4	300
8	250
9	200
25	300
33	480
38	250
40	200
41	240

(2) For containers made prior to the effective date of specifications, the service pressure is designated as the same as for the same type of container made in accordance with current specifications.

(f) *Container pressure at 130 ^{o}F. The pressure in the container at 130 ^{o}F. shall not exceed 5/4 times the service pressure, except:*

(1) Containers charged with acetylene, liquefied nitrous oxide and liquefied carbon dioxide.

(2) When a cylinder is charged in accordance with §173.302(c), the pressure in the cylinder at 130 °F. must not exceed 5/4 times the filling pressure authorized therein.

(g) *Container valve protection. Containers charged with flammable, corrosive, or noxious gases, must have their valves protected by one of the following methods:*

(1) By equipping the containers with securely attached metal caps of sufficient strength to protect the valves from injury during transit.

(2) By boxing or crating the containers so as to give proper protection to the valves.

(3) By so constructing the containers that the valve is recessed into the container or otherwise protected so that it will not be subjected to a blow when the container is dropped on a flat surface.

(4) By loading the containers compactly in an upright position and securely bracing in cars or motor vehicles, when loaded by the consignor and to be unloaded by the consignee.

(5) By equipping with valves strong enough to avoid damage during transit for containers containing non-liquefied gas under pressure not exceeding 300 psi at 70 °F.

(h) *Compressed gas containers. Compressed gases must be in metal containers built in accordance with the DOT specifications, as shown below, in effect at the time of manufacture, and marked as required by the specification and the regulation for retesting if applicable;*

Packagings

-	-	-	-
DOT-2P	DOT-3D	DOT-4BW	DOT-8AL
2Q	3E	4B240ET	9[1]
ICC-3[1]	3HT	4C	1CC-25[1]
DOT-3A	DOT-3T	4D	26[1]
DOT- 3AL	-	-	-
DOT-3AX	4	4DA	33[1]
3A480X	4A	4DS	38[1]
3AA	4AA	4E	DOT-39
DOT-3AAX	4B	4L	40[1]
3B	4B240FLW	5	41[1]
3BN	4B240X[1]	5F	-
3C	4BA	8	-

[1]Use of existing cylinders authorized, but new construction not authorized.

(i) *Foreign cylinders in domestic use. (1) Except as provided in this section and §171.12(c) of this subchapter, a charged cylinder manufactured outside the United States may not be offered for transportation to, from, or within the United States unless it has been manufactured, inspected, and tested in accordance with the applicable DOT specification set forth in part 178 of this subchapter.*

(2) Effective October 1, 1999, a CTC specification cylinder manufactured, originally marked and approved in accordance with the Canadian Transport Commission (CTC) regulations and in full conformance with the Canadian Transport of Dangerous Goods

(TDG) Regulations is authorized for the transportation of a hazardous material to, from or within the United States under the following conditions:

(i) The CTC specification corresponds with a DOT specification and the cylinder markings are the same as those specified in this subchapter except that they were originally marked with the letters "CTC in place of DOT;

(ii) The cylinder has been requalified under a program authorized by the Canadian TDG regulations or requalified in accordance with the requirements in §173.34(e) within the prescribed requalification period provided for the corresponding DOT specification;

(iii) When the regulations authorize a cylinder for a specific hazardous material with a specification marking prefix of "DOT, a cylinder marked "CTC which otherwise bears the same markings that would be required of the specified "DOT" cylinder may be used; and

(iv) Transport of the cylinder and the material it contains is in all other respects in conformance with the requirements of this subchapter (e.g. valve protection, filling requirements, operational requirements, etc.).

(j) *Charging of foreign cylinders for export. (1) A cylinder manufactured outside the United States that has not been manufactured, inspected, tested and marked in accordance with part 178 of this subchapter may be charged with compressed gas in the United States, and shipped solely for export if it meets the following requirements, in addition to other requirements of the subchapter:*

(i) It has been inspected, tested and marked (with only the month and year of retest) in conformance with the procedures and requirements of §173.34(e) or the Associate Administrator for Hazardous Materials Safety has authorized the charging company to fill foreign cylinders under an alternative method of qualification; and

(ii) It meets the maximum filling density and service pressure requirements of this part.

(2) The bill of lading or other shipping paper must identify the cylinder and carry the following certification: "This cylinder has [These cylinders have] been retested and refilled in accordance with DOT requirements for export."

(k) *Outside packagings. Specification 2P, 2Q, 3E, 3HT, 4BA spherical type, 4D, 4DA, 4DS, 9[1], 39, 40[1], and 41[1] must be shipped in strong outside packagings, except that the 4BA spherical type may be securely mounted on pallets to provide protection for the spheres and any attachments.*

[1]Use of existing cylinders authorized, but new construction not authorized.

(1) Outside packaging must provide protection for the cylinder. Unless the cylinder has a protective collar or neck ring, the outside packaging must provide protection to the valve against accidental functioning and damage.

(l) Specifications 3AX, 3AAX, and 3T cylinders are authorized for transportation only when horizontally mounted on a motor vehicle or in an ISO framework or other framework of equivalent structural integrity. Cylinders may be transported in COFC or TOFC service only under conditions approved by the Associate Administrator for Safety, Federal Railroad Administration. Cylinder valves and safety devices must be protected as follows:

(1) Each cylinder must be fixed at one end of the vehicle or framework with provision

for thermal expansion at the opposite end attachment.

(2) The valve and safety relief device protective structure must be sufficiently strong to withstand a force equal to twice the weight involved with a safety factor of four, based on the ultimate strength of the material used; and

(3) Each discharge for a safety relief device on a cylinder containing a flammable gas must be upward and unobstructed.

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.301, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.302 Charging of cylinders with non-liquefied compressed gases.

(a) *Detailed requirements. Nonliquefied compressed gases (except gas in solution) for which charging requirements are not definitely prescribed in §173.304(a)(2) must be shipped, subject to §173.301, and §173.305 in specification containers as follows:*

(1) Specification 3,[1] 3A, 3AA, 3B, 3C,[1] 3D,[1] 3E, 4,[1] 4A,[1] 4B, 4BA, 4BW, 4C,[1] 25,[1] 26,[1] 33,[1] or 38,[1] (§§178.36, 178.37, 178.38, 178.42, 178.50, 178.51, 178.61 of this subchapter). See §§173.34 and 173.301(e).

[1]Use of existing cylinders authorized, but new construction not authorized.

Note 1: Authorized cylinders containing oxygen which is continuously fed to tanks containing live fish may be shipped irrespective of the provisions of §173.24.

(2) Specification 3HT (§178.44 of this subchapter) cylinders for aircraft use only, having a maximum service life of 24 years. Authorized only for nonflammable gases. Cylinders must be equipped with safety relief devices only of the frangible disc type which meet the requirements of §173.34(d). Each frangible disc must have a rated bursting pressure which does not exceed 90 percent of the minimum required test pressure of the cylinder. Discs with fusible metal backing are not permitted. Spec. 3HT cylinders may be shipped only when packed in strong outside packagings.

(3) Specification 3AX, 3AAX, or 3T (§§178.36, 178.37, 178,45 of this subchapter) cylinders are authorized only for the following nonliquefied gases: Air, argon, boron trifluoride, carbon monoxide, ethane, ethylene, helium, hydrogen, methane, neon, nitrogen, or oxygen, except that specification 3T is not authorized for hydrogen. As used in this paragraph methane is a nonliquefied gas which has a minimum purity of 98.0 percent methane and which is commerically free of corroding components.

(4) Specification 39 (§178.65 of this subchapter) cylinder. For flammable gases, internal volume may not exceed 75 cubic inches. Aluminum cylinders are authorized for oxygen only under the following conditions:

(i) Cylinder threads must be straight threads;

(ii) Cylinder must be equipped only with brass or stainless steel valve; and
(iii) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR-C-901c, dated January 15, 1981, paragraphs 3.7.2 and 3.8.2. Cleaning agents equivalent to those specified in RR-C-901c, may be used; however any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or less cleaned at the same time, must be tested for oil contamination in accordance with specification RR-C-901c, paragraph 4.4.2.3 and meet the standard of cleanliness specified.
(5) Specification 3AL (§178.46 of this subchapter) cylinders are authorized only for the following nonliquefied gases: air, argon, carbon monoxide, diborane, ethylene, helium, mercury free hydrogen, krypton, methane, nitrogen, neon, oxygen and xenon. Flammable gases shipped in 3AL cylinders are authorized only when transported by highway, rail and cargo-only aircraft. When used in oxygen service, aluminum cylinders must be in compliance with the following conditions:
(i) Cylinder must be equipped only with brass or stainless steel valve;
(ii) Cylinder must have only straight threads in the opening;
(iii) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR-C-901c, dated August 1, 1967, paragraphs 3.7.2, and 3.8.2. Cleaning agents equivalent to those specified in RR-C-901c may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or less, cleaned at the same time, must be tested for oil contamination in accordance with Specification RR-C-901c, paragraph 4.4.2.3, and meet the standard of cleanliness specified; and
(iv) The pressure in the cylinder may not exceed 3,000 psig at 70 ^{o}F.
(b) *Filling limits. (See §173.301(e).)*
(c) Special filling limits for Specifications 3A, 3AX, 3AA, 3AAX, and 3T cylinders. Specifications 3A, 3AX, 3AA, 3AAX, and 3T (§§178.36, 178.37, 178.45 of this subchapter) cylinders may be charged with compressed gases, other than liquefied, dissolved, poisonous, or flammable gases to a pressure 10 percent in excess of their marked service pressure, provided:
(1) That such cylinders are equipped with frangible disc safety relief devices (without fusible metal backing) having a bursting pressure not exceeding the minimum prescribed test pressure.
(2) That the elastic expansion shall have been determined at the time of the last test or retest by the water jacket method.
(3) That either the average wall stress or the maximum wall stress does not exceed the wall stress limitation shown in the following table (see Notes 1, 2 and 3):

Type of steel	Average wall stress limitation	Maximum wall stress limitation
Plain carbon steels over 0.35 carbon and medium manganese steels	53,000	58,000
Steels of analysis and heat-treatment specified in spec. 3AA	67,000	73,000
Steel of analysis and heat treatment specified in Spec. DOT-3T	87,000	94,000

Plain carbon steels less than 0.35 carbon made prior to 1920	45,000	48,000

Note 1: The average wall stress shall be computed from the elastic expansion data using the following formula:

S = 1.7EE / KV - 0.4P

where:

S = wall stress, pounds per square inch;
EE = elastic expansion (total less permanent) in cubic centimeters;
K = factorx10^{-}7 , experimentally determined for the particular type of cylinder being tested, or derived in accordance with CGA Pamphlet C-5;
V = internal volume in cubic centimeter (1 cubic inch=16.387 cubic centimeters);
P = test pressure, pounds per square inch.

Formula derived from formula of Note 2 and the following:

$EE = (PKVD^2) / (D^2 - d^2)$

Note 2: The maximum wall stress shall be computed from the formula:

$S = (P(1.3D^2+0.4d^2)) / (D^2 - d^2)$

where:

S = wall stress, pounds per square inch;
P = test pressure, pounds per square inch;
D = outside diameter, inches;
d = D - 2t, where t= minimum wall thickness determined by a suitable method

Note 3: Compliance with average wall stress limitation may be determined through computation of the elastic expansion rejection limit in accordance with CGA Pamphlet C-5 or through the use of the manufacturer's marked elastic expansion rejection limit (REE) on the cylinder.

(4) That an external and internal visual examination made at the time of test or retest shows the cylinder to be free from excessive corrosion, pitting, or dangerous defects.

(5) That a plus sign (+) be added following the test date marking on the cylinder to indicate compliance with paragraphs (c) (2), (3), and (4) of this section.

(d) *Fluorine. Fluorine must be shipped in Specification 3A1000, 3AA1000, or 3BN400 (§178.36, §178.37 or §178.39 of this subchapter) cylinders without safety relief device and equipped with valve protection cap. Such containers must not be charged to over*

400 p.s.i.g. at 70 ^{o}F. and must not contain over 6 pounds of gas.

(e) Verification of container pressure. (1) Each day, the pressure in a container representative of that day's compression must be checked by the charging plant after the container has cooled to a settled temperature and a record of this test kept for at least 30 days.

(f) Carbon monoxide. Carbon monoxide must be shipped in a Specification 3A, 3AX, 3AA, 3AAX, 3AL, 3, 3E, or 3T, (§§178.36, 178.37, 178.46, 178.42, 178.45 of this subchapter) cylinder having a minimum service pressure of 1,800 psig. The pressure in the cylinder must not exceed 1000 psig at 70 ^{o}F. except that if the gas is dry and sulfur free, the cylinder may be charged to five-sixths of the cylinder service pressure or 2000 psig, whichever is the lesser. Specification 3AL cylinders are authorized only when transported by highway, rail and cargo-only aircraft.

(g) Diborane and diborane mixtures. Diborane and diborane mixed with compatible compressed gas in Specification 3AA1800 (§178.37 of this subchapter), cylinders. The maximum filling density of the diborane shall not exceed 7 percent. Diborane mixed with compatible compressed gas must not have a pressure exceeding the service pressure of the cylinder if complete decomposition of the diborane occurs. Cylinder valves must be protected either by metal caps or by over packing cylinder in strong wooden boxes.

(h) Poisonous mixtures. Cylinders containing poison gases and poison gas mixtures meeting Division 2.3 Hazard Zone A must conform to the requirements of §173.40 of this part.

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Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.302, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.303 Charging of cylinders with compressed gas in solution (acetylene).

(a) *Cylinder, filler and solvent requirements. (Refer to applicable parts of Specification 8 and 8AL). Acetylene gas must be shipped in Specification 8 or 8AL (§178.59 or §178.60 of this subchapter) cylinders. The cylinders shall consist of metal shells filled with a porous material, and this material must be charged with a suitable solvent. The cylinders containing the porous material and solvent, shall be tested with satisfactory results in accordance with CGA Pamphlet C-12. Representative samples of cylinders charged with acetylene shall be tested with satisfactory results in accordance with CGA Pamphlet C-12.*

(1) The specific gravity of acetone solvent in acetylene cylinders must be 0.796 or over at 15.5 ^{o}C. (59.9 ^{o}F.).

(2) The amount of solvent added in the refilling operation must not cause the tare weight of the cylinder to exceed its marked tare weight. The tare weight includes the weight of the cylinder shell, porous filling, valve, safety relief devices and solvent, but without

removable cap.
(b) *Filling limits. The pressure in cylinders containing acetylene gas must not exceed 250 psi at 70 ^{o}F., and in case the cylinders are marked for a lower allowable charging pressure, at 70 ^{o}F., then that pressure must not be exceeded.*
(c) Data requirements on filler and solvent. Cylinders containing acetylene gas must not be shipped unless they were charged by or with the consent of the owner, and by a person, firm, or company having possession of complete information as to the nature of the porous filling, the kind and quantity of solvent in the cylinders, and the meaning of such markings on the cylinders as are prescribed by the Department's regulations and specifications applying to containers for the transportation of acetylene gas.
(d) Verification of container pressure. (1) Each day, the pressure in a container representative of that day's compression must be checked by the charging plant after the container has cooled to a settled temperature and a record of this test kept for at least 30 days.
(e) Prefill requirements. Before each filling of an acetylene cylinder, the person filling the cylinder must visually inspect the outside of the cylinder in accordance with the prefill requirements contained in CGA Pamphlet C-13, Section 3.

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Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.303, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.304 Charging of cylinders with liquefied compressed gas.
(a) *Detailed charging requirements. Liquefied gases shall be charged in accordance with the specific provisions of paragraph (a)(2) of this section or paragraph (e) of this section. Where charging requirements are not specifically prescribed, liquefied gases, except gas in solution, must be shipped, subject to the applicable paragraphs under General Requirements for Shipment (see §173.301), the charging requirements of this section for liquefied compressed gas, or the charging requirements for mixtures (see §173.305), in containers manufactured under specifications, as follows:*
(1) Specification 3,[1] 3A, 3AA, 3B, 3BN, 3D[1] 3E, 4,[1] 4A,[1] 4B, 4BA, 4B240ET, 4BW, 4E, 9,[1] 25,[1] 26,[1] 38,[1] 39, 40,[1] or 41,[1] (§§178.36, 178.37, 178.38, 178.39, 178.42, 178.50, 178.51, 178.55, 178.61, 178.65, 178.68 of this subchapter), except that no Specification 4E, 9, 39, 40, 41 packaging may be charged and shipped with a mixture containing a pyroforic liquid, carbon bisulfide (disulfide), ethyl chloride, ethylene oxide, nickel carbonyl, spirits of nitroglycerin, or poisonous material (Division 6.1 or 2.3), unless specifically authorized in this part.
[1]Use of existing cylinders authorized, but new construction not authorized.
(2) The following requirements must be complied with for the gases named (for cryogenic liquids, see §173.316):

Kind of gas	Maximum permitted filling density (percent) (see Note 1)	Containers marked as shown in this column or of the same type with higher service pressure must be used except as provided in 173.34 (a), (b), 173.301(j) (see notes following table)
Anhydrous ammonia	54	DOT-4; DOT-3A480; DOT-3AA480; DOT-3A480X; DOT-4A480; DOT-3; DOT-4AA480; DOT-3E1800; DOT-3AL480.
Bromotri- fluoro- methane (R-13B1 or H-1301)	124	DOT-3A400; DOT-3AA400; DOT-3B400; DOT-4A400; DOT-4AA480; DOT-4B400; DOT-4BA400; DOT-4BW400; DOT-3E1800; DOT-39; DOT-3AL400.
Carbon dioxide (see notes 4, 7, and 8)	68	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-3HT2000; DOT-39; DOT-3AL1800.
Carbon dioxide, refrigerated liquid (see paragraph (h))	-	DOT-4L.
Chlorine (see Note 2)	125	DOT-3A480; DOT-3AA480; DOT-25; DOT-3; DOT-3BN480; DOT-3E1800.
Chlorodifluroethane (R-142b) *or* 1-chloro-1, 1-difluoroethane (see Note 8)	100	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800; DOT-39, DOT-3AL150.
Chlorodifluoromethane (R-22) (see Note 8)	105	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-4B240; DOT-4BA240; DOT-4BW240; DOT-4B240ET; DOT-4E240; DOT-39; DOT-41; DOT-3E1800; and DOT-3ALA240.
Chloropentafluorethane, (R-115)	110	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4BA225; DOT-4B225; DOT-4BW225; DOT-3E1800; DOT-39; and DOT-3AL225.
Chlorotrifluoromethane (R-13) (see Note 8)	100	DOT-3A1800; DOT-3AA1800; DOT-3; DOT-3E1800; DOT-39; and DOT-3AL1800.
Cyclopropane (see Notes 8 and 9)	55	DOT-3A225; DOT-3A480X; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4AA480; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-3; DOT-3E1800; DOT-39; and DOT-3AL225.
Dichlorodifluoromethane (R-12) (see Note 8)	119	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-4E225; DOT-9; DOT-39; DOT-41; DOT-3E1800; and DOT-3AL225.
Dichlorodifluoromethane and difluoroethane mixture (constant boiling mixture) (R-500) (see Note 8)	Not liquid full at 130 ^{o}F	DOT-3A240; DOT-3AA240, DOT-3B240; DOT-3E1800; DOT-4A240; DOT-4B240; DOT-4BA240; DOT-

		4BW240; DOT-4E240; DOT-9, DOT-39.
Difluoroethane (R-152a) (see Note 8)	79	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800; DOT-3AL150.
1,1-Difluoroethylene (R-1132A)	73	DOT-3A2200, DOT-3AA2200, DOT-3AX2200, DOT-3AAX2200, DOT-3T2200, DOT-39.
Dimethylamine, anhydrous	59	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150 DOT-4BA225; DOT-4BW225; ICC-3E1800.
Ethane (see Notes 8 and 9)	35.8	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; DOT-3AL1800.
Ethane (see Notes 8 and 9)	36.8	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; DOT-3AL2000.
Ethylene (see Notes 8 and 9)	31.0	DOT-3A1800; DOT-3AX1800 DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; and DOT-3AL1800 .
Ethylene (see Notes 8 and 9)	32.5	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; and DOT-3AL2000.
Ethylene (see Notes 8 and 9)	35.5	DOT-3A2400; DOT-3AX2400; DOT-3AA2400; DOT-3AAX2400; DOT-3T2400; DOT-39; DOT-3AL2400.
Hydrogen chloride	65	DOT-3A1800; DOT-3AA1800; DOT-3AX1800; DOT-3AAX1800; DOT-3; DOT-3T1800; DOT-3E1800.
Hydrogen sulfide (see Note 10)	62.5	DOT-3A480; DOT-3AA480; DOT-3B480; DOT-4A480; DOT-4B480; DOT-4BA480; DOT-4BW480.; DOT-26-480; DOT-3E1800; DOT-3AL480.
Insecticide, liquefied gas (See Notes 8 and 12)	Not liquid full at 130 ^{o}F	DOT-3A300; DOT-3AA300; DOT-3B300; DOT-4B300; DOT-4BA300; DOT-4BW300; DOT-9; DOT-40; DOT-41; DOT-3E1800.
Liquefied nonflammable gases, liquid other than those classified as flammable, corrosive, or poisonous, and mixtures or solutions thereof, charged with nitrogen, carbon dioxide, or air (see Notes 7 and 8)	Not liquid full at 130 ^{o}F	Specification packaging authorized in paragraph (a)(1) of this section and DOT-3HT; DOT-4D; DOT-4DA; DOT-4DS.
Methylacetylene-propadiene, stabilized (see Note 5)	Not liquid full at 130 ^{o}F	DOT-4B240 without brazed seams; DOT-4BA240 without brazed seams; DOT-3A240; DOT-3AA240; DOT-3B240; DOT-3E1800; DOT-4BW240; DOT-4E240; DOT-4B240ET; DOT-4; DOT-41; DOT-3AL240.
Methyl chloride	84	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-3; DOT-4; DOT-25; DOT-26-300; DOT-38; DOT-3E1800; DOT-4B240ET.

		Cylinders complying with DOT-3A150; DOT-3B150; DOT-4A150, and DOT-4B150 manufactured prior to Dec. 7, 1936 are also authorized.
Methyl mercaptan	80	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-4B240; DOT-4B240ET; DOT-3E1800; DOT-4BA240; DOT-4BW240.
Monomethylamine, anhydrous	60	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800.
Nitrosyl chloride	110	DOT-3BN400 only.
Nitrous oxide (see Notes 7, 8, and 11)	68	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-3HT2000; DOT-39; DOT-.AL1800.
Nitrous oxide, refrigerated liquid (see paragraph (h))	-	DOT-4L.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s. (see Notes 8 and 13)	Not liquid full at 130 °F	DOT-3A240; DOT-3AA240; DOT-3B240; DOT-3E1800; DOT-4A240; DOT-4B240; DOT-4BA240; DOT-4BW240; DOT-4E240; DOT-9; DOT-39; and DOT-3AL240.
Sulfur dioxide (see note 8)	125	DOT-3A225; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-3; DOT-4; DOT-25; DOT-26-150; DOT-38; DOT-39; DOT-3E1800; and DOT-3AL225.
Sulfur hexafluoride	120	DOT-3A1000; DOT-3AA1000; DOT-3AAX2400; DOT-3; DOT-3AL1000; DOT-3E1800; DOT-3T1800.
Sulfuryl fluoride	106	DOT-3A480; DOT-3AA480; DOT-3E1800; DOT-4B480; DOT-4BA480; DOT-4BW480.
Tetrafluoroethylene, inhibited	90	DOT-3A1200; DOT-3AA1200; DOT-3E1800.
Trifluorochloroethylene	115	DOT-3A300; DOT-3AA300; DOT-3B300; DOT-4A300; DOT-4B300; DOT-4BA300; DOT-4BW300; DOT-3E1800.
Trimethylamine, anhydrous	57	DOT-3A150; DOT-3AA150; DOT-3B150; DOT-4B150; DOT-4BA225; DOT-4BW225; DOT-3E1800.
Vinyl chloride (see Note 5)	84	DOT-4B150 without brazed seams; DOT-4BA225 without brazed seams; DOT-4BW225; DOT-3A150; DOT-3AA150; DOT-25; DOT-3E1800; DOT-3AL150.
Vinyl fluoride, inhibited	62	DOT-3A1800; DOT-3AA1800; DOT-3E1800; DOT-3AL1800.
Vinyl methyl ether (see Note 5)	68	DOT-4B150, without brazed seams; DOT-4BA225 without brazed seams; DOT-4BW225; DOT-3A150; DOT-3AA150; DOT-3B150; DOT-25; DOT-3E1800.

NOTE 1: The "filling density" is hereby defined as the percent ratio of the weight of gas in a container to the weight of water that the container will hold at 60 ^{o}F. (1 lb of water=27.737 cubic inches at 60 ^{o}F.).

NOTE 2: Cylinders purchased after Oct. 1, 1944, for the transportation of chlorine must contain no aperture other than that provided in the neck of the cylinder for attachment of a valve equipped with an approved safety relief device. Cylinders purchased after Nov. 1, 1935, and charged with chlorine must not contain over 150 pounds of gas.

NOTE 3: [Reserved]

NOTE 4: Special carbon dioxide mining devices containing a heating element and charged with not over 6 pounds of carbon dioxide may be filled to a density of not over 85 percent, provided the cylinder is made of steel with a calculated bursting pressure in excess of 39,000 psi, be fitted with a frangible disc that will operate at not over 57 percent of that pressure, and be able to withstand a drop of 10 feet when striking crosswise on a steel rail while under a pressure of at least 3,000 psi. Such devices must be shipped in strong boxes or must be wrapped in heavy burlap and bound by 12-gauge wire with the wire completely covered by friction tape. Wrapping must be applied so as not to interfere with the functioning of the frangible disc safety relief device. Shipments must be described as "liquefied carbon dioxide gas (mining device)" and marked, labeled, and certified as prescribed for liquefied carbon dioxide.

NOTE 5: All parts of valve and safety relief devices in contact with contents of cylinders must be of a metal or other material, suitably treated if necessary, which will not cause formation of any acetylides.

NOTE 6: [Reserved]

NOTE 7: Specification 3HT cylinders for aircraft use only, having a maximum service life of 24 years. Authorized only for nonflammable gases. Cylinders must be equipped with pressure relief devices only of the frangible disc type which meet the requirements of §173.34(d). Each frangible disc must have a rated bursting pressure which does not exceed 90 percent of the minimum required test pressure of the cylinder. Discs with fusible metal backing are not permitted. Cylinders may be shipped only when packed in strong outside packagings.

NOTE 8: See §173.301(k).

NOTE 9: When used for shipment of flammable gases, the internal volume of a specification 39 cylinder must not exceed 75 cubic inches.

NOTE 10: Each valve outlet must be sealed by a threaded cap or a threaded solid plug.

NOTE 11: See §173.304(a)(4).

NOTE 12: For an insecticide gas which is nonpoisonous and nonflammable, see §173.305(c).

NOTE 13: For a refrigerant or dispersant gas which is nonpoisonous and nonflammable, see §173.304(e).

(3) Specification 3AL (§178.46 of this subchapter) cylinders are authorized for the following liquefied gases: cyclobutane, hydrogen selenide, propylene, silane, carbonyl

sulfide, vinyl bromide, and dimethyl ether. Shipments of flammable gases are authorized only when transported by highway, rail and cargo aircraft only.

(4) Specification DOT 3AL (§178.46 of this subchapter) cylinders when used in nitrous oxide service must be in compliance with the following conditions:

(i) Cylinder must be equipped only with brass or stainless steel valve; and

(ii) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR-C-901c paragraphs 3.7.2 and 3.8.2. Cleaning agents equivalent to those specified in RR-C-901c may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or less cleaned at the same time must be tested for oil contamination in accordance with Specification RR-C-901c paragraph 4.4.2.3 and meet the standard of cleanliness specified.

(b) *Filling limits. Except for carbon dioxide, 1,1-Difluoroethylene (R-1132A), nitrous oxide and vinyl fluoride, inhibited, the liquid portion of a liquefied gas must not completely fill the packaging at any temperature up to and including 130 °F. The liquid portion of vinyl fluoride, inhibited, may completely fill the cylinder at 130 °F. provided the pressure at the critical temperature does not exceed one and one-fourth times the service pressure.*

(c) Verification of content in cylinder. (1) Liquefied gases must be charged by weight, by volume measurement of liquid, charging line, by the use of proper scales or when lower in pressure than required for liquefaction a pressure-temperature chart may be used in charging to insure that the service pressure at 70 °F. times 5/4 will not be exceeded at 130 °F.

(2) Except as noted in paragraph (d)(4) of this section, the amount of liquefied gas charged into a container must be determined by weight, or if charged at a pressure lower than the liquefaction point, by pressure shown on a chart for the specific gas. Weight must be checked, after disconnecting from the charging line, by the use of proper scales.

(d) *Requirements for liquefied petroleum gas. (1) Filling density limited as follows:*

Minimum specific gravity of the liquid material at 60 F.	Maximum filling density in percent of the water-weight capacity of the container
0.271 to 0.289	26
0.290 to 0.306	27
0.307 to 0.322	28
0.323 to 0.338	29
0.339 to 0.354	30
0.355 to 0.371	31
0.372 to 0.398	32
0.399 to 0.425	33
0.426 to 0.440	34
0.441 to 0.452	35

0.453 to 0.462	36
0.463 to 0.472	37
0.473 to 0.480	38
0.481 to 0.488	39
0.489 to 0.495	40
0.496 to 0.503	41
0.504 to 0.510	42
0.511 to 0.519	43
0.520 to 0.527	44
0.528 to 0.536	45
0.537 to 0.544	46
0.545 to 0.552	47
0.553 to 0.560	48
0.561 to 0.568	49
0.569 to 0.576	50
0.577 to 0.584	51
0.585 to 0.592	52
0.593 to 0.600	53
0.601 to 0.608	54
0.609 to 0.617	55
0.618 to 0.626	56
0.627 to 0.634	57

(2) Subject to §173.301(f), any filling density percentage prescribed in this section is authorized to be increased by 2 for liquefied petroleum gas in Spec. 26 or 3 cylinders or in Spec. 3A marked for 1,800 psig, or higher, service pressure.

(3) Liquefied petroleum gas must be shipped in specification containers as follows:

(i) Specification 3,[1] 3A, 3AA, 3B, 3E, 3AL, 4B, 4BA, 4B240FLW, 4B240ET, 4BW, 4B240X,[1] 4E, 4,[1] 4A,[1] 9,[1] 25,[1] 26,[1] 38,[1] 39, or 41[1] (§§178.36, 178.37, 178.38, 178.42, 178.46, 178.50, 178.51, 178.54, 178.55, 178.61, 178.65, 178.68 of this subchapter) cylinders. The internal volume of a Specification 39 cylinder must not exceed 75 cubic inches. Shipments of flammable gases in 3AL cylinders are authorized only when transported by highway, rail and cargo-only aircraft.

[1]Use of existing cylinders authorized, but new construction not authorized.

Note 1: Cylinders marked as complying with DOT Spec. 4B240FLW bearing manufacturer's symbol WCO and serial numbers 47A-1 to 47A-59200, inclusive, varying from the specification requirements as to physical properties of steel, are authorized for the transportation of liquefied petroleum gases.

(ii) Additional containers may be used within the limits of quantity and pressure as follows:

Type of container	Maximum capacity	Maximum charging pressure-p.s.i.g.

-	Cubic inches	Gallons	-
DOT-2P or DOT-2Q (see Note 1)	31.83	-	45 p.s.i.g. at 70 ^{o}F. and 105 p.s.i.g. at 130 ^{o}F. (see Note 2).
DOT-2P or DOT-2Q (see Note 1)	31.83	-	35 p.s.i.g. at 70 ^{o}F. and 100 p.s.i.g. at 130 ^{o}F.
DOT-3C or DOT-4C	3,881	16+5% tolerance	145 p.s.i.g. at 130 ^{o}F.

Note 1: Containers must be packed in strong wooden or fiber boxes of such design as to protect valves from injury or accidental functioning under conditions incident to transportation. Each completed container filled for shipment must have been heated until contents reached a minimum temperature of 130 ^{o}F., without evidence of leakage, distortion, or other defect. Each outside shipping container must be plainly marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS."

Note 2: Containers must be equipped with safety relief devices which will prevent rupture of the containers and dangerous projection of the closing devices when the containers are exposed to the action of fire.

(4) Verification of content. Containers with a water capacity of 200 pounds or more and for use with a liquefied petroleum gas with a specific gravity at 60 ^{o}F. of 0.504 or greater may have their contents determined by using a fixed length dip tube gauging device. The length of the dip tube shall be such that when a liquefied petroleum gas with a specific volume of 0.03051 cu. ft./lb. at a temperature of 40 ^{o}F. is charged into the container it just reaches the bottom of the tube. The weight of this liquid shall not exceed 42 percent of the water capacity of the container which must be stamped thereon. The length of the dip tube, expre ssed in inches carried out to one decimal place and prefixed with the letters "DT" shall be stamped on the container and on the exterior of removable type dip tube; for the purpose of this requirement the marked length shall be expressed as the distance measured along the axis of a straight tube from the top of the boss through which the tube is inserted to the proper level of the liquid in the container. The length of each dip tube shall be checked when installed by weighing each container after filling except when installed in groups of substantially identical containers in which case one of each 25 containers shall be weighed. The quantity of liquefied gas in each container must be checked by means of the dip tube after disconnecting from the charging line. The outlet from the dip tube shall be not larger than a No. 54 drill size orifice. A container representative of each day's filling at each charging plant shall have its contents checked by weighing after disconnecting from the charging line.

(e) *Refrigerant gases. Refrigerant gases which are nonpoisonous and nonflammable under this part, must be shipped in cylinders as prescribed in paragraph (a) (1) or (2) of this section, or as follows:*

(1) Specifications 2P and 2Q (§§178.33, 178.33a of this subchapter). Inside metal containers packed in a strong wooden or fiberboard box of such design as to protect valves from injury or accidental functioning under conditions incident to transportation.

Pressure in the container must not exceed 85 pounds per square inch absolute at 70 ^{o}F. Each completed metal container filled for shipment must be heated until content reaches a minimum temperature of 130 ^{o}F. without evidence of leakage, distortion, or other defect. Each outside shipping container must be plainly marked "Inside Containers Comply With Prescribed Specification."

(2) [Reserved]

(f) *Engine starting fluid. Engine starting fluid containing compressed gas or gases which are flammable under this part must be shipped in cylinders as prescribed in paragraph (a)(1) of this section, or as follows:*

(1) Inside nonrefillable metal containers having a capacity not over 32 cubic inches. Containers must be packaged in strong, tight packagings. Pressure in the container must not exceed 140 psi, absolute, at 130 ^{o}F. However, if the pressure exceeds 140 psi, absolute at 130 ^{o}F., a Spec. 2P (§178.33 of this subchapter) container must be used. In any event, the metal container must be capable of withstanding without bursting a pressure of one and one-half times the pressure of the content at 130 ^{o}F. The liquid content of the material and gas must not completely fill the container at 130 ^{o}F. Each completed container filled for shipment must have been heated until content reaches a minimum temperature of 130 ^{o}F., without evidence of leakage, distortion, or other defect. Each outside shipping container must be plainly marked, "INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS."

(2) [Reserved]

(g) *Poisonous mixtures. Cylinders containing poison gases and poison gas mixtures meeting Division 2.3 Hazard Zone A must conform to the requirements of §173.40 of this part.*

(h) Carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid. (1) The following provisions apply to carbon dioxide, refrigerated liquid and nitrous oxide, refrigerated liquid:

(i) DOT 4L cylinders conforming to the provisions of this paragraph are authorized.

(ii) Each cylinder must be protected with at least one pressure relief valve and at least one frangible disc conforming to §§173.34(d) and 173.304(a)(2). The relieving capacity of the pressure relief device system must be equal to or greater than that calculated by the applicable formula in paragraph 5.9 of CGA Pamphlet S-1.1.

(iii) The temperature and pressure of the gas at the time of loading may not exceed -18 ^{o}C (0 ^{o}F) and 2007 kPa (291 psig) for carbon dioxide and -15.6 ^{o}C (+4 ^{o}F) and 2007 kPa (291 psig) for nitrous oxide. Maximum time in transit may not exceed 120 hours.

(2) The following pressure control valve settings, design service temperatures and filling densities apply:

Pressure control valve setting maximum start-to discharge gauge pressure in kPa (psig)	Maximum permitted filling density (percent by weight)	
-	Carbon dioxide, refrigerated liquid	Nitrous oxide, refrigerated liquid
724 kPa (105 psig)	108	104

1172 kPa (170 psig)	105	101
1586 kPa (230 psig)	104	99
2034 kPa (295 psig)	102	97
2483 kPa (360 psig)	100	95
3103 kPa (450 psig)	98	83
3723 kPa (540 psig)	92	87
4309 kPa (625 psig)	86	80
Design service temperature °C (°F)	-196 °C (-320 °F)	-196 °C (-320 °F)

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.304, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.305 Charging of cylinders with a mixture of compressed gas and other material.

(a) *Detailed requirements. A mixture of a compressed gas and any other material must be shipped as a compressed gas if the mixture is a compressed gas as designated in §173.115 and when not in violation of §173.301(a).*

(b) Filling limits. (See §173.301(e).) For mixtures, the liquid portion of the liquefied compressed gas at 130 °F. plus any additional liquid or solid must not completely fill the container.

(c) Nonpoisonous and nonflammable mixtures. Mixtures containing compressed gas or gases including insecticides, which mixtures are nonpoisonous and nonflammable under this part must be shipped in cylinders as prescribed in §173.304(a) or as follows:

(1) Specification 2P (§178.33 of this subchapter). Inside metal containers equipped with safety relief devices of a type examined by the Bureau of Explosives and approved by the Associate Administrator for Hazardous Materials Safety, and packed in strong wooden or fiber boxes of such design as to protect valves from injury or accidental functioning under conditions incident to transportation. Pressure in the container may not exceed 85 psia at 70 °F. Each completed metal container filled for shipment must be heated until content reaches a minimum temperature of 130 °F., without evidence of leakage, distortion or other defect. Each outside shipping container must be plainly marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS."

(2) [Reserved]

(d) *Poisonous mixtures. A mixture containing any poisonous material (Division 6.1 or 2.3) in such proportions that the mixture would be classed as poisonous under §173.115 or §173.132 must be shipped in packagings as authorized for these poisonous materials.*

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§173.306 Limited quantities of compressed gases.

(a) Limited quantities of compressed gases for which exceptions are permitted as noted by reference to this section in §172.101 of this subchapter are excepted from labeling (except when offered for transportation by air) and, unless required as a condition of the exception, specification packaging requirements of this subchapter when packed in accordance with the following paragraphs. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter except §177.817. Each package may not exceed 30 kg (66 pounds) gross weight.

(1) When in containers of not more than 4 fluid ounces capacity (7.22 cubic inches or less) except cigarette lighters. Special exceptions for shipment of certain compressed gases in the ORM-D class are provided in paragraph (h) of this section.

(2) When in metal containers filled with a material that is not classed as a hazardous material to not more than 90 percent of capacity at 70 ^{o}F. and then charged with nonflammable, nonliquefied gas. Each container must be tested to three times the pressure at 70 ^{o}F. and, when refilled, be retested to three times the pressure of the gas at 70 ^{o}F. Also, one of the following conditions must be met:

(i) Container is not over 1 quart capacity and charged to not more than 170 psig at 70 ^{o}F. and must be packed in a strong outside packaging, or

(ii) Container is not over 30 gallons capacity and charged to not more than 75 psig at 70 ^{o}F.

(3) When in a metal container for the sole purpose of expelling a nonpoisonous (other than a Division 6.1 Packing Group III material) liquid, paste or powder, provided all of the following conditions are met. Special exceptions for shipment of aerosols in the ORM-D class are provided in paragraph (h) of this section.

(i) Capacity must not exceed one liter (61.0 cubic inches).

(ii) Pressure in the container must not exceed 180 psig at 130 ^{o}F. If the pressure exceeds 140 psig at 130 ^{o}F., but does not exceed 160 psig at 130 ^{o}F., a specification DOT 2P (§178.33 of this subchapter) inside metal container must be used; if the pressure exceeds 160 psig at 130 ^{o}F., a specification DOT 2Q (§178.33a of this subchapter) inside metal container must be used. In any event, the metal container must be capable of withstanding without bursting a pressure of one and one-half times the equilibrium pressure of the content at 130 ^{o}F.

(iii) Liquid content of the material and gas must not completely fill the container at 130 ^{o}F.

(iv) The container must be packed in strong outside packagings.

(v) Each container must be subjected to a test performed in a hot water bath; the temperature of the bath and the duration of the test must be such that the internal pressure reaches that which would be reached at 55 ^{o}C (131 ^{o}F) (50 ^{o}C (122 ^{o}F) if the liquid phase does not exceed 95% of the capacity of the container at 50 ^{o}C (122 ^{o}F)). If the contents are sensitive to heat, the temperature of the bath must be set at between 20 ^{o}C (68 ^{o}F) and 30 ^{o}C (86 ^{o}F) but, in addition, one container in 2,000 must be tested at the higher temperature. No leakage or permanent deformation of a container may occur.

(vi) Each outside packaging must be marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS."

(4) Gas samples must be transported under the following conditions:

(i) A gas sample may only be transported as non-pressurized gas when its pressure corresponding to ambient atmospheric pressure in the container is not more than 105 kPa absolute (15.22 psia).

(ii) Non-pressurized gases, toxic (or toxic and flammable) must be packed in hermetically sealed glass or metal inner packagings of not more than one L (0.3 gallons) overpacked in a strong outer packaging.

(iii) Non-pressurized gases, flammable must be packed in hermetically-sealed glass or metal inner packagings of not more than 2.5 L (0.5 gallons) overpacked in a strong outer packaging.

(b) *Exemptions for foodstuffs, soap, biologicals, electronic tubes, and audible fire alarm systems. Limited quantities of compressed gases, (except poisonous gases as defined by §173.115(a)(3) of this part) for which exceptions are provided as indicated by reference to this section in §172.101 of this subchapter, when in accordance with one of the following paragraphs are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter, except §177.817. Special exceptions for shipment of certain compressed gases in the ORM-D class are provided in paragraph (h) of this section.*

(1) Foodstuffs or soaps in a nonrefillable metal container not exceeding one liter (61.0 cubic inches), with soluble or emulsified compressed gas, provided the pressure in the container does not exceed 140 p.s.i.g. at 130 ^{o}F. The metal container must be capable of withstanding without bursting a pressure of one and one-half times the equilibrium pressure of the content at 130 ^{o}F.

(i) Containers must be packed in strong outside packagings.

(ii) Liquid content of the material and the gas must not completely fill the container at 130 ^{o}F.

(iii) Each outside packaging must be marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS."

(2) Cream in refillable metal receptacles with soluble or emulsified compressed gas. Containers must be of such design that they will hold pressure without permanent deformation up to 375 psig and must be equipped with a device designed so as to release pressure without bursting of the container or dangerous projection of its parts at

higher pressures. This exception applies to shipments offered for transportation by refrigerated motor vehicles only.

(3) Nonrefillable metal containers charged with a Division 6.1 Packing Group III or nonflammable solution containing biological products or a medical preparation which could be deteriorated by heat, and compressed gas or gases. The capacity of each container may not exceed 35 cubic inches (19.3 fluid ounces). The pressure in the container may not exceed 140 psig at 130 ^{o}F., and the liquid content of the product and gas must not completely fill the containers at 130 ^{o}F. One completed container out of each lot of 500 or less, filled for shipment, must be heated, until the pressure in the container is equivalent to equilibrium pressure of the content at 130 ^{o}F. There must be no evidence of leakage, distortion, or other defect. Container must be packed in strong outside packagings.

(4) Electronic tubes, each having a volume of not more than 30 cubic inches and charged with gas to a pressure of not more than 35 psig and packed in strong outside packagings.

(5) Audible fire alarm systems powered by a compressed gas contained in an inside metal container when shipped under the following conditions:

(i) Each inside container must have contents which are not flammable, poisonous, or corrosive as defined under this part,

(ii) Each inside container may not have a capacity exceeding 35 cubic inches (19.3 fluid ounces),

(iii) Each inside container may not have a pressure exceeding 70 psig at 70 ^{o}F. and the liquid portion of the gas may not completely fill the inside container at 130 ^{o}F., and

(iv) Each nonrefillable inside container must be designed and fabricated with a burst pressure of not less than four times its charged pressure at 130 ^{o}F. Each refillable inside container must be designed and fabricated with a burst pressure of not less than five times its charged pressure at 130 ^{o}F.

(c)-(d) [Reserved]

(e) *Refrigerating machines. (1) New (unused) refrigerating machines or components thereof are excepted from the specification packaging requirements of this part if they meet the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter except §177.817.*

(i) Each pressure vessel may not contain more than 5,000 pounds of Group A1 refrigerant as classified in ANSI/ASHRAE Standard 15 or not more than 50 pounds of refrigerant other than Group A1.

(ii) Machines or components having two or more charged vessels may not contain an aggregate of more than 2,000 pounds of Group I refrigerant or more than 100 pounds of refrigerant other than Group I.

(iii) Each pressure vessel must be equipped with a safety device meeting the requirements of ANSI/ASHRAE 15.

(iv) Each pressure vessel must be equipped with a shut-off valve at each opening except openings used for safety devices and with no other connection. These valves must be closed prior to and during transportation.

(v) Pressure vessels must be manufactured, inspected and tested in accordance with ANSI/ASHRAE 15, or when over 6 inches internal diameter, in accordance with the ASME Code.

(vi) All parts subject to refrigerant pressure during shipment must be tested in accordance with ANSI/ASHRAE 15.

(vii) The liquid portion of the refrigerant, if any, may not completely fill any pressure vessel at 130 ^{o}F.

(viii) The amount of refrigerant, if liquefied, may not exceed the filling density prescribed in §173.304.

(f) *Accumulators. The following applies to accumulators, which are hydraulic accumulators containing nonliquefied, nonflammable gas, and nonflammable liquids or pneumatic accumulators containing nonliquefied, nonflammable gas, fabricated from materials which will not fragment upon rupture.*

(1) Accumulators installed in motor vehicles, construction equipment, and assembled machinery and designed and fabricated with a burst pressure of not less than five times their charged pressure at 70 ^{o}F., when shipped, are not subject to the requirements of this subchapter.

(2) Accumulators charged with limited quantities of compressed gas to not more than 200 p.s.i.g. at 70 ^{o}F. are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 and to part 177 of this subchapter except §177.817.

(i) Each accumulator must be shipped as an inside packaging,

(ii) Each accumulator may not have a gas space exceeding 2,500 cubic inches under stored pressure, and

(iii) Each accumulator must be tested, without evidence of failure or damage, to at least three times its charged pressure of 70 ^{o}F., but not less than 120 p.s.i. before initial shipment and before each refilling and reshipment.

(3) Accumulators with a charging pressure exceeding 200 p.s.i.g. at 70 ^{o}F. are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions:

(i) Each accumulator must be in compliance with the requirements stated in paragraph (f)(2), (i), (ii), and (iii) of this section, and

(ii) Each accumulator must be designed and fabricated with a burst pressure of not less than five times its charged pressure at 70 ^{o}F. when shipped.

(4) Accumulators intended to function as shock absorbers, struts, gas springs, pneumatic springs or other impact or energy-absorbing devices are not subject to the requirements of this subchapter provided each:

(i) Has a gas space capacity not exceeding 1.6 liters and a charge pressure not exceeding 280 bar, where the product of the capacity expressed in liters and charge pressure expressed in bars does not exceed 80 (for example, 0.5 liter gas space and 160 bar charge pressure);

(ii) Has a minimum burst pressure of 4 times the charge pressure at 20^{o}C for products not exceeding 0.5 liter gas space capacity and 5 times the charge pressure for products greater than 0.5 liter gas space capacity;

(iii) Design type has been subjected to a fire test demonstrating that the article relieves its pressure by means of a fire degradable seal or other pressure relief device, such that the article will not fragment and that the article does not rocket; and

(iv) Accumulators must be manufactured under a written quality assurance program which monitors parameters controlling burst strength, burst mode and performance in a fire situation as specified in paragraphs (f)(4)(i) through (f)(4)(iii) of this section. A copy of the quality assurance program must be maintained at each facility at which the accumulators are manufactured.

(5) Accumulators not conforming to the provisions of paragraphs (f)(1) through (f) (4) of this section, may only be transported subject to the approval of the Associate Administrator for Hazardous Materials Safety.

(g) *Water pump system tank. Water pump system tanks charged with compressed air or limited quantities of nitrogen to not over 40 psig for single-trip shipment to installation sites are excepted from labeling (transportation by air not authorized) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of this subchapter, to part 174 of this subchapter except §174.24 and part 177 except §177.817.*

(1) The tank must be of steel, welded with heads concave to pressure, having a rated water capacity not exceeding 120 gallons and with outside diameter not exceeding 24 inches. Safety relief devices not required.

(2) The tank must be pneumatically tested to 100 psig. Test pressure must be permanently marked on the tank.

(3) The stress at prescribed pressure must not exceed 20,000 psi using formula:

$$S = Pd / 2t$$

where:

S = wall stress in pounds per square inch:
P = prescribed pressure for the tank of at least 3 times charged pressure at 70 ^{o}F or 100 psig, whichever is greater;
d = inside diameter in inches;
t = minimum wall thickness, in inches.

(4) The burst pressure must be at least 6 times the charge pressure at 70 ^{o}F.

(5) Each tank must be overpacked in a strong outside container in accordance with §173.301(k).

(h) A limited quantity which conforms to the provisions of paragraph (a)(1), (a)(3), or (b) of this section and is a "consumer commodity" as defined in §171.8 of this subchapter, may be renamed "consumer commodity" and reclassed as ORM-D material. Each package may not exceed 30 kg (66 pounds) gross weight. In addition to the exceptions provided by paragraphs (a) and (b) of this section-

(1) Outside packagings are not required to be marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED REGULATIONS";

(2) Shipments of ORM-D materials are not subject to the shipping paper requirements of subpart C of part 172 of this subchapter, unless the material meets the definition of a hazardous substance or hazardous waste or unless offered for transportation or transported by aircraft; and

(3) Shipments of ORM-D materials are eligible for the exceptions provided in §173.156.

(i) An aerosol is flammable if a positive test result is obtained using any of the following test methods:

(1) Using the Bureau of Explosives' Flame Projection Apparatus, the flame projects more than 18 inches beyond the ignition source with valve opened fully, or the flame flashes back and burns at the valve with any degree of valve opening.

(2) Using the Bureau of Explosives' Open Drum Apparatus, there is any significant propagation of flame away from the ignition source.

(3) Using the Bureau of Explosives' Closed Drum Apparatus, there is any explosion of the vapor-air mixture in the drum.

[Amdt. 173-94, 41 FR 16079, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.306, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.307 Exceptions for compressed gases.

(a) The following materials are not subject to the requirements of this subchapter:

(1) Carbonated beverages.

(2) Except as provided in §175.10(a)(2) of this subchapter, tires when inflated to pressures not greater than their rated inflation pressures.

(3) Balls used for sports.

(4) Refrigerating machines including dehumidifiers and air conditioners, and components thereof such as precharged tubing containing 25 pounds or less of nonflammable liquefied gas.

(b) [Reserved]

[Amdt. 173-94, 41 FR 16081, Apr. 15, 1976, as amended by Amdt. 173-135, 45 FR 13090, Feb. 28, 1980]

§173.308 Cigarette lighter or other similar device charged with fuel.

(a) In addition to the requirements of §173.21(i), a cigarette lighter or other similar device charged with a flammable gas must be shipped as follows:

(1) No more than 70 ml (2.3 fluid ounces) of liquefied gas may be loaded into each device;

(2) The liquid portion of the gas may not exceed 85 percent of the volumetric capacity of each fluid chamber at 15 ^oC (59 ^oF);

(3) Each device, including closures, must be capable of withstanding without leakage or rupture an internal pressure of at least two times the vapor pressure of the fuel at 55 ^oC (131 ^oF); and

(4) Devices must be overpacked in packaging that is designed or arranged to prevent movement of the device itself.

(b) When no more than 1,500 devices covered by this section are transported in one motor vehicle by highway, the requirements of subparts C through H of part 172 of this subchapter, and part 177 of this subchapter do not apply. However, no person may offer for transportation or transport the devices or prepare the devices for shipment unless that person has been specifically informed of the requirements of this section. The outer packaging, as specified in Special Provision N10 of §172.102(c)(5) of this subchapter, must be plainly and durably marked with the required proper shipping name specified in §172.101 of this subchapter, or the words "CIGARETTE LIGHTERS" and the number of devices contained in the package.

(c) For transportation by water in a closed transport vehicle or a closed freight container, the following warning must be affixed to the access doors:

WARNING-MAY CONTAIN EXPLOSIVE MIXTURES WITH AIR-KEEP IGNITION SOURCES AWAY WHEN OPENING.

The warning must be on a contrasting background and must be readily legible from a distance of 8 m (26 feet).

[Amdt. 173-94, 41 FR 16081, Apr. 15, 1976, as amended by Amdt. 173-94A, 41 FR 40683, Sept. 20, 1976; Amdt. 173-120, 43 FR 39792, Sept. 7, 1978; Amdt. 173-165, 48 FR 28101, June 20, 1983; Amdt. 173-224, 55 FR 52665 Dec. 21, 1990; 56 FR 66276, Dec. 20, 1991; 63 FR 37461, July 10, 1998]

§173.309 Fire extinguishers.

(a) Fire extinguishers charged with a limited quantity of compressed gas to not more than 1660 kPa (241 psig) at 21 ^oC (70 ^oF) are excepted from labeling (except when offered for transportation by air) and the specification packaging requirements of this subchapter when shipped under the following conditions. In addition, shipments are not subject to subpart F of part 172 of this subchapter, to part 174 of this subchapter except §174.24 or to part 177 of this subchapter except §177.817.

(1) Each fire extinguisher must have contents which are nonflammable, non-poisonous, and noncorrosive as defined under this subchapter.

(2) Each fire extinguisher must be shipped as an inner packaging.

(3) Nonspecification cylinders are authorized subject to the following conditions:

(i) The internal volume of each cylinder may not exceed 18 liters (1,100 cubic inches). For fire extinguishers not exceeding 900 ml (55 cubic inches) capacity, the liquid portion of the gas plus any additional liquid or solid must not completely fill the container at 55 °C (130 °F). Fire extinguishers exceeding 900 ml (55 cubic inches) capacity may not contain any liquefied compressed gas;

(ii) Each fire extinguisher manufactured on and after January 1, 1976, must be designed and fabricated with a burst pressure of not less than six times its charged pressure at 21 °C (70 °F) when shipped;

(iii) Each fire extinguisher must be tested, without evidence of failure or damage, to at least three times its charged pressure at 21 °C (70 °F) but not less than 825 kPa (120 psig) before initial shipment, and must be marked to indicate the year of the test (within 90 days of the actual date of the original test) and with the words "MEETS DOT REQUIREMENTS." This marking is considered a certification that the fire extinguisher is manufactured in accordance with the requirements of this section. The words "This extinguisher meets all requirements of 49 CFR 173.306" may be displayed on fire extinguishers manufactured prior to January 1, 1976; and

(iv) For any subsequent shipment, each fire extinguisher must be in compliance with the retest requirements of the Occupational Safety and Health Administration Regulations of the Department of Labor, 29 CFR 1910.157(e).

(4) Specification 2P or 2Q (§§178.33 and 178.33a of this subchapter) inner nonrefillable metal packagings are authorized for use as fire extinguishers subject to the following conditions:

(i) The liquid portion of the gas plus any additional liquid or solid may not completely fill the packaging at 55 °C (130 °F);

(ii) Pressure in the packaging shall not exceed 1250 kPa (181 psig) at 55 °C (130 °F). If the pressure exceeds 920 kPa (141 psig) at 55 °C (130 °F), but does not exceed 1100 kPa (160 psig) at 55 °C (130 °F), a specification DOT 2P inner metal packaging must be used; if the pressure exceeds 1100 kPa (160 psig) at 55 °C (130 °F), a specification DOT 2Q inner metal packaging must be used. The metal packaging must be capable of withstanding, without bursting, a pressure of one and one-half times the equilibrium pressure of the contents at 55 °C (130 °F); and

(iii) Each completed inner packaging filled for shipment must have been heated until the pressure in the container is equivalent to the equilibrium pressure of the contents at 55 °C (130 °F) without evidence of leakage, distortion, or other defect.

(b) Specification 3A, 3AA, 3E, 3AL, 4B, 4BA, 4B240ET or 4BW (§§178.36, 178.37, 178.42, 178.46, 178.50, 178.51, 178.55 and 178.61 of this subchapter) cylinders are authorized for use as fire extinguishers.

[Amdt. 173-235, 58 FR 50503, Sept. 27, 1993, as amended by Amdt. 173-138, 59 FR 49134, Sept. 26, 1994; Amdt. 173-258, 61 FR 51240, Oct. 1, 1996]

§173.314 Compressed gases in tank cars and multi-unit tank cars.

(a) *Definitions. For definitions of compressed gases, see §173.115.*

(b) General requirements. (1) Tank car tanks containing compressed gases must not be shipped unless they were loaded by or with the consent of the owner thereof.

(2) Tank car tanks must not contain gases capable of combining chemically and must not be loaded with any gas which combines chemically with the gas previously loaded therein, until all residue has been removed and interior of tank thoroughly cleaned.

(3) For tanks of the DOT-106A and 110A class, the tanks must be placed in position and attached to car structure by the shipper.

(4) Wherever the word "approved" is used in this part of the regulations, it means approval by the Association of American Railroads Committee on Tank Cars as prescribed in §179.3 of this subchapter.

(5) Each tank car used for the transportation of anhydrous ammonia or any material that meets the criteria of Division 2.1 or 2.3 must have gaskets for manway cover plates and for mounting of fittings designed (for temperature, application, media, pressure, and size) to create a positive seal so that, under conditions normally incident to transportation, there will not be an identifiable release of the material to the environment. The use of sealants to install gaskets is prohibited.

(c) *Authorized gases, filling limits for tank cars. A compressed gas in a tank car or a multi-unit tank car must be offered for transportation in accordance with §173.31 and this section. The named gases must be loaded and offered for transportation in accordance with the following table:*

Proper shipping name	Outage and filling limits (see note 1)	Authorized tank car class
Ammonia, anhydrous, or ammonia solutions > 50 percent ammonia	Notes 2, 10	105, 112, 114, 120.
-	Note 3	106.
Ammonia solutions with > 35 percent, but <= 50 percent ammonia by mass	Note 3	105, 109, 112, 114, 120.
Argon, compressed	Note 4	107.
Boron trichloride	Note 3	105, 106.
Carbon dioxide, refrigerated liquid	Note 5	105.
Chlorine	Note 6	105.
-	125	106.
Chlorine trifluoride	Note 3	106, 110.
Chlorine pentafluoride	Note 3	106, 110.
Dimethyl ether	Note 3	105, 106, 110, 112, 114, 120.
Dimethylamine, anhydrous	Note 3	105, 106, 112.
Dinitrogen tetroxide, inhibited	Note 3	105, 106, 110.

Division 2.1 materials not specifically identified in this table	Notes 9, 10	105, 106, 110, 112, 114, 120.
Division 2.2 materials not specifically identified in this table	Note 3	105, 106, 109, 110, 112, 114, 120.
Division 2.3 Zone A materials not specifically identified in this table	None	See §173.245.
Division 2.3 Zone B materials not specifically identified in this table	Note 3	105, 106, 110, 112, 114, 120.
Division 2.3 Zone C materials not specifically identified in this table	Note 3	105, 106, 110, 112, 114, 120.
Division 2.3 Zone D materials not specifically identified in this table	Note 3	105, 106, 109, 110, 112, 114, 120.
Ethylamine	Note 3	105, 106, 110, 112, 114, 120.
Helium, compressed	Note 4	107.
Hydrogen	Note 4	107.
Hydrogen chloride, refrigerated liquid	Note 7	105.
Hydrogen sulphide, liquified	68	106.
Methyl bromide	Note 3	105, 106.
Methyl chloride	Note 3	105, 106, 112.
Methyl mercaptan	Note 3	105, 106.
Methylamine, anhydrous	Note 3	105, 106, 112.
Nitrogen, compressed	Note 4	107.
Nitrosyl chloride	124	105.
-	110	106.
Nitrous oxide, refrigerated liquid	Note 5	105.
Oxygen, compressed	Note 4	107.
Phosgene	Note 3	106.
Sulfur dioxide, liquified	125	105, 106, 110.
Sulfuryl fluoride	120	105.
Vinyl fluoride, inhibited	Note 8	105.

Notes:

1. The percent filling density for liquefied gases is hereby defined as the percent ratio of the mass of gas in the tank to the mass of water that the tank will hold. For determining the water capacity of the tank in kilograms, the mass of one liter of water at 15.5 ^{o}C in air is 1 kg. (the mass of one gallon of water at 60 ^{o}F in air is 8.32828 pounds).

2. The liquefied gas must be loaded so that the outage is at least two percent of the total capacity of the tank at the reference temperature of 46 ^{o}C (115 ^{o}F) for a noninsulated tank; 43 ^{o}C (110 ^{o}F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 41 ^{o}C (105 ^{o}F) for an insulated tank having an insulation system incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential.

3. The requirements of §173.24b(a) apply.

4. The gas pressure at 54.44 ^{o}C (130 ^{o}F.) in any non-insulated tank car may not exceed 7/10 of the marked test pressure, except that a tank may be charged with

helium to a pressure 10 percent in excess of the marked maximum gas pressure at 54.44 ^{o}C (130 ^{o}F.) of each tank.

5. The liquid portion of the gas at -17.77 ^{o}C (0 ^{o}F.) must not completely fill the tank.

6. The maximum permitted filling density is 125 percent. The quantity of chlorine loaded into a single unit-tank car may not be loaded in excess of the normal lading weights nor in excess of 81.65 Mg (90 tons).

7. 89 percent maximum to 80.1 percent minimum at a test pressure of 6.2 Bar (90 psi).

8. 59.6 percent maximum to 53.6 percent minimum at a test pressure of 7.2 Bar (105 psi).

9. For a liquefied petroleum gas, the liquefied gas must be loaded so that the outage is at least one percent of the total capacity of the tank at the reference temperature of 46 ^{o}C (115 ^{o}F) for a noninsulated tank; 43 ^{o}C (110 ^{o}F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 41 ^{o}C (105 ^{o}F) for an insulated tank having an insulation system incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential.

10. For liquefied petroleum gas and anhydrous ammonia, during the months of November through March (winter), the following reference temperatures may be used: 38 ^{o}C (100 ^{o}F) for a noninsulated tank; 32 ^{o}C (90 ^{o}F) for a tank having a thermal protection system incorporating a metal jacket that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 10.22 kilojoules per hour per square meter per degree Celsius (0.5 Btu per hour/per square foot/per degree F) temperature differential; and 29 ^{o}C (85 ^{o}F) for an insulated tank having an insulation system incorporating a metal jacket and insulation that provides an overall thermal conductance at 15.5 ^{o}C (60 ^{o}F) of no more than 1.5333 kilojoules per hour per square meter per degree Celsius (0.075 Btu per hour/per square foot/per degree F) temperature differential. The winter reference temperatures may only be used for a tank car shipped directly to a consumer for unloading and not stored in transit. The offeror of the tank must inform each customer that the tank car was filled based on winter reference temperatures. The tank must be unloaded as soon as possible after March in order to retain the specified outage and to prevent a release of hazardous material which might occur due to the tank car becoming liquid full at higher temperatures.

(d) [Reserved]

(e) *Verification of content. The amount of liquefied gas loaded into each tank may be determined either by measurement or calculation of the weight. If by measurement, the weight must be checked after disconnecting the loading line by the use of proper scales. If by calculation, the weight of liquefied petroleum gas, methylacetylene propadiene, stabilized, dimethylamine, methylamine anhydrous, or trimethylamine may be calculated using the outage tables supplied by the tank car owners and the specific gravities as determined at the plant, and this computation must be checked by determination of* *specific gravity of product after loading. Carriers may verify calculated weights by use of proper scales. The use of a fixed tube gauge device is authorized for determining the weight of methyl mercaptan in Specification 105A300W tanks instead of weighing.*

(f) [Reserved]

(g) Special requirements for hydrogen chloride, refrigerated liquid, and vinyl fluoride, inhibited.

(1) The shipper shall notify the Bureau of Explosives whenever a car is not received by the consignee within 20 days from the date of shipment.

(2) A tank car containing hydrogen chloride, refrigerated liquid must have the auxiliary valve on the pressure relief device closed during transportation.

(3) See §179.102-17 of this subchapter for additional requirements.

(4) Tank cars containing hydrogen chloride, refrigerated liquid, must be unloaded to such an extent that any residue remaining in the tank at a reference temperature of 32 ^{o}C (90 ^{o}F) will not actuate the safety relief device.

(h)-(i) [Reserved]

(j) *Special requirements for materials having a primary or secondary Division 2.1 (flammable gas) hazard. For single unit tank cars, interior pipes of loading and unloading valves, sampling devices, and gauging devices with an opening for the passage of the lading exceeding 1.52 mm (0.060 inch) diameter must be equipped with excess flow valves. For single unit tank cars constructed before January 1, 1972, gauging devices must conform to this paragraph by no later than July 1, 2006. The protective housing cover must be provided with an opening, with a weatherproof cover, above each safety relief valve that is concentric with the discharge of the safety relief valve and that has an area at least equal to the valve outlet area. Class DOT 109 tank cars and tank cars manufactured from aluminum or nickel plate are not authorized.*

(k) Special requirements for chlorine. Tank cars built after September 30, 1991, must have an insulation system consisting of 5.08 cm (2 inches) glass fiber placed over 5.08 cm (2 inches) of ceramic fiber. Tank cars must have excess flow valves on the interior pipes of liquid discharge valves. Tank cars constructed to a DOT 105A500W specification may be marked as a DOT 105A300W specification with the size and type of safety relief valves required by the marked specification.

(l) Special requirements for hydrogen sulphide. Each multi-unit tank car must be equipped with adequate safety relief devices of the fusible plug type having a yield temperature not over 76.66 ^{o}C (170 ^{o}F.), and not less than 69.44 ^{o}C (157 ^{o}F.). Each device must be resistant to extrusion of the fusible alloy and leak tight at 55 ^{o}C (130 ^{o}F.). Each valve outlet must be sealed by a threaded solid plug. In addition, all valves must be protected by a metal cover.

(m) Special requirements for nitrosyl chloride. Single unit tank cars and their associated service equipment, such as venting, loading and unloading valves, and safety relief valves, must be made of metal or clad with a material that is not subject to rapid deterioration by the lading. Multi-unit tank car tanks must be nickel-clad and have safety relief devices incorporating a fusible plug having a yield temperature of 79.44 ^{o}C (175 ^{o}F.). Safety relief devices must be vapor tight at 54.44 ^{o}C (130 ^{o}F.).

(n) Special requirements for hydrogen. Each tank car must be equipped with one or more safety relief devices. The discharge outlet for each safety relief device must be connected to a manifold having a non-obstructed discharge area of at least 1.5 times the total discharge area of the safety relief devices connected to the manifold. All manifolds must be connected to a single common header having a non-obstructed discharge pointing upward and extending above the top of the car. The header and the header outlet must each have a non-obstructed discharge area at least equal to the total discharge area of the manifolds connected to the header. The header outlet must be equipped with an ignition device that will instantly ignite any hydrogen discharged through the safety relief device.

(o) Special requirements for carbon dioxide, refrigerated liquid and nitrous oxide, refrigerated liquid. Each tank car must have an insulation system so that the thermal conductance is not more than 0.613 kilojoules per hour, per square meter, per degree Celsius (0.03 B.t.u. per square foot per hour, per degree Fahrenheit) temperature differential. Each tank car must be equipped with one safety relief valve set to open at a pressure not exceeding 75 percent of the tank test pressure and one frangible disc design to burst at a pressure less than the tank test pressure. The discharge capacity of each safety relief device must be sufficient to prevent building up of pressure in the tank in excess of 82.5 percent of the test pressure of the tank. Tanks must be equipped with two regulating valves set to open at a pressure not to exceed 24.1 Bar (350 psi) on DOT 105A500W tanks and at a pressure not to exceed 27.6 Bar (400 psi) on DOT 105A600W tanks. Each regulating valve and safety relief device must have its final discharge piped to the outside of the protective housing.

[Amdt. 173-224, 55 FR 52665, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.314, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.315 Compressed gases in cargo tanks and portable tanks.

(a) A compressed gas offered for transportation in a cargo tank motor vehicle or a portable tank must be prepared in accordance with this section, §§173.32, 173.33 and subpart E of part 180 of this subchapter; for cryogenic liquids, see §173.318; for marking requirements, see §§172.326 and 172.328 of this subchapter. A compressed gas must be loaded and offered for transportation in accordance with the following table:

Kind of gas	Maximum permitted filling density		Specification container required	
-	Percent by weight (see	Percent by volume (see	Type (see Note 2)	Minimum design pressure

	Note 1)	par. (f) of this section)		(psig)
Ammonia, anhydrous or Ammonia solutions with greater than 50 percent ammonia (see Notes 14 and 17)	56	82, See Note 5	DOT-51, MC-330, MC-331; See Notes 12 and 17	265; See Note 17.
Ammonia solutions with more than 35 percent but not more than 50 percent ammonia	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331; see Note 12	100; See par. (c) of this section.
Bromotrifluoromethane (R-13B1 or H-1301); (See Note 9)	133	See Note 7	DOT-51, MC-330, MC-331	365.
Butadiene, inhibited	See par. (b) of this section	See par. (b) of this section	DOT-51, MC-330, MC-331	100.
Carbon dioxide, refrigerated liquid	See par. (c)(1) of this section	95	......do	200; see Note 3.
Chlorine	125	See Note 7	DOT-51, MC-330, MC-331	225; See Notes 4 and 8.
Chlorodifluoroethane (R-142b) (1-Chloro 1,1-difluoroethane); (See Note 9)	100	See Note 7	DOT-51, MC-330, MC-331	100.
Chlorodifluoromethane (R-22); (See Note 9)	105	See Note 7	DOT-51, MC-330, MC-331	250.
Chloropentafluoroethane (R-115); (See Note 9)	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331	See par. (c) of this section.
Chlorotrifluoromethane (R-13); (See Note 9)	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331	See par. (c) of this section.
Dichlorodifluoromethane (R-12); (See Note 9)	119	See Note 7	DOT-51, MC-330, MC-331	150.
Difluoroethane (R-152a); (See Note 9)	79	See Note 7	DOT-51, MC-330, MC-331	150.
Dimethyl ether (see Note 16)	59	......do	......do	200.
Dimethylamine, anhydrous	59	See Note 7	DOT-51, MC-330, MC-331	150.
Division 2.1, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331	See Note 18.
Division 2.2, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331	See Note 19.
Division 2.3, Hazard Zone A, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331; See Note 23	See Note 20.
Division 2.3, Hazard Zone B, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331; See Note 23	See Note 20.
Division 2.3, Hazard Zone C, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331; See Note 24	See Note 21.
Division 2.3, Hazard Zone D, materials not specifically provided for in this table	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331; See Note 25	See Note 22.
Ethane, refrigerated liquid	-	See par. (c) of this section	MC-331, MC-338	100; see Note 11.
Ethane-propane mixture, refrigerated liquid	-	See par. (c) of this section	MC-331, MC-338	275; see Note 11.
Hexafluoropropylene	110	See Note 7	DOT-51, MC-	250.

			330, MC-331	
Hydrogen chloride, refrigerated liquid	103.0	See Note 7	MC-331, MC-338	100; see Note 11.
-	91.6	......do	......do	300; see Note 11.
-	86.7	......do	......do	450; see Note 11.
Liquefied petroleum gas (see Note 15)	See par. (b) of this section	See par. (b) of this section	DOT-51, MC-330, MC-331; See Note 26	See par. (c) of this section.
Methylacetylene-propadiene, stabilized (see Note 13)	53	90	DOT 51, MC 330, MC 331	200.
Methylamine, anhydrous	60	See Note 7	DOT-51, MC-330, MC-331.	-
Methyl chloride	84	88.5	......do	150.
Methyl chloride (optional portable tank 2,000 pounds water capacity, fusible plug)	......do	See Note 6	DOT-51	225.
Methyl mercaptan	80	90	DOT-51, MC-330, MC-331; See Note 23	100.
Nitrous oxide, refrigerated liquid	See par. (c)(1) of this section	95	DOT-51, MC-330, MC-331	200; See Note 3.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s. (See Note 9)	See par. (c) of this section	See Note 7	DOT-51, MC-330, MC-331	See par. (c) of this section.
Sulfur dioxide (tanks not over 1,200 gallons water capacity)	125	87.5	DOT-51, MC-330, MC-331; See Note 24	150; See Note 4.
Sulfur dioxide (tanks over 1,200 gallons water capacity)	125	87.5	DOT-51, MC-330, MC-331; See Note 24	125; See Note 4.
Sulfur dioxide (optional portable tank 1,000-2,000 pounds water capacity, fusible plug)	125	See Note 6	DOT-51; See Note 24	225.
Trimethylamine, anhydrous	57	See Note 7	DOT-51, MC-330, MC-331	150.
Vinyl chloride	84 (see Note 13)	See Note 7	MC-330, MC-331	150.
Vinyl fluoride, inhibited	66	......do	......do	250; see Note 11.
Vinyl methyl ether	68	See Notes 7 and 13	......do	100.

NOTE 1: Maximum filling density for liquefied gases is hereby defined as the percent ratio of the weight of gas in the tank to the weight of water that the tank will hold. For determining the water capacity of the tank in pounds, the weight of a gallon (231 cubic inches) of water at 60 ^{o}F. in air shall be 8.32828 pounds.

NOTE 2: See §173.32 for authority to use other portable tanks and for manifolding cargo tanks, see §173.301(d). Specifications MC 330 cargo tanks may be painted as specified for MC 331 cargo tanks.

NOTE 3: If cargo tanks and portable tank containers for carbon dioxide, refrigerated liquid and nitrous oxide, refrigerated liquid are designed to conform to the requirements of the ASME Code for Low Temperature Operation, the design pressure may be reduced to 100 p.s.i.g. or the controlled pressure, whichever is greater.

NOTE 4: Material must be steel. Packagings must have a corrosion allowance of 20 percent or 0.10 inch, whichever is less, added to the metal thickness. The minimum wall thickness for chlorine packagings is 0.300 inch for stainless steel or 0.625 inch for carbon steel, including corrosion allowance.

NOTE 5: Unlagged cargo tanks and portable tank containers for liquid anhydrous ammonia may be filled to 87.5 percent by volume provided the temperature of the anhydrous ammonia being loaded into such tanks is determined to be not lower than 30 ^{o}F. or provided the filling of such tanks is stopped at the first indication of frost or ice formation on the outside surface of the tank and is not resumed until such frost or ice has disappeared.

NOTE 6: Tanks equipped with fusible plugs must be filled by weight.

NOTE 7: Tanks must be filled by weight.

NOTE 8: Chlorine packagings may be shipped only if the contents are to be unloaded at one unloading point.

NOTE 9: This gas may be transported in authorized cargo tanks and portable tanks marked "DISPERSANT GAS," or "REFRIGERANT GAS."

NOTE 10: [Reserved]

NOTE 11: MC-330, MC-331 and MC-338 cargo tanks must be insulated. Cargo tanks must meet all the following requirements. Each tank must have a design service temperature of minus 100 ^{o}F., or no warmer than the boiling point at one atmosphere of the hazardous material to be shipped therein, whichever is colder, and must conform to the low-temperature requirements of the ASME Code. When the normal travel time is 24 hours or less, the tank's holding time as loaded must be at least twice the normal travel time. When the normal travel time exceeds 24 hours, the tank's holding time as loaded must be at least 24 hours greater than the normal travel time. The holding time is the elapsed time from loading until venting occurs under equilibrium conditions. The cargo tank must have an outer jacket made of steel when the cargo tank is used to transport a flammable gas.

NOTE 12: No aluminum, copper, silver, zinc or an alloy of any of these metals shall be used in packaging construction where it comes into contact with the lading.

NOTE 13: All parts of valves and safety devices in contact with contents of tank must be of a metal or other material suitably treated if necessary, which will not cause formation of any acetylides.

NOTE 14: Specifications MC 330 and MC 331 cargo tanks constructed of other than quenched and tempered steel "(NQT)" are authorized for all grades of anhydrous ammonia. Specifications MC 330 and MC 331 cargo tanks constructed of quenched and tempered steel "(QT)" (see marking requirements of §172.328(c) of this subchapter) are authorized for anhydrous ammonia having a minimum water content of 0.2 percent by weight. Any tank being placed in anhydrous ammonia service or a tank which has been in other service or has been opened for inspection, test, or repair, must be cleaned of the previous product and must be purged of air before loading. See §172.203(h) of this subchapter for special shipping paper requirements.

NOTE 15: Specifications MC 330 and MC 331 cargo tanks constructed of other than quenched and tempered steel (NQT) are authorized for all grades of liquefied petroleum gases. Only grades of liquefied petroleum gases determined to be "noncorrosive" are authorized in Specification MC 330 and MC 331 cargo tanks constructed of quenched and tempered steel (QT). "Noncorrosive" means the corrosiveness of the gas does not exceed the limitations for classification 1 of the ASTM Copper Strip Classifications when tested in accordance with ASTM D1838-64, "Copper Strip Corrosion by Liquefied Petroleum (LP) Gases." (For (QT) and (NQT) marking requirements see §172.328(c) of this subchapter. For special shipping paper requirements, see §172.203(h) of this subchapter.)

NOTE 16: Specifications MC 330 and MC 331 cargo tanks must be equipped with emergency discharge controls that conform to §178.337-11(c) of this subchapter.

NOTE 17: A Specification MC-330 or MC-331 cargo tank or a nonspecification cargo tank meeting, and marked in conformance with, the edition of the ASME Code in effect when it was fabricated, may be used for the transportation of anhydrous ammonia if it:

(1) Has a minimum design pressure not lower than 250 psig;

(2) Was manufactured in conformance with the ASME Code prior to January 1, 1981, according to its ASME name plate and manufacturer's data report;

(3) Is painted white or aluminum;

(4) Complies with Note 12 of this paragraph;

(5) Has been inspected and tested in accordance with subpart E of part 180 of this subchapter as specified for MC 331 cargo tanks.

(6) Was used to transport anhydrous ammonia prior to January 1, 1981;

(7) Is operated exclusively in intrastate commerce (including its operation by a motor carrier otherwise engaged in interstate commerce) in a state where its operation was permitted by the laws of that State (not including the incorporation of this subchapter) prior to January 1, 1981; and

(8) Is operated in conformance with all other requirements of this subchapter.

NOTE 18: The minimum packaging design pressure must not be less than the vapor pressure at the reference temperature of the lading plus one percent or 173.4 kPa (25 psig), whichever is less.

NOTE 19: The minimum packaging design pressure must not be less than the vapor pressure at the reference temperature of the lading.

NOTE 20: The minimum packaging design pressure must not be less than 1.5 times the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F).

NOTE 21: The minimum packaging design pressure must not be less than 1.3 times the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F).

NOTE 22: The minimum packaging design pressure must not be less than 1.1 times the vapor pressure of the lading at 46 ^{o}C (115 ^{o}F).

NOTE 23: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this part. Thickness of stainless steel for shell and heads must be the greater of 7.62 mm (0.300 inch) or the thickness required for the packaging at its minimum design pressure.

NOTE 24: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this part. Thickness of stainless steel for shell and heads must be the greater of 6.35 mm (0.250 inch) or the thickness required for the packaging at its minimum design pressure. For sulphur dioxide, this Note does not apply until October 1, 1994.

NOTE 25: Packagings must be made of stainless steel except that steel other than stainless steel may be used in accordance with the provisions of §173.24b(b) of this part. Thickness for shell and heads must be as calculated for the packaging at its minimum design pressure.

NOTE 26: Non-specification cargo tanks may be used for the transportation of liquefied petroleum gas, subject to the conditions prescribed in paragraph (k) of this section.

(b) Maximum permitted filling densities for cargo and portable tank containers for transportation of butadiene, inhibited, and liquefied petroleum gas are as follows:

Maximum specific gravity of the liquid material at 60 F.	Maximum permitted filling density in percent of the water-weight capacity of the tanks (percent) See Note 1	
-	1200 gallons or less	Over 1200 gallons
0.473 to 0.480	38	41
0.481 to 0.488	39	42
0.489 to 0.495	40	43
0.496 to 0.503	41	44
0.504 to 0.510	42	45
0.511 to 0.519	43	46
0.520 to 0.527	44	47
0.528 to 0.536	45	48
0.537 to 0.544	46	49
0.545 to 0.552	47	50
0.553 to 0.560	48	51
0.561 to 0.568	49	52
0.569 to 0.576	50	53
0.577 to 0.584	51	54
0.585 to 0.592	52	55
0.593 to 0.600	53	56
0.601 to 0.608	54	57
0.609 to 0.617	55	58
0.618 to 0.626	56	59
0.627 and over	57	60

NOTE 1: Filling is permitted by volume provided the same filling density is used as permitted by weight, except when using fixed length dip tube or other fixed maximum liquid level indicators (paragraph (f) of this section), in which case the maximum permitted filling density shall not exceed 97 percent of the maximum permitted filling density by weight contained in the table.

(1) *Odorization. All liquefied petroleum gas shall be effectively odorized as required in*

Note 2 of this paragraph to indicate positively, by a distinctive odor, the presence of gas down to a concentration in air of not over one-fifth the lower limit of combustibility: Provided, however, That odorization is not required if harmful in the use or further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

Note 1: The lower limits of combustibility of the more commonly used liquefied petroleum gases are: Propane, 2.15 percent; butane, 1.55 percent. These figures represent volumetric percentages of gas-air mixtures in each case.

Note 2: The use of 1.0 pound of ethyl mercaptan, 1.0 pound of thiophane, or 1.4 pounds of amyl mercaptan per 10,000 gallons of liquefied petroleum gas shall be considered sufficient to meet the requirements of §173.315(b)(1). This note does not exclude the use of any other odorant in sufficient quantity to meet the requirements of §173.315(b)(1).

(c) Except as otherwise provided, the loading of a liquefied gas into a cargo tank or portable tank shall be determined by weight or by a suitable liquid level gauging device. The vapor pressure (psig) at 115 ^{o}F. must not exceed the design pressure of the cargo tank or portable tank container. The outage and filling limits for liquefied gases must be as prescribed in §173.24b of this part, except that this requirement does not apply to:

(1) *A tank containing carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid. Such tank is required to be equipped with suitable pressure control valves and may not be filled to a level exceeding 95 percent of the volumetric capacity of the tank.*

(2) A tank containing ethane, refrigerated liquid; ethane-propane mixture, refrigerated liquid; or hydrogen chloride, refrigerated liquid. Such tank must be filled to allow at least two percent outage below the inlet of the pressure relief valve or pressure control valve under conditions of incipient opening, with the tank in a level attitude.

(d) If the loading of cargo tanks and portable tank containers with liquefied gases is to be determined by weight, the gross weight shall be checked after the filling line is disconnected in each instance. The gross weight shall be calculated from the tank capacity and tare weight set forth on the metal plate required by the specification, and the maximum filling density permitted for the material being loaded into the tank as set forth in the table, paragraph (a) of this section.

(e) If the loading of cargo tanks and portable tank containers with liquefied gases is to be determined by adjustable liquid level device, each tank and each compartment thereof shall have a thermometer well, so that the internal liquid temperature can easily be determined, and the amount of liquid in the tank shall be corrected to a 60 ^{o}F. basis. Liquid levels shall not exceed a level corresponding to the maximum filling density permitted for the material being loaded into the tank as set forth in the table in paragraph (a) of this section.

(f) When the loading of cargo tanks and portable tank containers with liquefied gases is determined only by fixed length dip tube or other fixed maximum liquid level indicator, the device shall be arranged to function at a level not to exceed the maximum permitted volume prescribed by the table, paragraph (a)(1) of this section. Loading shall be stopped when the device functions.

(g) Containers, the liquid level of which has been determined by means of a fixed length dip tube gauging device, shall not be acceptable for stowage as cargo on vessels in commerce subject to the jurisdiction of the United States Coast Guard. Nothing contained in this section shall be so construed as to prohibit the transportation on car floats or car ferries of motor vehicles laden with containers nor cargo tanks the liquid level of either of which has been determined by means of fixed length dip tube devices.

(h) Each cargo tank and portable tank, except a tank filled by weight, must be equipped with one or more of the gauging devices described in the following table which indicate accurately the maximum permitted liquid level. Additional gauging devices may be installed but may not be used as primary controls for filling of cargo tanks and portable tanks. Gauge glasses are not permitted on any cargo tank or portable tank. Primary gauging devices used on cargo tanks of less than 3500 gallons water capacity are exempt from the longitudinal location requirements specified in paragraphs (h)(2) and (3) of this section provided: The tank length does not exceed three times the tank diameter; and the cargo tank is unloaded within 24 hours after each filling of the tank.

Kind of gas	Gaging device permitted for filling purposes
Anhydrous ammonia	Rotary tube; adjustable slip tube; fixed length dip tube.
Anhydrous dimethylamine	None.
Anhydrous monomethylamine	Do.
Anhydrous trimethylamine	Do.
Aqua ammonia solution containing anhydrous ammonia	Rotary tube; adjustable slip tube; fixed length dip tube.
Butadiene, inhibited	Do.
Carbon dioxide, refrigerated liquid	Do.
Chlorine	None.
Dichlorodifluoromethane	Do.
Difluoroethane	Do.
Difluoromonochloroethane	Do.
Dimethyl ether	Do.
Ethane, refrigerated liquid	Rotary tube; adjustable slip tube; fixed length dip tube.
Ethane-propane mixture, refrigerated liquid	Do.
Hexafluoropropylene	None.
Hydrogen chloride, refrigerated liquid	Do.
Liquefied petroleum gases	Rotary tube; adjustable slip tube; fixed length dip tube.
Methyl chloride	Fixed length dip tube.
Methyl mercaptan	Rotary tube; adjustable slip tube; fixed length dip tube.
Monochlorodifluoromethane	None.
Nitrous oxide, refrigerated liquid	Rotary tube; adjustable slip tube; fixed length dip tube.
Methylacetylenepropadiene, stabilized	Do.
Refrigerant gas, n.o.s. or Dispersant gas, n.o.s	None.
Sulfur dioxide	Fixed length dip tube.

Vinyl chloride	None.
Vinyl fluoride, inhibited	Do.

(1) The design pressure of the liquid level gauging devices shall be at least equal to the design pressure of the tank.

(2) If the primary gauging device is adjustable, it must be capable of adjustment so that the end of the tube will be in the location specified in paragraph (h)(3) of this section for at least one of the ladings to be transported, at the filling level corresponding to an average loading temperature. Exterior means must be provided to indicate this adjustment. The gauging device must be legibly and permanently marked in increments not exceeding 20 Fahrenheit degrees (or not exceeding 25 p.s.i.g. on tanks for carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid), to indicate the maximum levels to which the tank may be filled with liquid at temperatures above 20 ^{o}F. However, if it is not practicable to so mark the gauging device, this information must be legibly and permanently marked on a plate affixed to the tank adjacent to the gauging device.

(3) A dip tube gauging device consists of a pipe or tube with a valve at its outer end with its intake limited by an orifice not larger than 0.060 inch in diameter. If a fixed length dip tube is used, the intake must be located midway of the tank both longitudinally and laterally and at maximum permitted filling level. In tanks for liquefied petroleum gases, the intake must be located at the level reached by the lading when the tank is loaded to maximum filling density at 40 ^{o}F.

(4) Except on a tank used exclusively for the transportation of carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid, each opening for a pressure gauge must be restricted at or inside the tank by an orifice no larger than 0.060 inch in diameter. For carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid service, the pressure gauge need only be used during the filling operation.

(i) Each tank must be provided with one or more safety relief devices which, unless otherwise specified in this part, must be safety relief valves of the spring-loaded type. Each valve must be arranged to discharge upward and unobstructed to the outside of the protective housing to prevent any impingement of escaping gas upon the tank. For each chlorine tank the protective housing must be in compliance with the requirements set forth in the applicable specification.

(1) The safety relief valves on each tank must meet the following conditions:

(i) The total relieving capacity, as determined by the flow formulas contained in Section 5 of CGA Pamphlet S-1.2, must be sufficient to prevent a maximum pressure in the tank of more than 120 percent of the design pressure;

(ii) The flow capacity rating, testing and marking must be in accordance with Sections 5, 6 and 7 of CGA Pamphlet S-1.2.

(iii) For an insulated tank, the required relieving capacity of the relief valves must be the same as for an uninsulated tank, unless the insulation will remain in place and will be effective under fire conditions. In this case, each insulated tank must be covered by a sheet metal jacket of not less than 16 gauge thickness.

(iv) An MC 330 cargo tank that has relief valves sized by Fetterly's formula dated

November 27, 1928, may be continued in service. Copies of this formula may be obtained from the Bureau of Explosives.

(2) Each safety relief valve must be arranged to minimize the possibility of tampering. If the pressure setting or adjustment is external to the valve, the safety relief valve must be provided with means for sealing the adjustment and it must be sealed.

(3) Each safety relief valve on a tank must be set to start-to-discharge at pressure no higher than 110 percent of the tank design pressure and no lower than the design pressure specified in paragraph (a) of this section for the gas transported.

(4) Each safety relief valve must be plainly and permanently marked with the pressure in p.s.i.g. at which it is set to discharge, with the actual rate of discharge of the device in cubic feet per minute of the gas or of air at 60 ^{o}F. and 14.7 p.s.i.a., and with the manufacturer's name or trade name and catalog number. The start-to-discharge valve must be visible after the valve is installed. The rated discharge capacity of the device must be determined at a pressure of 120 percent of the design pressure of the tank.

(5) Each safety relief valve must have direct communication with the vapor space in the tank.

(6) Each connection to a safety relief valve must be of sufficient size to provide the required rate of discharge through the safety relief valve.

(7) No shut-off valve may be installed between a safety relief valve and the tank except in cases where two or more safety relief valves are installed on the same tank, and one or more safety shut-off valves are arranged to always provide the required relief capacity through at least one of the safety relief valves.

(8) Each safety relief valve outlet must be provided with a protective device to prevent the entrance and accumulation of dirt and water. This device must not impede flow through the valve.

(9) On tanks for carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid each safety relief device must be installed and located so that the cooling effect of the contents will not prevent the effective operation of the device. In addition to the required safety relief valves, these tanks may be equipped with one or more pressure controlling devices.

(10) Each tank for carbon dioxide, refrigerated liquid also may be equipped with one or more frangible disc devices set to function at a pressure not over two times nor less than 1.5 times the design pressure of the tank.

(11) Each portion of connected liquid piping or hose that can be closed at both ends must be provided with a safety relief valve without an intervening shut-off valve to prevent excessive hydrostatic pressure that could burst the piping or hose.

(12) Subject to conditions of paragraph (a) of this section for the methyl chloride and sulfur dioxide optional portable tanks, one or more fusible plugs examined by the Bureau of Explosives and approved by the Associate Administrator for Hazardous Materials Safety may be used on these tanks in place of safety relief valves of the spring-loaded type. The fusible plug or plugs must be in accordance with CGA Pamphlet S-1.2, to prevent a pressure rise in the tank of more than 120 percent of the design pressure. If the tank is over 30 inches long, each end must have the total

specified safety discharge area.

(13) A safety relief valve on a chlorine cargo tanks must conform to one of the following standards of The Chlorine Institute, Inc.: Type $1^{1/2}$ JQ225, Dwg. H51970, dated October 7, 1968; or Type $1^{1/2}$ JQ225, Dwg. H50155, Revision A, dated April 28, 1969.

(j) Storage containers for liquefied petroleum gas for permanent installation on consumer premises may be shipped by private motor carrier only under the following conditions:

(1) Each container must be constructed in compliance with the requirements of the ASME Code (containers built in compliance with earlier editions starting with 1943 are authorized) and must be marked to indicate compliance in the manner specified by the respective Code.

(2) Each container must be equipped with safety devices in compliance with the requirements for safety devices on containers as specified in NFPA Pamphlet No. 58.

(3) The containers shall be so braced or otherwise secured on the vehicle as to prevent relative motion while in transit. Valves or other fittings shall be adequately protected against injury during transportation. (See §177.834(g) of this subchapter.)

(4) Except as provided in paragraph (j)(5) of this section, containers shall not be shipped when charged with liquefied petroleum gas to more than 5 percent of their water capacity.

(5) Storage containers of less than 1,042 pounds water capacity (125 gallons) may be shipped when charged with liquefied petroleum gas in compliance with DOT filling density.

(k) A nonspecification cargo tank meeting, and marked in conformance with, the edition of the ASME Code in effect when it was fabricated may be used for the transportation of liquefied petroleum gas provided it meets all of the following conditions:

(1) It must have a minimum design pressure no lower than 250 psig.

(2) It must have a capacity of 13,247.5 liters (3,500 water gallons) or less.

(3) It must have been manufactured in conformance with the ASME Code prior to January 1, 1981, according to its ASME name plate and manufacturer's data report.

(4) It must conform to applicable provisions of NFPA Pamphlet 58, except to the extent that provisions of Pamphlet 58 are inconsistent with requirements in parts 178 and 180 of this subchapter.

(5) It must be inspected, tested, and equipped in accordance with subpart E of part 180 of this subchapter as specified for MC 331 cargo tanks.

(6) Except as provided in this paragraph (k), it must be operated exclusively in intrastate commerce, including its operation by a motor carrier otherwise engaged in interstate commerce, in a state where its operation was permitted by law (not including the incorporation of this subchapter) prior to January 1, 1981. A cargo tank motor vehicle operating under authority of this section may cross state lines to travel to and from a qualified assembly, repair, maintenance, or requalification facility. The cargo tank need not be cleaned and purged, but it may not contain liquefied petroleum gas in excess of five percent of the water capacity of the cargo tank. If the vehicle engine is

supplied fuel from the cargo tank, enough fuel in excess of five percent of the cargo tank's water capacity may be carried for the trip to or from the facility.

(7) It must have been used to transport liquefied petroleum gas prior to January 1, 1981.

(8) It must be operated in conformance with all other requirements of this subchapter.

(l) Anhydrous ammonia must not be offered for transportation or transported in specification MC 330 and MC 331 cargo tanks constructed of quenched and tempered ("QT") steel except as provided in this paragraph.

(1) The ammonia must have a minimum water content of 0.2 percent by weight. Any addition of water must be made using steam condensate, deionized, or distilled water.

(2) Except as otherwise provided in this paragraph, each person offering for transportation or transporting anhydrous ammonia shall perform a periodic analysis for prescribed water content in the ammonia. The analysis must be performed:

(i) From a sample of the ammonia in storage taken at least once every 7 days, or each time ammonia is added to the storage tanks, whichever is less frequent; or

(ii) At the time the cargo tanks are loaded, then a sample of the ammonia taken from at least one loaded cargo tank out of each 10 loads, or from one cargo tank every 24 hours, whichever is less frequent; or

(iii) At the same frequency as described in paragraph (l)(2)(ii) of this section, from a sample taken from the loading line to the cargo tank.

(3) If water is added at the time of loading:

(i) The sample for analysis must be taken from a point in the loading line between the water injection equipment and the cargo tank; and

(ii) Positive provisions must be made to assure water injection equipment is operating.

(4) If water injection equipment becomes inoperative, suitable corrective maintenance must be performed after which a sample from the first loaded cargo tank must be analyzed for prescribed water content.

(5) The analysis method for water content must be as prescribed in CGA Pamphlet G-2.2, titled "Tentative Standard Method for Determining Minimum of 0.2 per cent water in Anhydrous Ammonia," 1975 edition.

(6) Records indicating the results of the analysis taken, as required by this paragraph, must be retained for 2 years and must be open to inspection by representative of the Department.

(7) Each person receiving anhydrous ammonia containing 0.2 per cent water by weight may offer for transportation or transport that ammonia without performing the prescribed analysis for water content provided:

(i) The ammonia received was certified as containing 0.2 percent water as prescribed in §§172.203(h)(l)(i) and 177.817(a) of this subchapter; and

(ii) The amount of water in the ammonia has not been reduced by any means.

(m) A cargo tank (commonly known as a nurse tank and considered an implement of husbandry) transporting anhydrous ammonia, and operated by a private carrier exclusively for agricultural purposes does not have to meet the specification requirements of part 178 of this subchapter if it:

(1) Has a minimum design pressure of 250 psig and meets the requirements of the edition of the ASME code in effect at the time it was manufactured and is marked accordingly;

(2) Is equipped with safety relief valves meeting the requirements of CGA pamphlet S1.2;

(3) Is painted white or aluminum;

(4) Has capacity of 3,000 gallons or less;

(5) Is loaded to a filling density no greater than 56 percent;

(6) Is securely mounted on a farm wagon; and

(7) Is in conformance with the requirements of part 172 of this subchapter except that shipping papers are not required; and it need not be marked or placarded on one end if that end contains valves, fittings, regulators or gauges when those appurtenances prevent the markings and placard from being properly placed and visible.

(n) *Emergency discharge control for cargo tanks in liquefied compressed gas service.-(1) Required emergency discharge control equipment. Each cargo tank in liquefied compressed gas service must have an emergency discharge control capability as specified in the following table:*

173.315(n)(1)(*)	Material	Delivery service	Required emergency discharge control capability
(i)	Division 2.2 materials with no subsidiary hazard, excluding anhydrous ammonia	All	None.
(ii)	Division 2.3 materials	All	Paragraph (n)(2) of this section.
(iii)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia	Other than metered delivery service	Paragraph (n)(2) of this section.
(iv)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia in a cargo tank with a capacity of 13,247.5 liters (3,500 water gallons) or less	Metered delivery service	Paragraph (n)(3) of this section.
(v)	Division 2.2 materials with a subsidiary hazard, Division 2.1 materials, and anhydrous ammonia in a cargo tank with a capacity greater than 13,247.5 liters (3,500 water gallons)	Metered delivery service	Paragraph (n)(3) of this section, and, for obstructed view deliveries where permitted by §177.840(p) of this subchapter, paragraph (n)(3) or (n)(4) of this section.

(2) *Cargo tank motor vehicles in other than metered delivery service. A cargo tank motor vehicle in other than metered delivery service must have a means to automatically shut off the flow of product without the need for human intervention within 20 seconds of an unintentional release caused by a complete separation of a liquid delivery hose (passive shut-down capability).*

(i) Designed flow of product through a bypass in the valve is acceptable when authorized by this subchapter.

(ii) The design for the means to automatically shut off product flow must be certified by a Design Certifying Engineer. The certification must consider any specifications of the original component manufacturer and must explain how the passive means to shut off the flow of product operates. It must also outline the parameters (e.g., temperature, pressure, types of product) within which the passive means to shut off the flow of product is designed to operate. All components of the discharge system that are integral to the design must be included in the certification. A copy of the design certification must be provided to the owner of the cargo tank on which the equipment will be installed.

(iii) Installation must be performed under the supervision of a Registered Inspector unless the equipment is installed and removed as part of regular operation (e.g., a hose). The Registered Inspector must certify that the equipment is installed and tested, if it is possible to do so without damaging the equipment, in accordance with the Design Certifying Engineer's certification. The Registered Inspector must provide the certification to the owner of the cargo tank motor vehicle.

(3) *Cargo tanks in metered delivery service. When required by the table in paragraph (n)(1) of this section, a cargo tank motor vehicle must have an off-truck remote means to close the internal self-closing stop valve and shut off all motive and auxiliary power equipment upon activation by a qualified person attending the unloading of the cargo tank motor vehicle (off-truck remote shut-off). It must function reliably at a distance of 45.72 meters (150 feet). The off-truck remote shut-off activation device must not be capable of reopening the internal self-closing stop valve after emergency activation.*

(i) The emergency discharge control equipment must be installed under the supervision of a Registered Inspector. Each wireless transmitter/receiver must be tested to demonstrate that it will close the internal self-closing stop valve and shut off all motive and auxiliary power equipment at a distance of 91.44 meters (300 feet) under optimum conditions. Emergency discharge control equipment that does not employ a wireless transmitter/receiver must be tested to demonstrate its functioning at the maximum length of the delivery hose.

(ii) The Registered Inspector must certify that the remote control equipment is installed in accordance with the original component manufacturer's specifications and is tested in accordance with paragraph (n)(3)(i) of this section. The Registered Inspector must provide the owner of the cargo tank with this certification.

(4) *Query systems. When a transmitter/receiver system is used to satisfy the requirements of paragraph (n)(1)(v) of this section, it must close the internal self-closing stop valve and shut off all motive and auxiliary power equipment unless the qualified*

person attending the unloading operation prevents it from doing so at least once every five minutes. Testing and certification must be as specified in paragraph (n)(3) of this section.

(5) Compliance dates. (i) Each specification MC 331 cargo tank motor vehicle with a certificate of construction issued two or more years after July 1, 1999, must have an appropriate emergency discharge control capability as specified in this paragraph (n).

(ii) No MC 330, MC 331, or nonspecification cargo tank motor vehicle authorized under paragraph (k) of this section may be operated unless it has an appropriate emergency discharge control capability as specified in this paragraph (n) no later than the date of its first scheduled pressure retest required after July 1, 2001. No MC 330, MC 331 or nonspecification cargo tank motor vehicle authorized under paragraph (k) of this section may be operated after July 1, 2006, unless it has been equipped with emergency discharge control equipment as specified in this paragraph (n).

(iii) No MC 330, MC 331, or nonspecification cargo tank motor vehicle authorized under paragraph (k) of this section, with a capacity over 13,247.5 liters (3,500 gallons) used in metered delivery service may be operated unless it has an appropriate emergency discharge control capability as specified in this paragraph (n) no later than July 1, 2003, or the date of its first scheduled pressure retest required after July 1, 2001, whichever is earlier.

(o) *Chlorine cargo tanks. Each cargo tank motor vehicle used for the transportation of chlorine must meet the requirements in the following:*

(1) Any hose, piping, or tubing used for loading or unloading that is mounted or carried on the motor vehicle may not be attached to any valve and must be capped at all ends to prevent the entry of moisture, except at the time of loading or unloading. Except at the time of loading and unloading, the pipe connection of each angle valve must be closed with a screw plug which is chained or otherwise fastened to prevent misplacement.

(2) Each chlorine cargo tank angle valve must be tested to be leak free at not less than 225 psig using dry air or inert gas before installation and thereafter every 2 years when performing the required periodic retest in §180.407(c) of this subchapter. Prior to each loading, the cargo tank must be inspected and the angle valves and gasketed joints must be examined and tested at a pressure of not less than 50 psig to determine that they are not leaking and are in proper condition for transportation. Any leaks must be corrected before the cargo tank is offered for transportation.

(3) Excess flow valves on the cargo tank must meet the requirements in §178.337-11(a)(4) of this subchapter.

(p) *Fusible elements. Each MC 330, MC 331, or nonspecification cargo tank authorized under paragraph (k) of this section must have a thermal means of closure for each internal self-closing stop valve as specified in §178.337-8(a)(4) of this subchapter.*

[29 FR 18743, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.315, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS

SECTION OF THIS VOLUME.

§173.316 Cryogenic liquids in cylinders.

(a) *General requirements. (1) A cylinder may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.*

(2) A cylinder may not be loaded with any material which may combine chemically with any residue in the packaging to produce an unsafe condition.

(3) The jacket covering the insulation on a cylinder used to transport any flammable cryogenic liquid must be made of steel.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cylinder used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580.

(5) An aluminum valve, pipe or fitting may not be installed on any cylinder used to transport any flammable cryogenic liquid.

(6) Each cylinder must be provided with one or more pressure relief devices, which must be installed and maintained in compliance with the requirements of this subchapter.

(7) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent effective operation of the device.

(8) The maximum weight of the contents in a cylinder with a design service temperature colder than -320 ^{o}F. may not exceed the design weight marked on the cylinder (see §178.35 of this subchapter).

(b) *Pressure control systems. Each cylinder containing a cryogenic liquid must have a pressure control system that conforms to §173.34(d) and is designed and installed so that it will prevent the cylinder from becoming liquid full.*

(c) Specification cylinder requirements and filling limits. Specification DOT-4L cylinders (§178.57 of this subchapter) are authorized for the transportation of cryogenic liquids when carried in the vertical position as follows:

(1) For purposes of this section, "filling density," except for hydrogen, is defined as the percent ratio of the weight of lading in the packaging to the weight of water that the packaging will hold at 60 ^{o}F. (1 lb. of water = 27.737 cubic inches at 60 ^{o}F.).

(2) The cryogenic liquids of argon, nitrogen, oxygen, helium and neon must be loaded and shipped in accordance with the following table:

Pressure control valve setting (maximum start-to-discharge pressure psig)	Maximum permitted filling density (percent by weight)					
-	Air	Argon	Nitrogen	Oxygen	Helium	Neon
45	82.5	133	76	108	12.5	109
75	80.3	130	74	105	12.5	104

105	78.4	127	72	103	12.5	100
170	76.2	122	70	100	12.5	92
230	75.1	119	69	98	12.5	85
295	73.3	115	68	96	12.5	77
360	70.7	113	65	93	12.5	-
450	65.9	111	61	91	12.5	-
540	62.9	107	58	88	12.5	-
625	60.1	104	55	86	12.5	-
Design service temperature (^{o}F.)	-320	-320	-320	-320	-452	-411

(3) *Hydrogen (minimum 95 percent parahydrogen) must be loaded and shipped as follows:*

Column 1	Column 2
Design service temperature	Minus 423 ^{o}F. or colder.
Maximum permitted filling density, based on cylinder capacity at minus 423 ^{o}F (see Note 1)	6.7 percent.
The pressure control valve must be designed and set to limit the pressure in the cylinder to not more than	17 psig.

Note 1: The filling density for hydrogen, cryogenic liquid is defined as the percent ratio of the weight of lading in a packaging to the weight of water that the packaging will hold at minus 423 ^{o}F. The volume of the packaging at minus 423 ^{o}F is determined in cubic inches. The volume is converted to pounds of water (1 lb. of water = 27.737 cubic inches).

(i) Each cylinder must be constructed, insulated and maintained so that during transportation the total rate of venting shall not exceed 30 SCF of hydrogen per hour.
(ii) In addition to the marking requirements in §178.35 of this subchapter, the total rate of venting in SCF per hour (SCFH) shall be marked on the top head or valve protection band in letters at least one-half inch high as follows: "VENT RATE**SCFH" (with the asterisks replaced by the number representing the total rate of venting, in SCF per hour).
(iii) Carriage by highway is subject to the conditions specified in §177.840(a) of this subchapter.
(d) *Mixtures of cryogenic liquid. Where charging requirements are not specifically prescribed in paragraph (c) of this section, the cryogenic liquid must be shipped in packagings and under conditions approved by the Associate Administrator for Hazardous Materials Safety.*

[Amdt. 173-166, 48 FR 27695, June 16, 1983, as amended by Amdt. 173-166, 49 FR 24314, June 12, 1984; Amdt. 173-180, 49 FR 42735, Oct. 24, 1984; Amdt. 173-201, 52

FR 13041, Apr. 20, 1987: Amdt. 173-250, 61 FR 25942, May 23, 1996; Amdt. 173-261, 62 FR 24741, May 6, 1997]

§173.318 Cryogenic liquids in cargo tanks.

(a) *General requirements. (1) A cargo tank may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.*

(2) A cargo tank may not be loaded with any material that may combine chemically with any residue in the packaging to produce an unsafe condition (see §178.338-15).

(3) The jacket covering the insulation on a tank used to transport a cryogenic liquid must be made of steel if the cryogenic liquid:

(i) Is to be transported by vessel (see §176.76(g) of this subchapter); or

(ii) Is oxygen or a flammable material.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cargo tank used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580.

(5) An aluminum valve, pipe or fitting, external to the jacket that retains lading during transportation may not be installed on any cargo tank used to transport oxygen, cryogenic liquid or any flammable cryogenic liquid.

(6) A cargo tank used to transport oxygen, cryogenic liquid must be provided with a manhole (see §178.338-6 of this subchapter).

(b) *Pressure relief systems and pressure control valves-(1) Types of pressure relief systems-(i) Tanks in oxygen and flammable cryogenic liquid service. Except as otherwise provided in this paragraph, each tank in oxygen and flammable cryogenic liquid service must be protected by two independent pressure relief systems which are not connected in series, namely:*

(A) A primary system of one or more pressure relief valves; and

(B) A secondary system of one of more frangible discs or pressure relief valves. For a tank in carbon monoxide service, the secondary system must be pressure relief valves only.

(ii) *Tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service. For a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the tank must be protected by at least one pressure relief system consisting of:*

(A) One or more pressure relief valves; or

(B) A combination of one or more pressure relief valves and one or more frangible discs.

(2) *Capacities of pressure relief systems-(i) Tanks in oxygen or flammable cryogenic liquid service. For tanks in oxygen or flammable cryogenic liquid service, the primary system and the secondary system of pressure relief devices must each have a flow capacity equal to or greater than that calculated by the applicable formula in paragraph 5.3.2 or paragraph 5.3.3 of CGA Pamphlet S-1.2. In addition:*

(A) The primary pressure relief system must have a total flow capacity at a pressure not exceeding 120 percent of the tank's design pressure.

(B) The secondary pressure relief system must have a total flow capacity at a pressure not exceeding 150 percent of the tank's design pressure.

(C) The flow capacity and rating must be verified and marked by the manufacturer of the device in accordance with CGA Pamphlet S-1.2.

(ii) *Tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service. For tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service, the pressure relief system must have a flow capacity equal to or greater than that calculated by the applicable formula in paragraphs 5.3.2 or 5.3.3 of CGA Pamphlet S-1.2. If the pressure relief system consists of a combination of pressure relief valves and frangible discs, the pressure relief valves must have a total venting capacity equal to or greater than that calculated by the applicable formula in paragraph 4.1.10.1.1 of CGA Pamphlet S-1.2. The pressure relief system must have this total flow capacity at a pressure not exceeding 150 percent of the tank's design pressure. The flow capacity and rating must be verified and marked by the manufacturer of the device in accordance with CGA Pamphlet S-1.2.*

(3) Type and construction of pressure relief devices. (i) Each pressure relief device must be designed and constructed for a pressure equal to or exceeding the tank's design pressure at the coldest temperature reasonably expected to be encountered.

(ii) Pressure relief devices must be either spring-loaded pressure relief valves or frangible discs. Pressure relief valves must be of a type that automatically open and close at predetermined pressures.

(4) *Setting of pressure relief devices. (i) On a tank used in oxygen or flammable cryogenic liquid service, the pressure relief devices must perform as follows.*

(A) Each pressure relief valve in the primary relief system must be set-to-discharge at a pressure no higher than 110 percent of the tank's design pressure.

(B) Each pressure relief device in the secondary pressure relief system must be designed to commence functioning at a pressure no lower than 130 percent and no higher than 150 percent of the tank's design pressure.

(ii) On a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the pressure relief devices in the pressure relief system must be designed to commence functioning at no higher than 150 percent of the tank's design pressure.

(5) *Optional pressure relief devices and pressure control valves. In addition to the required pressure relief devices, a cargo tank in cryogenic liquid (except carbon monoxide) service may be equipped with one or both of the following:*

(i) One or more pressure control valves set at a pressure below the tank's design pressure.

(ii) One or more frangible discs set to function at a pressure not less than one and one-half times or more than two times the tank's design pressure.

(6) *Maximum filling rate. (i) For a tank used in oxygen and flammable cryogenic liquid service, the maximum rate at which the tank is filled must not exceed the liquid flow capacity of the primary pressure relief system rated at a pressure not exceeding 120 percent of the tank's design pressure.*

(ii) On a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the maximum rate at which the tank is filled must not exceed the liquid flow capacity of the pressure relief valves rated at 150 percent of the tank's design pressure.

(7) *Arrangement and location of pressure relief devices. (i) The discharge from any pressure relief system must be directed upward and be unobstructed to the outside of the protective housing in such a manner as to prevent impingement of gas upon the jacket or any structural part of the vehicle.*

(ii) Each pressure relief valve must be arranged or protected to prevent the accumulation of foreign material between the relief valve and the atmospheric discharge opening in any relief piping. The arrangement must not impede flow through the device.

(iii) Each pressure relief valve must be designed and located to minimize the possibility of tampering. If the pressure setting or adjustment is external to the valve, the valve adjustment must be sealed.

(iv) Each pressure relief device must have direct communication with the vapor space of the tank at the midlength of the top centerline.

(v) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent the effective operation of the device.

(8) *Connections. (i) Each connection to a pressure relief device must be of sufficient size to allow the required rate of discharge through the pressure relief device. The inlet connection must be not less than one-half inch nominal pipe size.*

(ii) A shut-off valve may be installed in a pressure relief system only when the required relief capacity is provided at all times.

(9) *Pressure relief devices for piping hose and vacuum-insulated jackets. (i) Each portion of connected liquid piping or hose that can be closed at both ends must be provided with either a hydrostatic pressure relief valve without an intervening shut-off valve, or a check valve permitting flow from the pipe or hose into the tank. If used, the relief valve must be located so as to prevent its discharge from impinging on the tank, piping, or operating personnel.*

(ii) On a vacuum-insulated cargo tank the jacket must be protected by a suitable relief device to release internal pressure. The discharge area of this device must be at least 0.00024 square inch per pound of water capacity of the tank. This relief device must function at a pressure not exceeding the internal design pressure of the jacket, calculated in accordance with the ASME Code, or 25 psig, whichever is less.

(10) *Tank inlet, outlet, pressure relief device and pressure control valve markings. (i) Each tank inlet and outlet, except pressure relief devices and pressure control valves, must be permanently marked to indicate whether it communicates with "vapor" or "liquid" when the tank is filled to the maximum permitted filling density.*

(ii) Each pressure relief valve must be plainly and permanently marked with the pressure, in psig, at which it is set-to-discharge, the discharge rate of the device in SCF per minute (SCFM) of free air, and the manufacturer's name or trade name and catalog number. The marked set-to-discharge pressure valve must be visible with the valve in its installed position. The rated discharge capacity of the device must be determined at a pressure of 120 percent of the design pressure of the tank.

(iii) Each pressure control valve must be plainly and permanently marked with the pressure, in psig, at which it is set-to-discharge.

(c) *Weight of lading requirements. The weight of a cryogenic liquid in the tank must be determined by weighing or by the use of a liquid level gauging device authorized in §178.338-14(a) of this subchapter, and may not exceed the lesser of:*

(1) The weight of lading in the tank, based on the water capacity stamped on the nameplate (§178.338-18(a)(4) of this subchapter) and the appropriate maximum permitted filling density specified in paragraph (f) of this section; or

(2) The maximum weight of lading for which the cargo tank was designed, as marked on the specification plate (see §178.338-18(b) of this subchapter).

(d) *Outage. Except for a cargo tank containing helium, cryogenic liquid, a cargo tank offered for transportation must have an outage of at least two percent below the inlet of the pressure relief device or pressure control valve, under conditions of incipient opening, with the tank in a level attitude.*

(e) Temperature. A flammable cryogenic liquid in a cargo tank at the start of travel must be at a temperature sufficiently cold that the pressure setting of the pressure control valve or the required pressure relief valve, whichever is lower, will not be reached in less time than the marked rated holding time for the cryogenic liquid (see paragraph (g)(3) of this section and §178.338-9(b) of this subchapter).

(f) Specification MC-338 (§178.338 of this subchapter) cargo tanks are authorized for the shipment of the following cryogenic liquids subject to the following additional requirements:

(1) For purposes of this section, "filling density" is defined as the percent ratio of the weight of lading in the tank to the weight of water that the tank will hold at the design service temperature (one pound of water=27.737 cubic inches at 60 ^{o}F., or one gallon of water = 231 cubic inches at 60 ^{o}F. and weighs 8.32828 pounds).

(2) *Air, argon, helium, nitrogen, and oxygen, cryogenic liquids must be loaded and shipped in accordance with the following table:*

Pressure Control Valve Setting or Relief Valve Setting

Maximum set-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)				
-	Air	Argon	Helium	Nitrogen	Oxygen
26	-	-	12.5	-	-
30	80.3	129	12.5	74	105
40	79.2	-	12.5	-	-
50	78.0	-	12.5	-	-
55	77.3	125	12.5	71	102
60	76.9	-	12.5	-	-
80	75.3	-	12.5	-	-
85	75.1	121	12.5	-	99
100	73.0	-	12.5	-	-
105	73.7	-	12.5	67	-
120	72.2	-	12.5	-	-
140	71.4	-	12.5	-	-

145	70.9	115	12.5	64	94
180	68.3	-	12.5	-	-
200	67.3	110	12.5	61	91
250	63.3	106	12.5	57	87
275	62.3	105	12.5	56	86
325	59.4	101	-	53	83
Design service temperature	-320 ^{o}F	-320 ^{o}F	-452 ^{o}F	-320 ^{o}F	-320 ^{o}F

(3) *Carbon monoxide, hydrogen (minimum 95 percent para-hydrogen), ethylene, and methane or natural gas, cryogenic liquids must be loaded and shipped in accordance with the following table:*

Pressure Control Valve Setting or Relief Valve Setting

Maximum set-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)			
-	Carbon monoxide	Ethylene	Hydrogen	Methane or natural gas
13	-	-	6.6	-
15	75.0	-	6.6	40.5
17	74.0	-	6.6	-
20	-	53.5	-	40.0
25	73.0	-	-	-
30	72.0	52.7	6.3	39.1
35	-	-	-	-
40	-	52.0	-	38.6
45	71.5	-	-	-
50	-	51.4	6.0	38.2
55	-	-	-	-
60	-	50.8	-	-
70	-	50.2	5.7	37.5
90	-	49.2	-	-
95	-	-	-	-
100	-	48.4	5.4	36.6
115	-	48.2	-	-
125	-	-	5.0	-
150	-	-	4.5	-
175	62.5	45.8	-	-
285	56.0	-	-	-
Design service temperature	-320 ^{o}F	-155 ^{o}F	-423 ^{o}F	-260 ^{o}F

(4) *Mixtures of cryogenic liquid. Where charging requirements are not specifically prescribed in this paragraph (f), the cryogenic liquid must be shipped in packagings and under conditions approved by the Associate Administrator for Hazardous Materials Safety.*

(g) One-way travel time; marking. The jacket of a cargo tank to be used to transport a flammable cryogenic liquid must be marked on its right side near the front, in letters and numbers at least two inches high, "One-Way-Travel-Time __ hrs.", with the blank filled in with a number indicating the one-way travel time (OWTT), in hours, of the cargo tank for the flammable cryogenic liquid to be transported. A cargo tank that is partially unloaded at one or more locations must have additional marking "One-Way-Travel-Time __ hrs. __ psig to __ psig at __ percent filling density," with the second blank filled in with the pressure existing after partial unloading and the third blank filled in with the set-to-discharge pressure of the control valve or pressure relief valve, and the fourth blank with the filling density following partial unloading. Multiple OWTT markings for different pressure levels are permitted. The abbreviation "OWTT" may be used in place of the words "One-way-travel-time" in the marking required by this paragraph.

(1) OWTT is based on the marked rated holding time (MRHT) of the cargo tank for the cryogenic liquid to be transported in the cargo tank. If the MRHT for the flammable cryogenic liquid is not displayed on or adjacent to the specification plate, this MRHT may be derived.

(2) The MRHT is converted to OWTT, in hours, as follows:

(i) For a tank with an MRHT of 72 hours or less,

$$OWTT = (MRHT - 24) / 2$$

(ii) For a tank with an MRHT greater than 72 hours,

$$OWTT = MRHT - 48$$

(3) Each cargo tank motor vehicle used to transport a flammable cryogenic liquid must be examined after each shipment to determine its actual holding time. The record required by §177.840(h) of this subchapter may be used for this determination. If the examination indicates that the actual holding time of the cargo tank, after adjustment to reflect an average ambient temperature of 85 ^{o}F, is less than 90 percent of the marked rated holding time (MRHT) for the cryogenic liquid marked on the specification plate or adjacent thereto (see §178.338-18(b) of this subchapter), the tank may not be refilled with any flammable cryogenic liquid until it is restored to its marked rated holding time value or it is re-marked with the actual marked rated holding time determined by this examination. If the name of the flammable cryogenic liquid that was transported and its marked rated holding time is not displayed on or adjacent to the specification plate, this requirement may be met by deriving the MRHT of the cargo tank for that flammable cryogenic liquid and comparing that derived MRHT with the actual holding time after adjustment.

[Amdt. 173-166, 48 FR 27696, June 16, 1983]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §173.318, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§173.319 Cryogenic liquids in tank cars.

(a) *General requirements. (1) A tank car containing a flammable cryogenic liquid may not be shipped unless it was loaded by, or with the consent of, the owner of the tank car.*
(2) The amount of flammable cryogenic liquid loaded into a tank car must be determined, either by direct measurement or by calculation based on weight, to verify that the tank has not been filled to a level in excess of the limits specified in paragraph (d)(2) of this section. The weight of any flammable cryogenic liquid loaded, except hydrogen, must be checked by use of scales after disconnecting the loading line.
(3) Whenever a tank car containing any flammable cryogenic lading is not received by the consignee within 20 days from the date of shipment, the shipper of the lading shall notify the Bureau of Explosives.
(4) A tank car may not be loaded with any flammable cryogenic liquid:
(i) That may combine chemically with any residue in the tank to produce an unsafe condition,
(ii) That is colder than the design service temperature of the tank,
(iii) If the average daily pressure rise in the tank exceeded 3 psi during the prior shipment,
(iv) Unless it is marked with the name of contents, in accordance with §172.330 of this subchapter.
(b) When a tank car containing a flammable cryogenic liquid is offered for transportation:
(1) At least 0.5 percent outage must be provided below the inlet of the pressure relief or pressure control valve at the start-to-discharge pressure setting of the valve, with the tank car in a level attitude, and
(2) The absolute pressure in the annular space must be less than 75 microns of mercury.
(c) *Temperature. A flammable cryogenic liquid must be loaded into a tank car at such a temperature that the average daily pressure rise during transportation will not exceed 3 psi (see paragraph (a)(4)(iii) of this section and §173.31(c)(13)).*
(d) A Class DOT-113 tank car is authorized for the shipment of the following cryogenic liquids subject to the following additional requirements:
(1) For purposes of this section, "filling density" is defined as the percent ratio of the weight of lading in the tank to the weight of water that the tank will hold at the design service temperature (one pound of water = 27.737 cubic inches at 60 ^{o}F., or one gallon of water = 231 cubic inches at 60 ^{o}F. and weighs 8.32828 pounds).
(2) *Ethylene, and hydrogen (minimum 95 percent parahydrogen), cryogenic liquids must be loaded and shipped in accordance with the following table:*

Pressure Control Valve Setting or Relief Valve Setting

Maximum start-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)			
-	Ethylene	Ethylene	Ethlyene	Hydrogen
17	-	-	-	6.60.
45	52.8	-	-	-
75	-	51.1	51.1	-
Maximum pressure when offered for transportation	10 psig	10 psig	20 psig	-
Design service temperature	Minus 260 ^{o}F	Minus 260 ^{o}F	Minus 155 ^{o}F	Minus 423 ^{o}F.
Specification (see §173.31(a)(9))	113D60W 113C60W	113C120W	113D120W	113A175W. 113A60W.

(e) *Special requirements for class DOT 113 tank cars. (1) A class DOT-113 tank car need not be periodically pressure tested; however, each shipment must be monitored to determine the average daily pressure rise in the tank car. If the average daily pressure rise during any shipment exceeds 0.2 Bar (3 psi) per day, the tank must be tested for thermal integrity prior to any subsequent shipment.*

(2) Thermal integrity test. When required by paragraph (e)(1) of this section, either of the following thermal integrity tests may be used:

(i) Pressure rise test. The pressure rise in the tank may not exceed 0.34 Bar (5 psi) in 24 hours. When the pressure rise test is performed, the absolute pressure in the annular space of the loaded tank car may not exceed 75 microns of mercury at the beginning of the test and may not increase more than 25 microns during the 24-hour period; or

(ii) Calculated heat transfer rate test. The insulation system must be performance tested as prescribed in §179.400-4 of this subchapter. When the calculated heat transfer rate test is performed, the absolute pressure in the annular space of the loaded tank car may not exceed 75 microns of mercury at the beginning of the test and may not increase more than 25 microns during the 24-hour period. The calculated heat transfer rate in 24 hours may not exceed:

(A) 120 percent of the appropriate standard heat transfer rate specified in §179.401-1 of this subchapter, for DOT-113A60W and DOT-113C120W tank cars;

(B) 122.808 joules (0.1164 Btu/day/lb.) of inner tank car water capacity, for DOT-113A175W tank cars;

(C) 345.215 joules (0.3272 Btu/day/lb.) of inner tank car water capacity, for DOT-113C60W and 113D60W tank cars; or

(D) 500.09 joules (0.4740 Btu/day/lb.) of inner tank car water capacity, for DOT-113D120W tank cars.

(3) A tank car that fails a test prescribed in paragraph (e)(2) of this section must be removed from hazardous materials service. A tank car removed from hazardous materials service because it failed a test prescribed in paragraph (e)(2) of this section

may not be used to transport a hazardous material unless the tank car conforms to all applicable requirements of this subchapter.

(4) Each frangible disc must be replaced with a new frangible disc every 12 months, and the replacement date must be marked on the car near the pressure relief valve information.

(5) Pressure relief valves and alternate pressure relief valves must be tested every five years. The start-to-discharge pressure and vapor tight pressure requirements for the pressure relief valves must be as specified in §179.401-1 of this subchapter. The alternate pressure relief device values specified in §179.401-1 of this subchapter for a DOT-113C120W tank car apply to a DOT-113D120W tank car.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53, app. A to part 1)

[Amdt. 173-166, 48 FR 27698, June 16, 1983, as amended by Amdt. 173-245, Sept. 21, 1995]

§173.320 Cryogenic liquids; exceptions.

(a) Atmospheric gases and helium, cryogenic liquids, in Dewar flasks, insulated cylinders, insulated portable tanks, insulated cargo tanks, and insulated tank cars, designed and constructed so that the pressure in such packagings will not exceed 25.3 psig under ambient temperature conditions during transportation are not subject to the requirements of this subchapter when transported by motor vehicle or railcar except as specified in paragraphs (a)(1), (a)(2), and (a)(3) of this section.

(1) Sections 171.15 and 171.16 of this subchapter pertaining to the reporting of incidents, not including a release that is the result of venting through a pressure control valve, or the neck of the Dewar flask.

(2) Subparts A, B, C, and D of part 172, (§§174.24 for rail and 177.817 for highway) and in addition, part 172 in its entirety for oxygen.

(3) Subparts A and B of part 173, and §§174.1 and 177.800, 177.804, and 177.823 of this subchapter.

(b) The requirements of this subchapter do not apply to atmospheric gases and helium:

(1) During loading and unloading operations (pressure rises may exceed 25.3 psig); or

(2) When used in operation of a process system; such as a refrigeration system (pressure may exceed 25.3 psig).

(c) For transportation aboard aircraft, see §171.11 of this subchapter.

[Amdt. 173-201, 52 FR 13043, Apr. 20, 1987, as amended at 62 FR 51561, Oct. 1, 1997]

§173.321 Ethylamine.

Ethylamine must be packaged as follows:

(a) In 1A1 drums which meet Packing Group I performance level requirements.

(b) In specification cylinders as prescribed for any compressed gas except acetylene.

[Amdt. 173-224, 55 FR 52667, Dec. 21, 1990]

§173.322 Ethyl chloride.

Ethyl chloride must be packaged in any of the following single or combination non-bulk packagings which meet Packing Group I performance level requirements:

(a) In 4C1, 4C2, 4D or 4F wooden boxes with glass, earthenware, or metal inner receptacles not over 500 g (17.6 ounces) capacity each;

(b) In 4G fiberboard boxes with glass, earthenware, or metal inner receptacles not over 500 g (17.6 ounces) capacity each. Outer packagings may not exceed 30 kg (66 pounds) gross weight;

(c) In 1A1 drums of not over 100 L (26 gallons) capacity each; or

(d) In specification cylinders as prescribed for any compressed gas except acetylene.

[Amdt. 173-224, 55 FR 52667, Dec. 21, 1990]

§173.323 Ethylene oxide.

(a) For packaging ethylene oxide in non-bulk packagings, silver mercury or any of its alloys or copper may not be used in any part of a packaging, valve, or other packaging appurtenance if that part, during normal conditions of transportation, may come in contact with ethylene oxide liquid or vapor. Copper alloys may be used only where gas mixtures do not contain free acetylene at any concentration that will form copper acetylene. All packaging and gaskets must be constructed of materials which are compatible with ethylene oxide and do not lower the auto-ignition temperature of ethylene oxide.

(b) Ethylene oxide must be packaged in one of the following:

(1) In 4G fiberboard boxes with inner glass ampoules or vials. Total quantity of ethylene oxide may not exceed 100 grams (3.5 ounces) per package. The completed package must be capable of passing Packing Group I performance tests.

(2) In 4G fiberboard boxes constructed with top and bottom pads and perimeter liner. Inner packagings must be aluminum receptacles of no more than 135 g (4.8 ounces) capacity cushioned with incombustible material. No more than 12 receptacles may be packed in one box, and no more than 10 boxes may be overpacked under the provisions of §173.25 of this part. Each completed package must be capable of passing Packing Group I performance tests.

(3) In 4C1, 4C2, 4D or 4F wooden boxes or 4G fiberboard boxes with inner metal receptacles of no more than 340 g (12 ounces) capacity. The metal receptacle must be capable of withstanding no less than a 1241.1 kPa (180 psig) burst pressure. No more than 12 receptacles may be packed in one box, and each receptacle may not be liquid full below 82 ^{o}C (180 ^{o}F). Each inner receptacle must be insulated and equipped with a relief device of the fusible plug type with yield temperature of 69 ^{o}C to 77 ^{o}C (156 ^{o}F to 171 ^{o}F). The capacity of relief device and insulation must be such that the charged receptacle will not explode when tested by the method described in CGA Pamphlet C-14 or other equivalent method. Each completed package must be capable of passing all Packing Group I performance tests.

(4) In specification cylinders, as authorized for any compressed gas except acetylene. Pressurizing valves and insulation are required for cylinders over 4 L (1 gallon) capacity. Eductor tubes must be provided for cylinders over 19 L (5 gallons) capacity. Cylinders must be seamless or welded steel (not brazed) with a nominal capacity of no more than 115 L (30 gallons) and may not be liquid full below 82 ^{o}C (180 ^{o}F). Before each refilling, each cylinder must be tested for leakage at no less than 103.4 kPa (15 psig) pressure. In addition, each cylinder must be equipped with a fusible type relief device with yield temperature of 69 ^{o}C to 77 ^{o}C (157 ^{o}F to 170 ^{o}F). The capacity of the relief device and the effectiveness of the insulation must be such that the charged cylinder will not explode when tested by the method described in CGA Pamphlet C-14 or other equivalent method.

(5) In 1A1 steel drums of no more than 231 L (61 gallons) and meeting Packing Group I performance standards. The drum must be lagged, of all welded construction with the inner shell having a minimum thickness of 1.7 mm (0.068 inches) and the outer shell having a minimum thickness of 2.4 mm (0.095 inches). Drums must be capable of withstanding a hydrostatic test pressure of 690 kPa (100 psig). Lagging must be of sufficient thickness so that the drum, when filled with ethylene oxide and equipped with the required pressure relief device, will not rupture when exposed to fire. The drum may not be liquid full below 85 ^{o}C (185 ^{o}F), and must be marked "THIS END UP" on the top head. Before each refilling, each drum must be tested for leakage at no less than 103 kPa (15 psig) pressure. Each drum must be equipped with a fusible type relief device with yield temperature of 69 ^{o}C to 77 ^{o}C (157 ^{o}F to 170 ^{o}F), and the capacity of the relief device must be such that the filled drum is capable of passing, without rupture, the test method described in CGA Pamphlet C-14 or other equivalent method.

(c) When §172.101 of this subchapter specifies that a hazardous material be packaged under this section, only the following bulk packagings are authorized, subject to the requirements of subparts A and B of this part, the special provisions specified in column 7 of the §172.101 table, and paragraphs (d) through (j) of this section:

(1) *Tank cars. Class DOT 105J tank cars: Notwithstanding the requirements of §173.31(c), each tank car must have a tank test pressure of at least 20.7 Bar (300 psi) no later than July 1, 2006.*

(2) Cargo tanks. Specification MC 330 and MC 331 cargo tank motor vehicles.

(3) Portable tanks. DOT 51 portable tanks.

(d) The pressure relief devices must be set to function at 517 kPa (75 psig). Portable tanks fitted with non-reclosing devices made and in use prior to December 31, 1987, may continue to be used in ethylene oxide service.

(e) In determining outage, consideration must be given to the lading temperature and solubility of inert gas padding in ethylene oxide as well as the partial pressure exerted by the gas padding.

(f) Each tank, loaded or empty, must be padded with dry nitrogen or other suitable inert gas of sufficient quantity to render the vapor space of the tank nonflammable up to 41 ^{o}C (105 ^{o}F). The gas used for padding must be free of impurities which may cause the ethylene oxide to polymerize, decompose or undergo other violent chemical reaction.

(g) Copper, silver, mercury, magnesium or their alloys may not be used in any part of the tank or appurtenances that are normally in contact with the lading.

(h) Neoprene, natural rubber and asbestos gaskets are prohibited. All packing and gaskets must be made of materials which do not react with or lower the autoignition temperature of the lading.

(i) Each tank must be insulated with cork (at least 10 cm (4 inches) thick), or mineral wool, fiberglass or other suitable insulation material of sufficient thickness so that the thermal conductance at 16 ^{o}C (60 ^{o}F) is not more than 0.075 Btu per hour per square foot per degree F. temperature differential. Portable tanks made and in use prior to December 31, 1987 equipped with fusible plugs instead of a safety relief valve or frangible disc, must have sufficient insulation so that the tank as filled for shipment will not rupture in a fire. The insulation on portable tanks or cargo tank motor vehicles must be protected with a steel jacket at least 2.54 mm (0.100 inch) thick, or as required by the specification.

(j) Tank car tanks built after December 30, 1971 must be equipped with a thermometer well.

[Amdt. 173-224, 55 FR 52667, Dec. 21, 1990, as amended at 56 FR 66279, Dec. 20, 1991; Amdt. 173-236, 58 FR 50237, Sept. 24, 1993; Amdt. 173-234, 58 FR 51532, Oct. 1, 1993; Amdt. 173-145, 60 FR 49076, Sept. 21, 1995]

§173.334 Organic phosphates mixed with compressed gas.

Hexaethyl tetraphosphate, parathion, tetraethyl dithio pyrophosphate, tetraethyl pyrophosphate, or other Division 6.1 organic phosphates (including a compound or mixture), may be mixed with a non-flammable compressed gas. This mixture must not contain more than 20 percent by weight of organic phosphate and must be packaged in specification 3A240, 3AA240, 3B240, 4A240, 4B240, 4BA240, or 4BW240 cylinders meeting the following requirements.

(a) Each cylinder may be charged with not more than 5 kg (11.0 pounds) of the mixture, to a maximum filling density of not more than 80 percent of the water capacity;

(b) Each cylinder must be charged in compliance with §173.301 (e) and (f);

(c) No cylinder may be equipped with an eduction tube or a fusible plug;

(d) No cylinder may be equipped with any valve unless the valve is a type approved by the Associate Administrator for Hazardous Materials Safety;

(e) Cylinders must be overpacked in a box so arranged to protect each valve or other closing device from damage. Except as provided in paragraph (f) of this section, no more than four cylinders may be packed in a box. Each box with its closing device protection must be sufficiently strong to protect all parts of each inside cylinder from deformation or breakage if the completed package is dropped 1.8 m (5.9 feet) onto solid concrete and impacted at the package's weakest point.

(f) Cylinders may be packed in strong wooden boxes with valves or other closing devices protected from injury, with not more than twelve cylinders in one outside wooden box. An outer fiberboard box may be used when not more than four such cylinders are to be shipped in one packaging. Valves must be adequately protected. Box and valve protection must be of strength sufficient to protect all parts of inner packagings and valves from deformation or breakage resulting from a drop of at least 1.8 m (5.9 feet) onto a concrete floor, impacting at the weakest point.

[Amdt. 173-224, 55 FR 52668, Dec. 21, 1990]

§173.335 Gas generator assemblies.

Gas generator assemblies (aircraft) containing liquefied non-flammable, non-toxic gas and a solid propellant cartridge must be packaged as follows:

(a) The gas must be packaged in specification steel cylinders authorized for any compressed gas except acetylene not exceeding 10.5 L (2.8 gallons) internal volume and having a minimum design burst pressure of 19,700 kPa (2,857 psi);

(b) Fittings must be protected against damage under conditions normal incident to transport, any trigger must be fitted with a safety locking pin, and a non-propulsive plug must be installed on the discharge tube; and

(c) Each complete unit must be individually and tightly packed to prevent movement in wooden boxes (4C1 or 4C2), plywood boxes (4D), reconstituted wood boxes (4F), fiberboard boxes (4G), or plastic boxes, (4H1and 4H2) of Packing Group II performance level, or in the original manufacturer's transit box.

[Amdt. 173-224, 55 FR 52669, Dec. 21, 1990]

§173.336 Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied.

Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied, must be packaged in specification cylinders as follows:

(a) As prescribed in §173.192, or

(b) Specification 3A480, 3AA480, 3AL1800, or 3E1800 metal cylinders, with valves removed, are authorized. Each valve opening must be closed by means of a solid metal plug with tapered thread properly luted to prevent leakages; valve protection cap must be used and be at least 4.76 mm (0.187 inches) thick gas-tight, with 4.76 mm (0.187 inches) faced seat for gasket and with United States standard form thread. Transportation in 3AL cylinders is authorized only by highway or rail. Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR-C-901c, paragraphs 3.7.2 and 3.8.2. Cleaning agents equivalent to those specified in RR-C-901b may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or less cleaned at the same time must be tested for oil contamination in accordance with Specification RR-C-901b paragraph 4.4.2.3 and meet the standard of cleanliness specified therein.

[Amdt. 173-224, 55 FR 52669, Dec. 21, 1990, as amended at 57 FR 45464, Oct. 1, 1992]

§173.337 Nitric oxide.

Nitric oxide must be packed in Specification 3A1800, 3AA1800, 3E1800, or 3AL1800 cylinders charged to a pressure of not more than 5,170 kPa (750 psi) at 21 °C (70 °F). Cylinders must be equipped with a valve of stainless steel and valve seat of material which will not be deteriorated by contact with nitric oxide or nitrogen dioxide. Cylinders or valves may not be equipped with pressure relief devices of any type. Valve outlets must be sealed by a solid threaded cap or plug and an inert gasketing material. In addition-

(a) Specification 3E1800 cylinders must be overpacked in strong wooden boxes of such design as to protect valves from injury or accidental functioning under conditions incident to transportation. Each overpack must conform to §173.25.

(b) Specification 3A, 3AA, and 3AL cylinders must have their valves protected by metal caps or other equally protective guards securely attached to the cylinders and be of sufficient strength to protect the valves from injury during transit, or by overpacking in strong wooden boxes of such design as to protect valves from injury or accidental functioning under conditions incident to transportation. Each overpack must conform to §173.25. Transportation in 3AL cylinders is authorized only by highway or rail.

(c) Each cylinder must be cleaned in compliance with the requirements of Federal Specification RR-C-901C, paragraphs 3.7.2 and 3.8.2. Cleaning agents equivalent to those specified in RR-C-901C may be used; however, any cleaning agent must not be capable of reacting with oxygen. One cylinder selected at random from a group of 200 or less cleaned at the same time must be tested for oil contamination in accordance with Specification RR-C-901C paragraph 4.4.2.3 and meet the standard of cleanliness specified therein.

[Amdt. 173-224, 55 FR 52669, Dec. 21, 1990]

§173.338 Tungsten hexafluoride.

Tungsten hexafluoride must be packed in specification 3A, 3AA, 3BN, or 3E (§§178.36, 178.37, 178.39, 178.42 of this subchapter) cylinders. Cylinders must be equipped with a valve protection cap or be packed in a strong outside container complying with the provisions of §173.40. Outlets of any valves must be capped or plugged. As an alternative, the cylinder opening may be closed by the use of a metal plug. Specification 3E cylinders must be shipped in an overpack that complies with the provisions of §173.40.

][Amdt. 173-224, 55 FR 52669, Dec. 21, 1990]

§173.340 Tear gas devices.

(a) Packagings for tear gas devices must be approved prior to initial transportation by the Associate Administrator for Hazardous Materials Safety.

(b) Tear gas devices may not be assembled with, or packed in the same packaging with, mechanically- or manually-operated firing, igniting, bursting, or other functioning elements unless of a type and design which has been approved by the Associate Administrator for Hazardous Materials Safety.

(c) Tear gas grenades, tear gas candles, and similar devices must be packaged in one of the following packagings conforming to the requirements of part 178 of this subchapter at the Packing Group II performance level:

(1) In UN 4C1, 4C2, 4D, or 4F metal-strapped wooden boxes. Functioning elements not assembled in grenades or devices must be in a separate compartment of these boxes, or in inner or separate outer boxes, UN 4C1, 4C2, 4D, or 4F, and must be so packed and cushioned that they may not come in contact with each other or with the walls of the box during transportation. Not more than 50 tear gas devices and 50 functioning elements must be packed in one box, and the gross weight of the outer box may not exceed 35 kg (77 pounds).

(2) In a UN 1A2 metal drum. Functioning elements must be packed in a separate inner packaging or compartment. Not more than 24 tear gas devices and 24 functioning elements must be packed in one outer drum, and the gross weight of the drum may not exceed 35 kg (77 pounds).

(3) In a UN 4G fiberboard box with inside tear gas devices meeting Specifications 2P or 2Q. Each inside packaging must be placed in fiberboard tubes fitted with metal ends or a fiber box with suitable padding. Not more than 30 inner packagings must be packed in one outer box, and the gross weight of the outer box may not exceed 16 kg (35 pounds).

(4) In other packagings of a type or design which has been approved by the Associate Administrator for Hazardous Materials Safety.

(d) Tear gas devices may be shipped completely assembled when offered by or consigned to the U.S. Department of Defense, provided the functioning elements are so packed that they cannot accidentally function. Outer packagings must be UN 4C1, 4C2, 4D, or 4F metal-strapped wooden boxes.

[Amdt. 173-224, 55 FR 52669, Dec. 21, 1990]

[CFR] PART 173 SUBPART H - [Reserved]

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART H]

Subpart H - [Reserved]

[CFR] PART 173 SUBPART I - Class 7 (Radioactive) Materials

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART I]

Subpart I - Class 7 (Radioactive) Materials

Source: Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, unless otherwise noted.

§173.401 Scope.

(a) This subpart sets forth requirements for the packaging and transportation of Class 7 (radioactive) materials by offerors and carriers subject to this subchapter. The requirements prescribed in this subpart are in addition to, not in place of, other requirements set forth in this subchapter for Class 7 (radioactive) materials and those of the Nuclear Regulatory Commission in 10 CFR part 71.
(b) This subpart does not apply to:

(1) Class 7 (radioactive) materials produced, used, transported, or stored within an establishment other than during the course of transportation, including storage in transportation.
(2) Class 7 (radioactive) materials contained in a medical device, such as a heart pacemaker, which is implanted in a human being or live animal.
(3) Class 7 (radioactive) materials that have been injected into, ingested by, or are otherwise placed into, and are still in, human beings or live animals.

§173.403 Definitions.

For purposes of this subpart-

A_1 means the maximum activity of special form Class 7 (radioactive) material permitted in a Type A package.

A_2 means the maximum activity of Class 7 (radioactive) material, other than special form, LSA or SCO, permitted in a Type A package. These values are either listed in §173.435 or derived in accordance with the procedure prescribed in §173.433.

Class 7 (radioactive) material. See the definition of Radioactive material in this section.

Closed transport vehicle means a transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials may be of the "see-through" type, and must limit access from top, sides, and bottom.

Containment system means the assembly of components of the packaging intended to retain the radioactive contents during transportation.

Conveyance means:
(1) For transport by public highway or rail: any transport vehicle or large freight container;
(2) For transport by water: any vessel, or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel; and
(3) For transport by aircraft, any aircraft.

Design means the description of a special form Class 7 (radioactive) material, a package, packaging, or LSA-III, that enables those items to be fully identified. The description may include specifications, engineering drawings, reports showing compliance with regulatory requirements, and other relevant documentation.

Exclusive use (also referred to in other regulations as "sole use" or "full load") means sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions in writing, for maintenance of exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the consignor.

Fissile material means plutonium-238, plutonium-239, plutonium-241, uranium-233, uranium-235, or any combination of these radionuclides. The definition does not apply to unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in a thermal reactor. Certain additional exceptions are provided in §173.453.
Fissile material, controlled shipment means any shipment that contains one or more packages that have been assigned, in accordance with §173.457, nuclear criticality control transport indices greater than 10.
Freight container means a reusable container having a volume of 1.81 cubic meters (64 cubic feet) or more, designed and constructed to permit its being lifted with its contents intact and intended primarily for containment of packages in unit form during transportation. A "small freight container" is one which has either one outer dimension less than 1.5 meters (4.9 feet) or an internal volume of not more than 3.0 cubic meters (106 cubic feet). All other freight containers are designated as "large freight containers."
Highway route controlled quantity means a quantity within a single package which exceeds:
(1) 3,000 times the A_1 value of the radionuclides as specified in §173.435 for special form Class 7 (radioactive) material;
(2) 3,000 times the A_2 value of the radionuclides as specified in §173.435 for normal form Class 7 (radioactive) material; or
(3) 1,000 TBq (27,000 Ci), whichever is least.
Limited quantity of Class 7 (radioactive) material means a quantity of Class 7 (radioactive) material not exceeding the materials package limits specified in §173.425 and conforming with requirements specified in §173.421.
Low Specific Activity (LSA) material means Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:
(1) LSA-I.
(i) Ores containing only naturally occurring radionuclides (e.g., uranium, thorium) and uranium or thorium concentrates of such ores; or
(ii) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or
(iii) Class 7 (radioactive) material, other than fissile material, for which the A_2 value is unlimited; or
(iv) Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the Class 7 (radioactive) material is essentially uniformly distributed and the average specificactivitydoesnotexceed 10^{-}\6^{A}G5**2/g.**
(2) *LSA-II.*
(i) Water with tritium concentration up to 0.8 TBq/liter (20.0 Ci/liter); or
(ii) Material in which the Class 7 (radioactive) material is distributed throughout and the average specific activity does not exceed 10^{-}\4^{A}G5**2/g for solids and gases, and 10^{-} \5^{A}G52/g for liquids.**

(3) *LSA-III. Solids (e.g., consolidated wastes, activated materials) that meet the requirements of §173.468 and which:*
(i) The Class 7 (radioactive) material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.); and
(ii) The Class 7 (radioactive) material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) material per package by leaching when placed in water for seven days would not exceed 0.1 A_2; and
(iii) The average specific activity of the solid does not exceed 2x10^{-}\3^{A}G5**2/g.**
Low toxicity alpha emitters are:
(1) Natural uranium, depleted uranium, and natural thorium;
(2) Ores, concentrates or tailings containing uranium-235, uranium-238, thorium-232, thorium-228 and thorium-230; or
(3) Alpha emitters with a half-life of less than 10 days.
Maximum normal operating pressure means the maximum gauge pressure that would develop in a receptacle in a period of one year, in the absence of venting or cooling, under the heat conditions specified in 10 CFR 71.71(c)(1)
Multilateral approval means approval of a package or shipment by the relevant competent authority of the country of origin and of each country through or into which the package or shipment is to be transported. This definition does not include approval from a country over which Class 7 (radioactive) materials are carried in aircraft, if there is no scheduled stop in that country.
Natural thorium means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 percent by weight of thorium-232).
Non-fixed radioactive contamination means radioactive contamination that can be readily removed from a surface by wiping with an absorbent material. Non-fixed (removable) radioactive contamination is not significant if it does not exceed the limits specified in §173.443.
Normal form Class 7 (radioactive) material means Class 7 (radioactive) material which has not been demonstrated to qualify as "special form Class 7 (radioactive) material."
Package means, for Class 7 (radioactive) materials, the packaging together with its radioactive contents as presented for transport.
(1) "Excepted package" means a packaging together with its excepted Class 7 (radioactive) materials as specified in §§173.421-173.426 and 173.428.
(2) "Type A package" means a packaging that, together with its radioactive contents limited to A_1 or A_2 as appropriate, meets the requirements of §§173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by the tests set forth in §173.465 or §173.466, as appropriate. A Type A package does not require Competent Authority Approval.
(3) "Type B package" means a Type B packaging that, together with its radioactive contents, is designed to retain the integrity of containment and shielding required by this part when subjected to the normal conditions of transport and hypothetical accident test

conditions set forth in 10 CFR part 71.
(i) "Type B(U) package" means a Type B packaging that, together with its radioactive contents, for international shipments requires unilateral approval only of the package design and of any stowage provisions that may be necessary for heat dissipation.
(ii) "Type B(M) package" means a Type B packaging, together with its radioactive contents, that for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment. Type B(M) packages are those Type B package designs which have a maximum normal operating pressure of more than 700 kilopascals per square centimeter (100 pounds per square inch) gauge or a relief device which would allow the release of Class 7 (radioactive) material to the environment under the hypothetical accident conditions specified in 10 CFR part 71.
(4) "Industrial package" means a packaging that, together with its low specific activity (LSA) material or surface contaminated object (SCO) contents, meets the requirements of §§173.410 and 173.411. Industrial packages are categorized in §173.411 as either:
(i) "Industrial package Type 1 (IP-1)";
(ii) "Industrial package Type 2 (IP-2)"; or
(iii) "Industrial package Type 3 (IP-3)".
Packaging means, for Class 7 (radioactive) materials, the assembly of components necessary to ensure compliance with the packaging requirements of this subpart. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, service equipment for filling, emptying, venting and pressure relief, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging.
Radiation level means the radiation dose-equivalent rate expressed in millisievert(s) per hour or mSv/h (millirem(s) per hour or mrem/h). Neutron flux densities may be converted into radiation levels according to table 1:

Table 1-Neutron Fluence Rates To Be Regarded as Equivalent to a Radiation Level of 0.01 mSv/h (1 MREM/H)[1]

ENERGY OF NEUTRON	FLUX DENSITY EQUIVALENT TO 0.01 MSV/H (1 MREM/H) NEUTRONS PER SQUARE CENTIMETER PER SECOND (N/CM/S)
Thermal (2.510E-8)MeV	272.0
1 keV	272.0
10 keV	281.0
100 keV	47.0
500 keV	11.0

1 MeV	7.5
5 MeV	6.4
10 MeV	6.7

[1]Flux densities equivalent for energies between those listed in this table may be obtained by linear interpolation.

Radioactive contents means a Class 7 (radioactive) material, together with any contaminated liquids or gases within the package.

Radioactive instrument and article means any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article having Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.

Radioactive material means any material having a specific activity greater than 70 Bq per gram (0.002 microcurie per gram) (see definition of "specific activity").

Special form Class 7 (radioactive) material means Class 7 (radioactive) material which satisfies the following conditions:

(1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

(2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

(3) It satisfies the test requirements of §173.469. Special form encapsulations designed in accordance with the requirements of §173.389(g) in effect on June 30, 1983 (see 49 CFR part 173, revised as of October 1, 1982), and constructed prior to July 1, 1985 and special form encapsulations designed in accordance with the requirements of §173.403 in effect on March 31, 1996 (see 49 CFR part 173, revised as of October 1, 1995), and constructed prior to April 1, 1997, may continue to be used. Any other special form encapsulation must meet the requirements of this paragraph.

Specific activity of a radionuclide means the activity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

Surface Contaminated Object (SCO) means a solid object which is not itself radioactive but which has Class 7 (radioactive) material distributed on any of its surfaces. SCO must be in one of two groups with surface activity not exceeding the following limits:

(1) SCO-I: A solid object on which:

(i) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 (10^{-4} $microcurie/cm^2$) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 (10^{-5} $microcurie/cm^2$) for alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 x 10^4 Bq/cm^2 (1.0 $microcurie/cm^2$) for beta and gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 $microcurie/cm^2$) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 x 10^4 Bq/cm^2 (1 $microcurie/cm^2$) for beta and gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 $microcurie/cm^2$) for all other alpha emitters.

(2) SCO-II: A solid object on which the limits for SCO-I are exceeded and on which:

(i) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 (10^{-2} $microcurie/cm^2$) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm^2 (10^{-3} $microcurie/cm^2$) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 $microcurie/cm^2$) for beta and gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 $microcuries/cm^2$) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 $microcuries/cm^2$) for beta and gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 $microcuries/cm^2$) for all other alpha emitters.

Transport index (TI) means the dimensionless number (rounded up to the next tenth) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined as follows:

(1) For nonfissile material packages, the number determined by multiplying the maximum radiation level in milliSievert(s) per hour at one meter (3.3 feet) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 feet)); or

(2) For fissile material packages, the number determined by multiplying the maximum radiation level in milliSievert per hour at one meter (3.3 feet) from any external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 feet)) or, for criticality control purposes, the number obtained by dividing 50 by the allowable number of packages which may be transported together, whichever number is larger.

Type A quantity means a quantity of Class 7 (radioactive) material, the aggregate radioactivity which does not exceed A_1 for special form Class 7 (radioactive) material or A_2 for normal form Class 7 (radioactive) material, where A_1 and A_2 values are given in §173.435 or are determined in accordance with §173.433.

Type B quantity means a quantity of material greater than a Type A quantity.

Unilateral approval means approval of a package solely by the competent authority of the country of origin.

Unirradiated thorium means thorium containing not more than 10^{-7} grams uranium-233 per gram of thorium-232.

Unirradiated uranium means uranium containing not more than 10^{-6} grams plutonium per gram of uranium-235 and a fission product activity of not more than 9 MBq (0.24 millicuries) of fission products per gram of uranium-235.

Uranium-natural, depleted or enriched means the following:

(1) "Natural uranium" means uranium with the naturally occurring distribution of

uranium isotopes (approximately 0.711 weight percent uranium-235, and the remainder essentially uranium-238).

(2) "Depleted uranium" means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

(3) "Enriched uranium" means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20750, May 8, 1996; 63 FR 52849, Oct. 1, 1998]

§173.410 General design requirements.

In addition to the requirements of subparts A and B of this part, each package used for the shipment of Class 7 (radioactive) materials must be designed so that-

(a) The package can be easily handled and properly secured in or on a conveyance during transport.

(b) Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.

(c) The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.

(d) The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.

(e) Each feature that is added to the package will not reduce the safety of the package.

(f) The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (see §§173.24, 173.24a, and 173.24b).

(g) The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.

(h) All valves through which the package contents could escape will be protected against unauthorized operation.

(i) For transport by air-

(1) The temperature of the accessible surfaces of the package will not exceed 50 ^{o}C (122 ^{o}F) at an ambient temperature of 38 ^{o}C (100 ^{o}F) with no account taken for insulation;

(2) The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40 ^{o}C (-40 ^{o}F) to +55 ^{o}C (131 ^{o}F); and

(3) Packages containing liquid contents will be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than 95 kPa (13.8 lb/in^2).

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20750, May 8, 1996; 64 FR 51919, Sept. 27, 1999]

§173.411 Industrial packagings.

(a) *General. Each industrial packaging must comply with the requirements of this section which specifies packaging tests, and record retention applicable to Industrial Packaging Type 1 (IP-1), Industrial Packaging Type 2 (IP-2), and Industrial Packaging Type 3 (IP-3).*

(b) Industrial packaging certification and tests. (1) Each IP-1 must meet the general design requirements prescribed in §173.410.

(2) Each IP-2 must meet the general design requirements prescribed in §173.410 and when subjected to the tests specified in §173.465 (c) and (d) or evaluated against these tests by any of the methods authorized by §173.461(a), must prevent:

(i) Loss or dispersal of the radioactive contents; and

(ii) A significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test.

(3) Each IP-3 packaging must meet the requirements for an IP-1 and an IP-2, and must meet the requirements specified in §173.412(a) through §173.412(j).

(4) Each specification IM 101 or IM 102 portable tank (§§178.270, 178.271, 178.272 of this subchapter) that is certified as meeting the requirements for an IP-2 or IP-3 must:

(i) Satisfy the requirements for IP-2 or IP-3, respectively;

(ii) Be capable of withstanding a test pressure of 265 kPa (37.1 pounds per square inch) gauge;

(iii) Be designed so that any added shielding is capable of withstanding the static and dynamic stresses resulting from normal handling and normal conditions of transport; and

(iv) Be designed so that loss of shielding will not result in a significant increase in the radiation levels recorded at the external surfaces.

(5) Each freight container that is certified as meeting the requirements of IP-2 or IP-3, must-

(i) Satisfy the requirements for IP-2 or IP-3, respectively;

(ii) Be designed to conform to the requirements of ISO 1496-3-1995(E), "Series 1 Freight Containers-Specifications and Testing-Part 3: Tank Containers for Liquids, Gases and Pressurized Dry Bulk";

(iii) Be designed so that loss of shielding will not result in a significant increase in the radiation levels recorded at the external surfaces if they are subjected to the tests specified in ISO 1496/1-1995(E); and

(iv) For international transportation, have a safety approval plate in conformance with 49 CFR 451.21 through 451.25.

(c) Except for IP-1 packagings, each offeror of an industrial package must maintain on file for at least one year after the latest shipment, and shall provide to the Associate Administrator for Hazardous Materials Safety on request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20750, May 8, 1996]

§173.412 Additional design requirements for Type A packages.

In addition to meeting the general design requirements prescribed in §173.410, each Type A packaging must be designed so that-

(a) The outside of the packaging incorporates a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened. In the case of packages shipped in closed transport vehicles in exclusive use, the cargo compartment, instead of the individual packages, may be sealed.

(b) The smallest external dimension of the package is not less than 10 centimeters (4 inches).

(c) Containment and shielding is maintained during transportation and storage in a temperature range of -40 ^{o}C (-40 ^{o}F) to 70 ^{o}C (158 ^{o}F). Special attention shall be given to liquid contents and to the potential degradation of the packaging materials within the temperature range.

(d) The packaging must include a containment system securely closed by a positive fastening device that cannot be opened unintentionally or by pressure that may arise within the package during normal transport. Special form Class 7 (radioactive) material, as demonstrated in accordance with §173.469, may be considered as a component of the containment system. If the containment system forms a separate unit of the package, it must be securely closed by a positive fastening device that is independent of any other part of the package.

(e) For each component of the containment system account is taken, where applicable, of radiolytic decomposition of materials and the generation of gas by chemical reaction and radiolysis.

(f) The containment system will retain its radioactive contents under the reduction of ambient pressure to 25 kPa (3.6 pounds per square inch).

(g) Each valve, other than a pressure relief device, is provided with an enclosure to retain any leakage.

(h) Any radiation shield that encloses a component of the packaging specified as part of the containment system will prevent the unintentional escape of that component from the shield.

(i) Failure of any tie-down attachment that is a structural part of the packaging, under both normal and accident conditions, must not impair the ability of the package to meet other requirements of this subpart.

(j) When evaluated against the performance requirements of this section and the tests specified in §173.465 or using any of the methods authorized by §173.461(a), the packaging will prevent-

(1) Loss or dispersal of the radioactive contents; and

(2) A significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test.

(k) Each packaging designed for liquids will-

(1) Be designed to provide for ullage to accommodate variations in temperature of the contents, dynamic effects and filling dynamics;

(2) Meet the conditions prescribed in paragraph (j) of this section when subjected to the tests specified in §173.466 or evaluated against these tests by any of the methods authorized by §173.461(a); and

(3) Either-

(i) Have sufficient suitable absorbent material to absorb twice the volume of the liquid contents. The absorbent material must be compatible with the package contents and suitably positioned to contact the liquid in the event of leakage; or

(ii) Have a containment system composed of primary inner and secondary outer containment components designed to assure retention of the liquid contents within the secondary outer component in the event that the primary inner component leaks.

(l) Each package designed for gases, other than tritium not exceeding 40 TBq (1000Ci) or noble gases not exceeding the A_2 value appropriate for the noble gas, will be able to prevent loss or dispersal of contents when the package is subjected to the tests prescribed in §173.466 or evaluated against these tests by any of the methods authorized by §173.461(a).

§173.413 Requirements for Type B packages.

Except as provided in §173.416, each Type B(U) or Type B(M) package must be designed and constructed to meet the applicable requirements specified in 10 CFR part 71.

§173.415 Authorized Type A packages.

The following packages are authorized for shipment if they do not contain quantities exceeding A_1 or A_2 as appropriate:

(a) DOT Specification 7A (§178.350 of this subchapter) Type A general packaging. Each offeror of a Specification 7A package must maintain on file for at least one year after the latest shipment, and shall provide to DOT on request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification. Use of Specification 7A packagings designed in accordance with the requirements of §178.350 of this subchapter in effect on June 30, 1983 (see 49 CFR part 178 revised as of October 1, 1982), is not authorized after April 1, 1997.
(b) Any other Type A packaging that also meets the applicable standards for fissile materials in 10 CFR part 71 and is used in accordance with §173.471.
(c) Any Type B, B(U) or B(M) packaging authorized pursuant to §173.416.
(d) Any foreign-made packaging that meets the standards in IAEA "Safety Series No. 6" and bears the marking "Type A" and was used for the import of Class 7 (radioactive) materials. Such packagings may be subsequently used for domestic and export shipments of Class 7 (radioactive) materials provided the offeror obtains the applicable documentation of tests and engineering evaluations and maintains the documentation on file in accordance with paragraph (a) of this section. These packagings must conform with requirements of the country of origin (as indicated by the packaging marking) and the IAEA regulations applicable to Type A packagings.

§173.416 Authorized Type B packages.

Each of the following packages is authorized for shipment of quantities exceeding A_1 or A_2, as appropriate:
(a) Any Type B, Type B(U) or Type B(M) packaging that meets the applicable requirements of 10 CFR part 71 and that has been approved by the U.S. Nuclear Regulatory Commission may be shipped pursuant to §173.471.
(b) Any Type B, B(U) or B(M) packaging that meets the applicable requirements of the regulations of the International Atomic Energy Agency (IAEA) in its "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6" and for which the foreign competent authority certificate has been revalidated by DOT pursuant to §173.473. These packagings are authorized only for export and import shipments.
(c) DOT Specification 6M (§178.354 of this subchapter) metal packaging, only for solid or gaseous Class 7 (radioactive) materials that will not undergo pressure-generating decomposition at temperatures up to 121 ^{o}C (250 ^{o}F) and that do not generate more than 10 watts of radioactive decay heat.
(d) For contents in other than special form; DOT Specification 20WC (§178.362 of this subchapter), wooden protective jacket, when used with a single, snug-fitting inner DOT Specification 2R (§178.360 of this subchapter). For liquid contents, the inner packaging must conform to §173.412(j) and (k).
(e) For contents in special form only; DOT Specification 20WC (§178.362 of this subchapter), wooden protective jacket, with a single snug-fitting inner Type A packaging that has a metal outer wall and conforms to §178.350 of this subchapter. Radioactive

decay heat may not exceed 100 watts.

(f) For contents in special form only; DOT Specification 21WC (§178.364 of this subchapter), wooden protective overpack, with a single inner DOT Specification 2R (§178.360 of this subchapter). Contents must be loaded within the inner packaging in such a manner as to prevent loose movement during transportation. The inner packaging must be securely positioned and centered within the overpack so that there will be no significant displacement of the inner packaging if the overpack containing it is subjected to the 9 meter (30 feet) drop test described in 10 CFR part 71.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by 63 FR 52849, Oct. 1, 1998]

§173.417 Authorized fissile materials packages.

(a) Except as provided in §173.453, fissile materials containing not more than A_1 or A_2 as appropriate, must be packaged in one of the following packagings:

(1) DOT Specification 6L (§178.352 of this subchapter), metal packaging, for materials prescribed in paragraph (b)(1) of this section.

(2) DOT Specification 6M (§178.354 of this subchapter), metal packaging, for materials prescribed in paragraph (b)(2) of this section.

(3) Any packaging listed in §173.415, limited to the Class 7 (radioactive) materials specified in 10 CFR part 71, subpart C.

(4) Any other Type A or Type B, Type B(U), or Type B(M) packaging for fissile Class 7 (radioactive) materials that also meets the applicable standards for fissile materials in 10 CFR part 71.

(5) Any other Type A or Type B, Type B(U), or Type B(M) packaging that also meets the applicable requirements for fissile material packaging in Section V of the International Atomic Energy Agency "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6," and for which the foreign competent authority certificate has been revalidated by the U.S. Competent Authority, in accordance with §173.473. These packages are authorized only for export and import shipments.

(6) A 55-gallon 1A2 steel drum, meeting the applicable packaging testing requirements of subpart M of part 178 of this subchapter at the packing group I performance level, subject to the following conditions:

(i) The quantity may not exceed 350 grams of uranium-235 in any non-pyrophoric form, enriched to any degree in the uranium-235 isotope;

(ii) Each drum must have a minimum 18 gauge body and bottom head and 16 gauge removable top head with one or more corrugations in the cover near the periphery;

(iii) Closure must conform to §178.352 of this subchapter;

(iv) At least four equally spaced 12 millimeter (0.5 inch) diameter vent holes must be provided on the sides of the drum near the top, each covered with weatherproof tape; or equivalent device;

(v) Appropriate primary, inner containment of the contents and sufficient packaging material, such as plastic or metal jars or cans, must be provided such that Specification 7A (§178.350 of this subchapter) provisions are satisfied by the inner packaging;

(vi) Each inner container must be capable of venting if subjected to the thermal test described in 10 CFR part 71;

(vii) Liquid contents must be packaged in accordance with §173.412 (j) and (k); and

(viii) The maximum weight of contents, including internal packaging, may not exceed 91 kilograms (200 pounds) with fissile material content limited as shown in table 2:

Table 2-Fissile Material Content and Transport Index for UN1A2 Package

Maximum quantity and minimum transport index		Maximum No. of packages transported as a fissile material controlled shipment
U-235 per package (grams)	Minimum transport index per package	-
350	1.8	72
300	1.0	129
250	0.5	256
200	0.3	500
150	0.1	500
100	0.1	500
50	([1])	([2])

[1]Transport index is limited by the external radiation levels.

[2]Maximum number is limited by the total transport index.

(7) Any metal cylinder that meets the requirements of §173.415 and §178.350 of this subchapter for Specification 7A Type A packaging may be used for the transport of residual "heels" of enriched solid uranium hexafluoride without a protective overpack in accordance with table 3, as follows:

Table 3-Allowable Content of Uranium Hexafluoride (UF_6) "Heels" in a Specification 7A Cylinder

Maximum cylinder diameter		Cylinder volume		Maximum uranium-235 enrichment (weight percent)	Maximum "Heel" weight per cylinder			
Centimeters	Inches	Liters	Cubic feet	-	UF6		Uranium-235	
-	-	-	-	-	kg	lb	kg	lb
12.7	5	8.8	0.311	100.0	0.045	0.1	0.031	0.07
20.3	8	39.0	1.359	12.5	0.227	0.5	0.019	0.04
30.5	12	68.0	2.410	5.0	0.454	1.0	0.015	0.03
76.0	30	725.0	25.64	5.0	11.3	25.0	0.383	0.84

122.0	48	3,084.0	[1]108.9	4.5	22.7	50.0	0.690	1.52
122.0	48	4,041.0	[2]142.7	4.5	22.7	50.0	0.690	1.52
-	-	-	-	-	-	-	-	-

[1]10 ton.

[2]14 ton.

(8) DOT Specification 20PF-1, 20PF-2, or 20PF-3 (§178.356 of this subchapter), or Specification 21PF-1A, 21PF-1B, or 21PF-2 (§178.358 of this subchapter) phenolic-foam insulated overpack with snug fitting inner metal cylinders, meeting all requirements of §§173.24, 173.410, 173.412, and 173.420 and the following:

(i) Handling procedures and packaging criteria must be in accordance with DOE Report ORO-651 or ANSI N14.1.

(ii) Quantities of uranium hexafluoride are authorized as shown in table 6 of this section, with each package assigned a minimum transport index as also shown.

(b) Fissile Class 7 (radioactive) materials with radioactive content exceeding A_1 or A_2 must be packaged in one of the following packagings:

(1) DOT Specification 6L (§178.352 of this subchapter), metal packaging. These packages may contain only uranium-235, plutonium-239, or plutonium-241, as metal, oxide, or compounds that do not decompose at temperatures up to 149 ^{o}C (300 ^{o}F). Radioactive decay heat output may not exceed 5 watts. Class 7 (radioactive) materials in normal form must be packaged in one or more tightly sealed metal or polyethylene bottles within a DOT Specification 2R (§178.360 of this subchapter) containment vessel. Authorized contents are limited in accordance with table 4, as follows:

Table 4-Authorized Contents in Kilograms (kg) and Conditions for Specification 6L Packages

Uranium-235		Plutonium (Plutonium solutions are not authorized)		Minimum fissile transport index	Maximum No. of packages transported as a fissile material control shipment
H/X<=3	3 H/X<= 10	H/X<= 10	10 <= H/X <= 20	-	-
14	[2]3.6	-	-	1.3	80
-	-	2.5	2.4	1.8	50

[1]H/X is the ratio of hydrogen to fissile atoms in their inner containment with all sources of hydrogen in the containment considered.

[2]Volume not to exceed 3.6 liters.

(2) DOT Specification 6M (§178.354 of this subchapter), metal packaging. These packages must contain only solid Class 7 (radioactive) materials that will not decompose at temperatures up to 121°C (250°F). Radioactive decay heat output may not exceed 10 watts. Class 7 (radioactive) materials in other than special form must be packaged in one or more tightly sealed metal cans or polyethylene bottles within a DOT Specification 2R (§178.360 of this subchapter) containment vessel.

(i) For fissile material with a criticality TI equal to 0.0, packages are limited to the following amounts of fissile Class 7 (radioactive) materials: 1.6 kilograms of uranium-235; 0.9 kilograms of plutonium (except that due to the 10-watt thermal decay heat limitation, the limit for plutonium-238 is 0.02 kilograms); and 0.5 kilograms of uranium-233. The maximum ratio of hydrogen to fissile material may not exceed three, including all of the sources of hydrogen within the DOT Specification 2R containment vessel.

(ii) Maximum quantities of fissile material and other restrictions for materials with a criticality TI of greater than 0.0 are given in table 5. The minimum transport index to be assigned per package and, for fissile material, controlled shipments, the allowable number of similar packages per conveyance and per transport vehicle are shown in table 5. Where a maximum ratio of hydrogen to fissile material is specified in table 5, only the hydrogen interspersed with the fissile material must be considered. For a uranium-233 shipment, the maximum inside diameter of the inner containment vessel may not exceed 12.1 centimeters (4.75 inches). Where necessary, a tight-fitting steel insert must be used to reduce a larger diameter inner containment vessel specified in §178.354 of this subchapter to the 12.1 centimeter (4.75 inch) limit. Table 5 is as follows:

Table 5-Authorized Contents for Specification 6M Packages[1]

Uranium-233			Uranium-235,[7]			Plutonium,[4]			Minimum transport index	Maximum no. pkgs. transported as a fissile material control shipment
Metal or alloy	Compounds		Metal or alloy	Compounds		Metal or alloy	Compounds		-	-
H/X=0	H/X=0	H/X<=3	H/X=0	H/X=0	H/X<=3	H/X=0	H/X=0	H/X<=3	-	-
0.5	0.5	0.5	1.6	1.6	1.6	[9]0.9	[9]0.9	[9]0.9	0	N/A
3.6	4.4	2.9	7.2	7.6	5.3	3.1	4.1	3.4	0.1	1,250
[6]4.2	5.2	3.5	8.7	9.6	6.4	3.4	4.5	4.1	0.2	625

[6]5.2	6.8	4.5	11.2	13.9	8.3	4.2	-	4.5	0.5	250
-	-	-	13.5	16.0	10.1	4.5	-	-	1.0	125
-	-	-	-	26.0	16.1	-	-	-	5.0	25
-	-	-	-	32.0	19.5	-	-	-	10.0	12

[1]Quantity in kilograms.
[2]Minimum percentage of plutonium-240 is 5 weight percent.
[3]4.5 kilogram limitation of plutonium due to watt decay heat limitation.
[4]For a mixture of uranium-235 and plutonium an equal amount of uranium-235 may be substituted for any portion of the plutonium authorized.
[5]Maximum inside diameter of specification 2R containment vessel not to exceed 12.1 centimeters (4.75 inches) (see paragraph (b)(2)(ii) of this section).
[6]Granulated or powdered metal with any particle less than 6.4 millimeters (0.25 inch) in the smallest dimension is not authorized.
7Except for material with a criticality TI of 0.0, the maximum permitted uranium-235 enrichment is 93.5 percent.
[8]H/X is the ratio of hydrogen to fissile atoms in the inner containment.
[9]For Pu-238, the limit is 0.02 kg because of the 10 watt thermal decay heat limitation.

(3) Type B, or Type B(U), or B(M) packaging that meets the standards for packaging of fissile materials in 10 CFR part 71, and is approved by the U.S. Nuclear Regulatory Commission and used in accordance with §173.471.

(4) Type B, B(U), or B(M) packaging that meets the applicable requirements for fissile Class 7 (radioactive) materials in Section V of the IAEA "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6" and for which the foreign competent authority certificate has been revalidated by the U.S. Competent Authority in accordance with §173.473. These packagings are authorized only for import and export shipments.

(5) DOT Specifications 20PF-1, 20PF-2, or 20PF-3 (§178.356 of this subchapter), or DOT Specifications 21PF-1A or 21PF-1B (§178.358 of this subchapter) phenolic-foam insulated overpack with snug fitting inner metal cylinders, meeting all requirements of §§173.24, 173.410, and 173.412, and the following:

(i) Handling procedures and packaging criteria must be in accordance with DOE Report ORO-651 or ANSI N14.1; and

(ii) Quantities of uranium hexafluoride are authorized as shown in table 6, with each package assigned a minimum transport index as also shown:

Table 6-Authorized Quantities of Uranium Hexafluoride

Protective overpack specification number	Maximum inner cylinder diameter	Maximum weight of UF6 contents	Maximum U-235 enrichment	Minimum transport index

					(weight/ percent)	
-	Centimeters	Inches	Kilograms	Pounds	-	-
20PF-1	12.7	5	25	55	100.0	0.1
20PF-2	20.3	8	116	255	12.5	0.4
20PF-3	30.5	12	209	460	5.0	1.1
21PF-1A[1] or 21PF-1B[1]	[2]76.0	[2]30	2,250	4,950	5.0	5.0
21PF-1A[1] or 21PF-1B[1]	376.0	330	2,282	5,020	5.0	5.0
21PF-2[1]	[2]76.0	[2]30	2,250	4,950	5.0	5.0
21PF-2[1]	[3]76.0	[3]30	2,282	5,020	5.0	5.0

[1]For 76 cm (30 in) cylinders, the maximum H/U atomic ratio is 0.088.
[2]Model 30A inner cylinder (reference ORO-651).
[3]Model 30B inner cylinder (reference ORO-651).

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20750, May 8, 1996]

§173.418 Authorized packages-pyrophoric Class 7 (radioactive) materials.

Pyrophoric Class 7 (radioactive) materials, as referenced in the §172.101 table of this subchapter, in quantities not exceeding A_2 per package must be transported in DOT Specification 7A packagings constructed of materials that will not react with, nor be decomposed by, the contents. Contents of the package must be-

(a) In solid form and must not be fissile unless excepted by §173.453;

(b) Contained in sealed and corrosion resistant receptacles with positive closures (friction or slip-fit covers or stoppers are not authorized);

(c) Free of water and contaminants that would increase the reactivity of the material; and

(d) Inerted to prevent self-ignition during transport by either-

(1) Mixing with large volumes of inerting materials, such as graphite, dry sand, or other suitable inerting material, or blended into a matrix of hardened concrete; or

(2) Filling the innermost receptacle with an appropriate inert gas or liquid.

§173.419 Authorized packages-oxidizing Class 7 (radioactive) materials.

(a) An oxidizing Class 7 (radioactive) material, as referenced in the §172.101 table of this subchapter, is authorized in quantities not exceeding an A_2 per package, in a DOT Specification 7A package provided that-

(1) The contents are:

(i) Not fissile;
(ii) Packed in inside packagings of glass, metal or compatible plastic; and
(iii) Cushioned with a material that will not react with the contents; and
(2) The outside packaging is made of wood, metal, or plastic.
(b) The package must be capable of meeting the applicable test requirements of §173.465 without leakage of contents.
(c) For shipment by air, the maximum quantity in any package may not exceed 11.3 kilograms (25 pounds).

§173.420 Uranium hexafluoride (fissile, fissile excepted and non-fissile).
(a) In addition to any other applicable requirements of this subchapter, uranium hexafluoride, fissile, fissile excepted or non-fissile, must be offered for transportation as follows:
(1) Before initial filling and during periodic inspection and test, packagings must be cleaned in accordance with American National Standard N14.1.
(2) Packagings must be designed, fabricated, inspected, tested and marked in accordance with-
(i) American National Standard N14.1 (1990, 1987, 1982, 1971) in effect at the time the packaging was manufactured;
(ii) Specifications for Class DOT-106A multi-unit tank car tanks (§§179.300 and 179.301 of this subchapter); or
(iii) Section VIII, Division I of the ASME Code, provided the packaging-
(A) Was manufactured on or before June 30, 1987;
(B) Conforms to the edition of the ASME Code in effect at the time the packaging was manufactured;
(C) Is used within its original design limitations; and
(D) Has shell and head thicknesses that have not decreased below the minimum value specified in the following table:

Packaging model	Minimum thickness; millimeters (inches)
1S, 2S	1.58 (0.062)
5A, 5B, 8A	3.17 (0.125)
12A, 12B	4.76 (0.187)
30B	7.93 (0.312)
48A, F, X, and Y	12.70 (0.500)
48T, O, OM, OM Allied, HX, H, AND G	6.35 (0.250)

(3) Uranium hexafluoride must be in solid form.
(4) The volume of solid uranium hexafluoride, except solid depleted uranium

hexafluoride, at 20 ^{o}C (68 ^{o}F) may not exceed 61% of the certified volumetric capacity of the packaging. The volume of solid depleted uranium hexafluoride at 20 ^{o}C (68 ^{o}F) may not exceed 62% of the certified volumetric capacity of the packaging.

(5) The pressure in the package at 20 ^{o}C (68 ^{o}F) must be less than 101.3 kPa (14.8 psia).

(b) Packagings for uranium hexafluoride must be periodically inspected, tested, marked and otherwise conform with the American National Standard N14.1-1990.

(c) Each repair to a packaging for uranium hexafluoride must be performed in accordance with American National Standard N14.1-1990.

§173.421 Excepted packages for limited quantities of Class 7 (radioactive) materials.

(a) A Class 7 (radioactive) material whose activity per package does not exceed the limits specified in §173.425 and its packaging are excepted from the specification packaging, marking, labeling and, if not a hazardous substance or hazardous waste, the shipping paper and certification requirements of this subchapter and requirements of this subpart if:

(1) Each package meets the general design requirements of §173.410;

(2) The radiation level at any point on the external surface of the package does not exceed 0.005 mSv/hour (0.5 mrem/ hour);

(3) The nonfixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in §173.443(a);

(4) The outside of the inner packaging or, if there is no inner packaging, the outside of the packaging itself bears the marking "Radioactive";

(5) Except as provided in §173.426, the package does not contain more than 15 grams of uranium-235; and

(6) The material is otherwise prepared for shipment as specified in accordance with §173.422.

(b) A limited quantity of Class 7 (radioactive) material that is a hazardous substance or a hazardous waste, is not subject to the provisions in §172.203(d) or §172.204(c)(4) of this subchapter.

§173.422 Additional requirements for excepted packages containing Class 7 (radioactive) materials.

(a) Except for materials subject to the shipping paper requirements of subpart C of part 172 of this subchapter, excepted packages prepared for shipment under the provisions of §173.421, §173.424, §173.426, or §173.428 must be certified as being acceptable for transportation by having a notice enclosed in or on the package, included with the packing list, or otherwise forwarded with the package. This notice must include the name of the consignor or consignee and one of the following statements, as

appropriate:
(1) "This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910";
(2) "This package conforms to the conditions and limitations specified in 49 CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910";
(3) "This package conforms to the conditions and limitations specified in 49 CFR 173.426 for radioactive material, excepted package-articles manufactured from natural or depleted uranium, or natural thorium, UN2910"; or
(4) "This package conforms to the conditions and limitations specified in 49 CFR 173.428 for radioactive material, excepted package-empty package, UN2910."
(b) An excepted package of Class 7 (radioactive) material that is classed as Class 7 and is prepared for shipment under the provisions of §173.421, §173.423, §173.424, §173.426, or §173.428 is not subject to the requirements of this subchapter, except for-
(1) Sections 171.15, 171.16, 174.750 and 176.710 of this subchapter, pertaining to the reporting of incidents and decontamination, when transported by a mode other than air;
(2) Sections 171.15, 171.16, and 175.700(b) of this subchapter pertaining to the reporting of incidents and decontamination when transported by aircraft; and
(3) The training requirements of subpart H of part 172 of this subchapter and, for materials that meet the definition of a hazardous substance or a hazardous waste, the shipping paper requirements of subpart C of part 172 of this subchapter.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20751, May 8, 1996; 62 FR 51561, Oct. 1, 1997; 63 FR 52849, Oct. 1, 1998]

§173.423 Requirements for multiple hazard limited quantity Class 7 (radioactive) materials.

(a) Except as provided in §173.4, when a limited quantity radioactive material meets the definition of another hazard class or division, it must be-

(1) Classed for the additional hazard;

(2) Packaged to conform with the requirements specified in §173.421(a)(1) through (a)(5) or §173.424(a) through (g), as appropriate; and

(3) Offered for transportation in accordance with the requirements applicable to the hazard for which it is classed.

(b) A limited quantity Class 7 (radioactive) material which is classed other than Class 7 in accordance with this subchapter is excepted from the requirements of §§173.422(a), 172.203(d), and 172.204(c)(4) of this subchapter if the entry "Limited quantity radioactive material" appears on the shipping paper in association with the basic description.

§173.424 Excepted packages for radioactive instruments and articles.
A radioactive instrument or article and its packaging is excepted from the specification packaging, shipping paper and certification, marking and labeling requirements of this subchapter and requirements of this subpart, if:
(a) Each package meets the general design requirements of §173.410;
(b) The activity of the instrument or article does not exceed the relevant limit listed in table 7 in §173.425;
(c) The total activity per package does not exceed the relevant limit listed in table 7 in §173.425;
(d) The radiation level at 10 cm (4 in) from any point on the external surface of any unpackaged instrument or article does not exceed 0.1 mSv/hour (10 mrem/hour);
(e) The radiation level at any point on the external surface of a package bearing the article or instrument does not exceed 0.005 mSv/hour (0.5 mrem/hour), or, for exclusive use domestic shipments, 0.02 mSv (2 mrem/hour);
(f) The nonfixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in §173.443(a);
(g) Except as provided in §173.426, the package does not contain more than 15 grams of uranium-235; and
(h) The package is otherwise prepared for shipment as specified in §173.422.

§173.425 Table of activity limits-excepted quantities and articles.
The limits applicable to instruments, articles, and limited quantities subject to exceptions under §§173.421 and 173.424 are set forth in table 7 as follows:

TABLE 7-ACTIVITY LIMITS FOR LIMITED QUANTITIES, INSTRUMENTS, AND ARTICLES

NATURE OF CONTENTS	INSTRUMENTS AND ARTICLES		LIMITED QUANTITY PACKAGE LIMITS
-	LIMITS FOR EACH INSTRUMENT OR ARTICLE	PACKAGE LIMITS	-
Solids:	-	-	-
Special form	10^{-2} A_1	A_1	10^{-3} A_1
Normal form	10^{-2} A_2	A_2	10^{-3} A_2
Liquids:	-	-	-
Tritiated water:	-	-	-
<0.0037 TBq/liter (0.1 Ci/L)	-	-	37 TBq (1,000 Ci)
0.0037 TBq to 0.037 TBq/L (0.1 Ci to 1.0 Ci/L)	-	-	3.7 TBq (100 Ci)
>0.037 TBq/L (1.0 Ci/L)	-	-	0.037 TBq (1.0 Ci)

Other Liquids	$10^{-3} A_2$	$10^{-1} A_2$	$10^{-4} A_2$
Gases:	-	-	-
Tritium[2]	$2 \times 10^{-2} A_2$	$2 \times 10^{-1} A_2$	$2 \times 10^{-2} A_2$
Special form	$10^{-3} A_1$	$10^{-2} A_1$	$10^{-3} A_1$
Other form	$10^{-3} A_2$	$10^{-2} A_2$	$10^{-3} A_2$

[1]For mixtures of radionuclides see §173.433(d).
[2]These values also apply to tritium in activated luminous paint and tritium adsorbed on solid carriers.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20751, May 8, 1996; 63 FR 52849, Oct. 1, 1998]

§173.426 Excepted packages for articles containing natural uranium or thorium.
A manufactured article in which the sole Class 7 (radioactive) material content is natural or unirradiated depleted uranium or natural thorium and its packaging is excepted from the specification packaging, shipping paper and certification, marking, and labeling requirements of this subchapter and requirements of this subpart if:
(a) Each package meets the general design requirements of §173.410;
(b) The outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or other durable protective material;
(c) The conditions specified in §173.421(a) (2), (3) and (4) are met; and
(d) The article is otherwise prepared for shipment as specified in §173.422.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20752, May 8, 1996]

§173.427 Transport requirements for low specific activity (LSA) Class 7 (radioactive) materials and surface contaminated objects (SCO).
(a) In addition to other applicable requirements specified in this subchapter, low specific activity (LSA) materials and surface contaminated objects (SCO), unless excepted by paragraph (d) of this section, must be packaged in accordance with paragraph (b) or (c) of this section and must be transported in accordance with the following conditions:
(1) The external dose rate must not exceed an external radiation level of 10 mSv/h (1 rem/h) at 3 meters from the unshielded material;
(2) The quantity of LSA and SCO material in any single conveyance must not exceed the limits specified in table 9;
(3) LSA material and SCO that are or contain fissile material must meet the

applicable requirements of §§173.453, 173.457, 173.459 and 173.467;
(4) Packages must meet the contamination control limits specified in §173.443;
(5) External radiation levels must comply with §173.441; and
(6) For LSA material and SCO required by this section to be consigned as exclusive use:
(i) Shipments must be loaded by the consignor and unloaded by the consignee from the conveyance or freight container in which originally loaded;
(ii) There must be no loose Class 7 (radioactive) material in the conveyance, however, when the conveyance is the packaging there must be no leakage of Class 7 (radioactive) material from the conveyance;
(iii) Packages must be braced so as to prevent shifting of lading under conditions normally incident to transportation;
(iv) Specific instructions for maintenance of exclusive use shipment controls must be provided by the offeror to the carrier. Such instructions must be included with the shipping paper information;
(v) Except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded in accordance with subpart F of part 172 of this subchapter;
(vi) For domestic transportation only, packages are excepted from the marking and labeling requirements of this subchapter. However, the exterior of each nonbulk package must be stenciled or otherwise marked "Radioactive-LSA" or "Radioactive-SCO", as appropriate, and nonbulk packages that contain a hazardous substance must also be stenciled or otherwise marked with the letters "RQ" in association with the above description; and
(vii) Except when transported in an industrial package in accordance with table 8, transportation by aircraft is prohibited.
(b) Except as provided in paragraph (c) of this section, LSA material and SCO must be packaged as follows:
(1) In an industrial package (IP-1, IP-2 or IP-3; §173.411), subject to the limitations of table 8;
(2) For domestic transportation only, in a DOT Specification 7A (§178.350 of this subchapter) Type A package. The requirements of §173.412 (a), (b), (c) and (k) do not apply;
(3) For domestic transportation only, in a strong, tight package that prevents leakage of the radioactive content under normal conditions of transport. In addition to the requirements of paragraph (a) of this section, the following requirements must be met:
(i) The shipment must be exclusive use;
(ii) The quantity of Class 7 (radioactive) material in each packaging may not exceed an A_2 quantity;
(4) For domestic transportation only, in a packaging that complies with the provisions of 10 CFR 71.52, and is transported in exclusive use; or
(5) Any Type B, B(U) or B(M) packaging authorized pursuant to §173.416.
(c) LSA-I and SCO-I (see §173.403), unless packaged in accordance with paragraph (b) of this section, must be packaged in bulk packagings in accordance with this paragraph. The shipment must be, in addition to complying with the applicable

requirements of paragraph (a) of this section, exclusive use:

(1) *Solids. Packages must be strong tight packagings, meeting the requirements of subpart B of this part. The requirements of §173.410 do not apply.*

(2) Liquids. Liquids must be transported in the following packagings:

(i) Specification 103CW, 111A60W7 (§§179.200, 179.201, 179.202 of this subchapter) tank cars. Bottom openings in tanks are prohibited; or

(ii) Specification MC 310, MC 311, MC 312, MC 331 or DOT 412 (§178.348 or §178.337 of this subchapter) cargo tank motor vehicles. Bottom outlets are not authorized. Trailer-on-flat-car service is not authorized.

(d) Except for transportation by aircraft, LSA material and SCO that conform to the provisions specified in 10 CFR 20.2005 are excepted from all requirements of this subchapter pertaining to Class 7 (radioactive) materials when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions of this subchapter relating to that hazard class.

(e) LSA and SCO that exceed the packaging limits in this section must be packaged in accordance with 10 CFR part 71.

(f) Tables 8 and 9 are as follows:

Table 8-Industrial Package Integrity Requirements for LSA Material and SCO

Contents	Industrial packaging type	
-	Exclusive use shipment	Nonexclusive use shipment
LSA-I:	-	-
Solid	IP-1	IP-1
Liquid	IP-1	IP-2
LSA-II:	-	-
Solid	IP-2	IP-2
Liquid and gas	IP-2	IP-3
LSA-III	IP-2	IP-3
SCO-I	IP-1	IP-1
SCO-II	IP-2	IP-2

Table 9-Conveyance Activity Limits for LSA Material and SCO

Nature of material	Activity limit for conveyances
LSA-I	No limit.
LSA-II and LSA-III; noncombustible solids	No limit.
LSA-II and LSA-III; Combustible solids and all liquids and gases	100 A_2

SCO	100 A_2

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20752, May 8, 1996; 63 FR 52849, Oct. 1, 1998]

§173.428 Empty Class 7 (radioactive) materials packaging.

A packaging which previously contained Class 7 (radioactive) materials and has been emptied of contents as far as practical, is excepted from the shipping paper, certification, and marking requirements of this subchapter, and from requirements of this chapter, provided that-

(a) The packaging meets the requirements of §173.421(a) (2), (3), and (5) of this subpart;

(b) The packaging is in unimpaired condition and is securely closed so that there will be no leakage of Class 7 (radioactive) material under conditions normally incident to transportation;

(c) Internal contamination does not exceed 100 times the limits in §173.443(a);

(d) Any labels previously applied in conformance with subpart E of part 172 of this subchapter are removed, obliterated, or covered and the "Empty" label prescribed in §172.450 of this subchapter is affixed to the packaging; and

(e) The packaging is prepared for shipment as specified in §173.422.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20752, May 8, 1996; 64 FR 51919, Sept. 27, 1999]

§173.431 Activity limits for Type A and Type B packages.

(a) Except for LSA material and SCO, a Type A package may not contain a quantity of Class 7 (radioactive) materials greater than A_1 for special form Class 7 (radioactive) material or A_2 for normal form Class 7 (radioactive) material as listed in §173.435, or, for Class 7 (radioactive) materials not listed in §173.435, as determined in accordance with §173.433.

(b) The limits on activity contained in a Type B, Type B(U), or Type B(M) package are those prescribed in §§173.416 and 173.417, or in the applicable approval certificate under §§173.471, 173.472 or 173.473.

§173.433 Requirements for determining A

(a) Values of A_1 and A_2 for individual radionuclides that are the basis for many activity

limits elsewhere in this subchapter are given in the table in §173.435.
(b) For individual radionuclides whose identities are known, but which are not listed in the table in §173.435, the determination of the values of A^1 and A_2 requires approval from the Associate Administrator for Hazardous Materials Safety except that the values of A_1 and A_2 in table 10 may be used without obtaining approval from Associate Administrator for Hazardous Materials Safety.
(c) In calculating A_1 and A_2 values for a radionuclide not listed in the table in §173.435, a single radioactive decay chain in which the radionuclides are present in their naturally-occurring proportions, and in which no daughter nuclide has a half life either longer than 10 days or longer than that of the parent nuclide, will be considered as a single radionuclide, and the activity to be taken into account and the A_1 or A_2 value to be applied will be those corresponding to the parent nuclide of that chain. Otherwise, the parent and daughter nuclides will be considered as a mixture of different nuclides.
(d) Mixtures of radionuclides whose identities and respective activities are known, must conform to the following conditions:
(1) For special form Class 7 (radioactive) material:

$$\sum_i \frac{B(i)}{A_1(i)} \text{ less than or equal to 1}$$

Where B(i) is the activity of radionuclide i and $A_1(i)$ is the A_1 value for radionuclide i;

or
(2) For other forms of Class 7 (radioactive) material, either-

$$\sum_i \frac{B(i)}{A_2(i)} \text{ less than or equal to 1}$$

Where B(i) is the activity of radionuclide i and $A_2(i)$ is the A_2 value for radionuclide i;

or

$$A_2 \text{ for mixture} = \frac{1}{\sum_i \frac{f(i)}{A_2(i)}}$$

where f(i) is the fraction of activity of nuclide i in the mixture and $A_2(i)$ is the appropriate A_2 value for nuclide i.

(e) When the identity of each nuclide is known but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph (d) of this section. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters or beta/gamma emitters, respectively.

(f) *Shipping papers and labeling. (1) For mixtures of radionuclides, the radionuclides (n) that must be shown on shipping papers and labels in accordance with §§172.203 and 172.403 of this subchapter, respectively, must be determined on the basis of the following formula:*

$$\sum_{i=1}^{n} \frac{a_{(i)}}{A_{(i)}} \geq 0.95 \sum_{i=1}^{n+m} \frac{a_{(i)}}{A_{(i)}}$$

Where n + m represents all the radionuclides in the mixture, m are the radionuclides that do not need to be considered, a_i is the activity of radionuclide i in the mixture, and A_i is the A_1 or A_2 value, as appropriate for radionuclide i.

(g) Table 10 is as follows:

Table 10-General Values for A_1 and A_2

Contents	A		A	
-	(TBq)	(Ci)	(TBq)	(Ci)
only beta or gamma emitting nuclides are known to be present	*0.2*	*5*	*0.02*	*0.5*
Alpha emitting nuclides are known to be present or no relevant data are available	*0.10*	*2.70*	*$2x10^{-5}$*	$5.41x10^{-4}$

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended at 63 FR 52849, Oct. 1, 1998]

§173.434 Activity-mass relationships for uranium and natural thorium.

The table of activity-mass relationships for uranium and natural thorium are as follows:

Thorium and uranium enrichment(Wt% 35 U present)	Specific activity			
-	TBq/gram	Grams/Tbq	Ci/gram	Grams/Ci
0.45 (depleted)	$1.9x10^{-8}$	$5.4x10^{7}$	$5.0x10^{-7}$	$2.0x10^{6}$
0.72 (natural)	$2.6x10^{-8}$	$3.8x10^{7}$	$7.1x10^{-7}$	$1.4x10^{6}$
1.0	$2.8x10^{-8}$	$3.6x10^{7}$	$7.6x10^{-7}$	$1.3x10^{6}$
1.5	$3.7x10^{-8}$	$2.7x10^{7}$	$1.0x10^{-6}$	$1.0x10^{6}$
5.0	$1.0x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-6}$	$3.7x10^{5}$
10.0	$1.8x10^{-7}$	$5.6x10^{6}$	$4.8x10^{-6}$	$2.1x10^{5}$

20.0	$3.7x10^{-7}$	$2.7x10^{6}$	$1.0x10^{-5}$	$1.0x10^{5}$
35.0	$7.4x10^{-7}$	$1.4x10^{6}$	$2.0x10^{-5}$	$5.0x10^{4}$
50.0	$9.3x10^{-7}$	$1.1x10^{6}$	$2.5x10^{-5}$	$4.0x10^{4}$
90.0	$2.1x10^{-6}$	$4.7x10^{5}$	$5.8x10^{-5}$	$1.7x10^{4}$
93.0	$2.6x10^{-6}$	$3.9x10^{5}$	$7.0x10^{-5}$	$1.4x10^{4}$
95.0	$3.4x10^{-6}$	$3.0x10^{5}$	$9.1x10^{-5}$	$1.1x10^{4}$
Natural thorium	$8.1x10^{-9}$	$1.2x10^{8}$	$2.2x10^{-7}$	$4.6x10^{6}$

[1]The figures for uranium include representative values for the activity of uranium-234 which is concentrated during the enrichment process. The activity for thorium includes the equilibrium concentration of thorium-228.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by 63 FR 52849, Oct. 1, 1998]

§173.435 Table of A

The table of A_1 and A_2 values for radionuclides is as follows:

Symbol of radionuclide	Element and atomic number	A (TBq)	A (Ci)	A (TBq)	A (Ci)	Specific activity	
-	-	-	-	-	-	(TBq/g)	(Ci/g)
Ac-225	Actinium(89)	0.6	16.2	$1x10^{-2}$	0.270	$2.1x10^{3}$	$5.8x10^{4}$
Ac-227	-	40	1080	$2x10^{-5}$	$5.41x10^{-4}$	2.7	$7.2x10^{1}$
Ac-228	-	0.6	16.2	0.4	10.8	$8.4x10^{4}$	$2.2x10^{6}$
Ag-105	Silver(47)	2	54.1	2	54.1	$1.1x10^{3}$	$3.0x10^{4}$
Ag-108m	-	0.6	16.2	0.6	16.2	$9.7x10^{-1}$	$2.6x10^{1}$
Ag-110m	-	0.4	10.8	0.4	10.8	$1.8x10^{2}$	$4.7x10^{3}$
Ag-111	-	0.6	16.2	0.5	13.5	$5.8x10^{3}$	$1.6x10^{5}$
Al-26	Aluminum(13)	0.4	10.8	0.4	10.8	$7.0x10^{-4}$	$1.9x10^{-2}$
Am-241	Americium(95)	2	54.1	$2x10^{-4}$	$5.41x10^{-3}$	$1.3x10^{1}$	3.4
Am-242m	-	2	54.1	$2x10^{-4}$	$5.4.1x10^{-3}$	$3.6x10^{-1}$	$1.0x10^{1}$
Am-243	-	2	54.1	$2x10^{-4}$	$5.41x10^{-3}$	$7.4x10^{-3}$	$2.0x10^{-1}$
Ar-37	Argon(18)	40	1080	40	1080	$3.7x10^{3}$	$9.9x10^{4}$
Ar-39	-	20	541	20	541	1.3	3.4x10

							1
Ar-41	-	0.6	16.2	0.6	16.2	1.5x10^{6}	4.2x10^{7}
Ar-42	-	0.2	5.41	0.2	5.41	9.6	2.6x10^{2}
As-72	Arsenic(33)	0.2	5.41	0.2	5.41	6.2x10^{4}	1.7x10^{6}
As-73	-	40	1080	40	1080	8.2x10^{2}	2.2x10^{4}
As-74	-	1	27.0	0.5	13.5	3.7x10^{3}	9.9x10^{4}
As-76	-	0.2	5.41	0.2	5.41	5.8x10^{4}	1.6x10^{6}
As-77	-	20	541	0.5	13.5	3.9x10^{4}	1.0x10^{6}
At-211	Astatine(85)	30	811	2	54.1	7.6x10^{4}	2.1x10^{6}
Au-193	Gold(79)	6	162	6	162	3.4x10^{4}	9.2x10^{5}
Au-194	-	1	27.0	1	27.0	1.5x10^{4}	4.1x10^{5}
Au-195	-	10	270	10	270	1.4x10^{2}	3.7x10^{3}
Au-196	-	2	54.1	2	54.1	4.0x10^{3}	1.1x10^{5}
Au-198	-	3	81.1	0.5	13.5	9.0x10^{3}	2.4x10^{5}
Au-199	-	10	270	0.9	24.3	7.7x10^{3}	2.1x10^{5}
Ba-131	Barium(56)	2	54.1	2	54.1	3.1x10^{3}	8.4x10^{4}
Ba-133m	-	10	270	0.9	24.3	2.2x10^{4}	6.1x10^{5}
Ba-133	-	3	81.1	3	81.1	9.4	2.6x10^{2}
Ba-140	-	0.4	10.8	0.4	10.8	2.7x10^{3}	7.3x10^{4}
Be-7	Beryllium(4)	20	541	20	541	1.3x10^{4}	3.5x10^{5}
Be-10	-	20	541	0.5	13.5	8.3x10^{-4}	2.2x10^{-2}
Bi-205	Bismuth(83)	0.6	16.2	0.6	16.2	1.5x10^{3}	4.2x10^{4}
Bi-206	-	0.3	8.11	0.3	8.11	3.8x10^{3}	1.0x10^{5}
Bi-207	-	0.7	18.9	0.7	18.9	1.9	5.2x10^{1}
Bi-210m	-	0.3	8.11	3x10^{-2}	0.811	2.1x10^{-5}	5.7x10^{-4}
Bi-210	-	0.6	16.2	0.5	13.5	4.6x10^{3}	1.2x10^{5}
Bi-212	-	0.3	8.11	0.3	8.11	5.4x10^{5}	1.5x10^{7}
Bk-247	Berkelium(97)	2	54.1	2x10^{-4}	5.41x 10^{-3}	3.8x10^{-2}	1.0
Bk-249	-	40	1080	8x10^{-2}	2.16	6.1x10	1.6x10

						1	3
Br-76	Bromine(35)	0.3	8.11	0.3	8.11	9.4×10^{4}	2.5×10^{6}
Br-77	-	3	81.1	3	81.1	2.6×10^{4}	7.1×10^{5}
Br-82	-	0.4	10.8	0.4	10.8	4.0×10^{4}	1.1×10^{6}
C-11	Carbon(6)	1	27	0.5	13.5	3.1×10^{7}	8.4×10^{8}
C-14	-	40	1080	2	54.1	1.6×10^{-1}	4.5
Ca-41	Calcium(20)	40	1080	40	1080	3.1×10^{-3}	8.5×10^{-2}
Ca-45	-	40	1080	0.9	24.3	6.6×10^{2}	1.8×10^{4}
Ca-47	-	0.9	24.3	0.5	13.5	2.3×10^{4}	6.1×10^{5}
Cd-109	Cadmium(48)	40	1080	1	27.0	9.6×10^{1}	2.6×10^{3}
Cd-113m	-	20	541	9×10^{-2}	2.43	8.3×10^{4}	2.2×10^{2}
Cd-115m	-	0.3	8.11	0.3	8.11	9.4×10^{2}	2.5×10^{4}
Cd-115	-	4	108	0.5	13.5	1.9×10^{4}	5.1×10^{5}
Ce-139	Cerium(58)	6	162	6	162	2.5×10^{2} 6	$.8\times10^{3}$
Ce-141	-	10	270	0.5	13.5	1.1×10^{3}	2.8×10^{4}
Ce-143	-	0.6	16.2	0.5	13.5	2.5×10^{4}	6.6×10^{5}
Ce-144	-	0.2	5.41	0.2	5.41	1.2×10^{2}	3.2×10^{3}
Cf-248	Californium (98)	30	811	3×10^{-3}	8.11×10^{-2}	5.8×10^{1}	1.6×10^{3}
Cf-249	-	2	54.1	2×10^{-4}	5.41×10^{-3}	1.5×10^{-1}	4.1
Cf-250	-	5	135	5×10^{-4}	1.35×10^{-2}	4.0	1.1×10^{2}
Cf-251	-	2	54.1	2×10^{-4}	5.41×10^{-3}	5.9×10^{-2}	1.6
Cf-252	-	0.1	2.70	1×10^{-3}	2.70×10^{-2}	2.0×10^{1}	5.4×10^{2}
Cf-253	-	40	1080	6×10^{-2}	1.62	1.1×10^{3}	2.9×10^{4}
Cf-254	-	3×10^{-3}	8.11×10^{-2}	6×10^{-4}	1.62×10^{-2}	3.1×10^{2}	8.5×10^{3}
Cl-36	Chlorine (17)	20	541	0.5	13.5	1.2×10^{-3}	3.3×10^{-2}
Cl-38	-	0.2	5.41	0.2	5.41	4.9×10^{6}	1.3×10^{8}
Cm-240	Curium(96)	40	1080	2×10^{-2}	0.541	7.5×10^{2}	2.0×10^{4}
Cm-241	-	2	54.1	0.9	24.3	6.1×10^{2}	1.7×10^{4}
Cm-242	-	40	1080	1×10^{-2}	0.270	1.2x10	3.3x10

						2	3
Cm-243	-	3	81.1	3×10^{-4}	8.11×10^{-3}	1.9	5.2×10^{1}
Cm-244	-	4	108	4×10^{-4}	1.08×10^{-2}	3.0	8.1×10^{5}
Cm-245	-	2	54.1	2×10^{-4}	5.41×10^{-3}	6.4×10^{-3}	1.7×10^{-1}
Cm-246	-	2	54.1	2×10^{-4}	5.41×10^{-3}	1.1×10^{-2}	3.1×10^{-1}
Cm-247	-	2	54.1	2×10^{-4}	5.41×10^{-3}	3.4×10^{-6}	9.3×10^{-5}
Cm-248	-	4×10^{-2}	1.08	5×10^{-5}	1.35×10^{-3}	1.6×10^{-4}	4.2×10^{-3}
Co-55	Cobalt(27)	0.5	13.5	0.5	13.5	1.1×10^{5}	3.1×10^{6}
Co-56	-	0.3	8.11	0.3	8.11	1.1×10^{3}	3.0×10^{4}
Co-57	-	8	216	8	216	3.1×10^{2}	8.4×10^{3}
Co-58m	-	40	1080	40	1080	2.2×10^{5}	5.9×10^{6}
Co-58	-	1	27.0	1	27.0	1.2×10^{3}	3.2×10^{4}
Co-60	-	0.4	10.8	0.4	10.8	4.2×10^{1}	1.1×10^{3}
Cr-51	Chromium(24)	30	811	30	811	3.4×10^{3}	9.2×10^{4}
Cs-129	Cesium(55)	4	108	4	108	2.8×10^{4}	7.6×10^{5}
Cs-131	-	40	1080	40	1080	3.8×10^{3}	1.0×10^{5}
Cs-132	-	1	27.0	1	27.0	5.7×10^{3}	1.5×10^{5}
Cs-134m	-	40	1080	9	243	3.0×10^{5}	8.0×10^{6}
Cs-134	-	0.6	16.2	0.5	13.5	4.8×10^{1}	1.3×10^{3}
Cs-135	-	40	1080	0.9	24.3	4.3×10^{-5}	1.2×10^{-3}
Cs-136	-	0.5	13.5	0.5	13.5	2.7×10^{3}	7.3×10^{4}
Cs-137	-	2	54.1	0.5	13.5	3.2	8.7×10^{1}
Cu-64	Copper(29)	5	135	0.9	24.3	1.4×10^{5}	3.9×10^{6}
Cu-67	-	9	243	0.9	24.3	2.8×10^{4}	7.6×10^{5}
Dy-159	Dysprosium(66)	20	541	20	541	2.1×10^{2}	5.7×10^{3}
Dy-165	-	0.6	16.2	0.5	13.5	3.0×10^{5}	8.2×10^{6}
Dy-166	-	0.3	8.11	0.3	8.11	8.6×10^{3}	2.3×10^{5}
Er-169	Erbium(68)	40	1080	0.9	24.3	3.1×10^{3}	8.3×10^{4}
Er-171	-	0.6	16.2	0.5	13.5	9.0x10	2.4x10

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Es-253	Einsteinium(99)[a]	200	5400	2.1×10^{-2}	5.4×100^{-1}	-	-
Es-254	-	30	811	3×10^{-3}	8.11×10^{-2}	-	-
Es-254m	-	0.6	16.2	0.4	10.8	-	-
Es-255	-	-	-	-	-	-	-
Eu-147	Europium(63)	2	54.1	2	54.1	1.4×10^{3}	3.7×10^{4}
Eu-148	-	0.5	13.5	0.5	13.5	6.0×10^{2}	1.6×10^{4}
Eu-149	-	20	541	20	541	3.5×10^{2}	9.4×10^{3}
Eu-150	-	0.7	18.9	0.7	18.9	6.1×10^{4}	1.6×10^{6}
Eu-152m	-	0.6	16.2	0.5	13.5	8.2×10^{4}	2.2×10^{6}
Eu-152	-	0.9	24.3	0.9	24.3	6.5	1.8×10^{2}
Eu-154	-	0.8	21.6	0.5	13.5	9.8	2.6×10^{2}
Eu-155	-	20	541	2	54.1	1.8×10^{1}	4.9×10^{2}
Eu-156	-	0.6	16.2	0.5	13.5	2.0×10^{3}	5.5×10^{4}
F-18	Fluorine(9)	1	27.0	0.5	13.5	3.5×10^{6}	9.5×10^{7}
Fe-52	Iron(26)	0.2	5.41	0.2	5.41	2.7×10^{5}	7.3×10^{6}
Fe-55	-	40	1080	40	1080	8.8×10^{1}	2.4×10^{3}
Fe-59	-	0.8	21.6	0.8	21.6	1.8×10^{3}	5.0×10^{4}
Fe-60	-	40	1080	0.2	5.41	7.4×10^{-4}	2.0×10^{-2}
Fm-255	Fermium(100)[b]	40	1080	0.8	21.6	-	-
Fm-257	-	10	270	8×10^{-3}	21.6×10^{-1}	-	-
Ga-67	Gallium(31)	6	162	6	162	2.2×10^{4}	6.0×10^{5}
Ga-68	-	0.3	8.11	0.3	8.11	1.5×10^{6}	4.1×10^{7}
Ga-72	-	0.4	10.8	0.4	10.8	1.1×10^{5}	3.1×10^{6}
Gd-146	Gadolinium(64)	0.4	10.8	0.4	10.8	6.9×10^{2}	1.9×10^{4}
Gd-148	-	3	81.1	3×10^{-4}	8.11×10^{-3}	1.2	3.2×10^{1}
Gd-153	-	10	270	5	135	1.3×10^{2}	3.5×10^{3}
Gd-159	-	4	108	0.5	13.5	3.9×10^{4}	1.1×10^{6}
Ge-68	Germanium(32)	0.3	8.11	0.3	8.11	2.6×10^{2}	7.1×10^{3}
Ge-71	-	40	1080	40	1080	5.8×10^{3}	1.6×10^{5}

Ge-77	-	0.3	8.11	0.3	8.11	1.3×10^{5}	3.6×10^{6}
H-3	Hydrogen(1) SeeT-Tritium	-	-	-	-	-	-
Hf-172	Hafnium(72)	0.5	13.5	0.3	8.11	4.1×10^{1}	1.1×10^{3}
Hf-175	-	3	81.1	3	81.1	3.9×10^{2}	1.1×10^{4}
Hf-181	-	2	54.1	0.9	24.3	6.3×10^{2}	1.7×10^{4}
Hf-182	-	4	108	3×10^{-2}	0.811	8.1×10^{-6}	2.2×10^{-4}
Hg-194	Mercury(80)	1	27.0	1	27.0	1.3×10^{-1}	3.5
Hg-195m	-	5	135	5	135	1.5×10^{4}	4.0×10^{5}
Hg-197m	-	10	270	0.9	24.3	2.5×10^{4}	6.7×10^{5}
Hg-197	-	10	270	10	270	9.2×10^{3}	2.5×10^{5}
Hg-203	-	4	108	0.9	24.3	5.1×10^{2}	1.4×10^{4}
Ho-163	Holmium(67)	40	1080	40	1080	2.7	7.6×10^{1}
Ho-166m	-	0.6	16.2	0.3	8.11	6.6×10^{-2}	1.8
Ho-166	-	0.3	8.11	0.3	8.11	2.6×10^{4}	7.0×10^{5}
I-123	Iodine(53)	6	162	6	162	7.1×10^{4}	1.9×10^{6}
I-124	-	0.9	24.3	0.9	24.3	9.3×10^{3}	2.5×10^{5}
I-125	-	20	541	2	54.1	6.4×10^{2}	1.7×10^{4}
I-126	-	2	54.1	0.9	24.3	2.9×10^{3}	8.0×10^{4}
I-129	-	Unlimited	Unlimited	Unlimited	Unlimited	6.5×10^{-6}	1.8×10^{-4}
I-131	-	3	81.1	0.5	13.5	4.6×10^{3}	1.2×10^{5}
I-132	-	0.4	10.8	0.4	10.8	3.8×10^{5}	1.0×10^{7}
I-133	-	0.6	16.2	0.5	13.5	4.2×10^{4}	1.1×10^{6}
I-134	-	0.3	8.11	0.3	8.11	9.9×10^{5}	2.7×10^{7}
I-135	-	0.6	16.2	0.5	13.5	1.3×10^{5}	3.5×10^{6}
In-111	Indium(49)	2	54.1	2	54.1	1.5×10^{4}	4.2×10^{5}
In-113m	-	4	108	4	108	6.2×10^{5}	1.7×10^{7}
In-114m	-	0.3	8.11	0.3	8.11	8.6×10^{2}	2.3×10^{4}
In-115m	-	6	162	0.9	24.3	2.2×10^{5}	6.1×10^{6}
Ir-189	Iridium(77)	10	270	10	270	1.9x10	5.2x10

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Ir-190	-	0.7	18.9	0.7	18.9	2.3×10^{3}	6.2×10^{4}
Ir-192	-	1	27.0	0.5	13.5	3.4×10^{2}	9.2×10^{3}
Ir-193m	-	10	270	10	270	2.4×10^{3}	6.4×10^{4}
Ir-194	-	0.2	5.41	0.2	5.41	3.1×10^{4}	8.4×10^{5}
K-40	Potassium(19)	0.6	16.2	0.6	16.2	2.4×10^{-7}	6.4×10^{-6}
K-42	-	0.2	5.41	0.2	5.41	2.2×10^{5}	6.0×10^{6}
K-43	-	1.0	27.0	0.5	13.5	1.2×10^{5}	3.3×10^{6}
Kr-81	Krypton(36)	40	1080	40	1080	7.8×10^{-4}	2.1×10^{-2}
Kr-85m	-	6	162	6	162	3.0×10^{5}	8.2×10^{6}
Kr-85	-	20	541	10	270	1.5×10^{1}	3.9×10^{2}
Kr-87	-	0.2	5.41	0.2	5.41	1.0×10^{6}	2.8×10^{7}
La-137	Lanthanum(57)	40	1080	2	54.1	1.6×10^{-3}	4.4×10^{-2}
La-140	-	0.4	10.8	0.4	10.8	2.1×10^{4}	5.6×10^{5}
Lu-172	Lutetium(71)	0.5	13.5	0.5	13.5	4.2×10^{3}	1.1×10^{5}
Lu-173	-	8	216	8	216	5.6×10^{1}	1.5×10^{3}
Lu-174m	-	20	541	8	216	2.0×10^{2}	5.3×10^{3}
Lu-74	-	8	216	4	108	2.3×10^{1}	6.2×10^{2}
Lu-177	-	30	811	0.9	24.3	4.1×10^{3}	1.1×10^{5}
MFP	-	(see §173.433)	-	(see §173.433)	-	-	-
Mg-28	Magnesium(12)	0.2	5.41	0.2	5.41	2.0×10^{5}	5.4×10^{6}
Mn-52	Manganese(25)	0.3	8.11	0.3	8.11	1.6×10^{4}	4.4×10^{5}
Mn-53	-	Unlimited	Unlimited	Unlimited	Unlimited	6.8×10^{-5}	1.8×10^{-3}
Mn-54	-	1	27.0	1	27.0	2.9×10^{2}	7.7×10^{3}
Mn-56	-	0.2	5.41	0.2	5.41	8.0×10^{5}	2.2×10^{7}
Mo-93	Molybdenum(42)	40	1080	7	189	4.1×10^{-2}	1.1
Mo-99	-	0.6	16.2	0.5	13.5[c]	1.8×10^{4}	4.8×10^{5}
N-13	Nitrogen(7)	0.6	16.2	0.5	13.5	5.4×10^{7}	1.5×10^{9}

Na-22	Sodium(11)	0.5	13.5	0.5	13.5	2.3×10^{2}	6.3×10^{3}
Na-24	-	0.2	5.41	0.2	5.41	3.2×10^{5}	8.7×10^{6}
Nb-92m	Niobium(41)	0.7	18.9	0.7	18.9	5.2×10^{3}	1.4×10^{5}
Nb-93m	-	40	1080	6	162	8.8	2.4×10^{2}
Nb-94	-	0.6	16.2	0.6	16.2	6.9×10^{-3}	1.9×10^{-1}
Nb-95	-	1	27.0	1	27.0	1.5×10^{3}	3.9×10^{4}
Nb-97	-	0.6	16.2	0.5	13.5	9.9×10^{5}	2.7×10^{7}
Nd-147	Neodymium(60)	4	108	0.5	13.5	3.0×10^{3}	8.1×10^{4}
Nd-149	-	0.6	16.2	0.5	13.5	4.5×10^{5}	1.2×10^{7}
Ni-59	Nickel(28)	40	1080	40	1080	3.0×10^{-3}	8.0×10^{-2}
Ni-63	-	40	1080	30	811	2.1	5.7×10^{1}
Ni-65	-	0.3	8.11	0.3	8.11	7.1×10^{5}	1.9×10^{7}
Np-235	Neptunium(93)	40	1080	40	1080	5.2×10^{1}	1.4×10^{3}
Np-236	-	7	189	1×10^{-3}	2.70×10^{-2}	4.7×10^{-4}	1.3×10^{-2}
Np-237	-	2	54.1	2×10^{-4}	5.41×10^{-3}	2.6×10^{-5}	7.1×10^{-4}
Np-239	-	6	162	0.5	13.5	8.6×10^{3}	2.3×10^{5}
Os-185	Osmium(76)	1	27.0	1	27.0	2.8×10^{2}	7.5×10^{3}
Os-191m	-	40	1080	40	1080	4.6×10^{4}	1.3×10^{6}
Os-191	-	10	270	0.9	24.3	1.6×10^{3}	4.4×10^{4}
Os-193	-	0.6	16.2	0.5	13.5	2.0×10^{4}	5.3×10^{5}
Os-194	-	0.2	5.41	0.2	5.41	1.1×10^{1}	3.1×10^{2}
P-32	Phosphorus(15)	0.3	8.11	0.3	8.11	1.1×10^{4}	2.9×10^{5}
P-33	-	40	1080	0.9	24.3	5.8×10^{3}	1.6×10^{5}
Pa-230	Protactinium(91)	2	54.1	0.1	2.70	1.2×10^{3}	3.3×10^{4}
Pa-231	-	0.6	16.2	6x10-5	1.62×10^{-3}	1.7×10^{-3}	4.7×10^{-2}
Pa-233	-	5	135	0.9	24.3	7.7×10^{2}	2.1×10^{4}
Pb-201	Lead(82)	1	27.0	1	27.0	6.2×10^{4}	1.7×10^{6}
Pb-202	-	40	1080	2	54.1	1.2×10^{-4}	3.4×10^{-3}

Pb-203	-	3	81.1	3	81.1	1.1×10^{4}	3.0×10^{5}
Pb-205	-	Unlimited	Unlimited	Unlimited	Unlimited	4.5×10^{-6}	1.2×10^{-4}
Pb-210	-	0.6	16.2	9×10^{-3}	0.243	2.8	7.6×10^{1}
Pb-212	-	0.3	8.11	0.3	8.11	5.1×10^{4}	1.4×10^{6}
Pd-103	Palladium(46)	40	1080	40	1080	2.8×10^{3}	7.5×10^{4}
Pd-107	-	Unlimited	Unlimited	Unlimited	Unlimited	1.9×10^{-5}	5.1×10^{-4}
Pd-109	-	0.6	16.2	0.5	13.5	7.9×10^{4}	2.1×10^{6}
Pm-143	Promethium(61)	3	81.1	3	81.1	1.3×10^{2}	3.4×10^{3}
Pm-144	-	0.6	16.2	0.6	16.2	9.2×10^{1}	2.5×10^{3}
Pm-145	-	30	811	7	189	5.2	1.4×10^{2}
Pm-147	-	40	1080	0.9	24.3	3.4×10^{1}	9.3×10^{2}
Pm-148m	-	0.5	13.5	0.5	13.5	7.9×10^{2}	2.1×10^{4}
Pm-149	-	0.6	16.2	0.5	13.5	1.5×10^{4}	4.0×10^{5}
Pm-151	-	3	81.1	0.5	13.5	2.7×10^{4}	7.3×10^{5}
Po-208	Polonium(84)	40	1080	2×10^{-2}	0.541	2.2×10^{1}	5.9×10^{2}
Po-209	-	40	1080	2×10^{-2}	0.541	6.2×10^{-1}	1.7×10^{1}
Po-210	-	40	1080	2×10^{-2}	0.541	1.7×10^{2}	4.5×10^{3}
Pr-142	Praseodymium (59)	0.2	5.41	0.2	5.41	4.3×10^{4}	1.2×10^{6}
Pr-143	-	4	108	0.5	13.5	2.5×10^{3}	6.7×10^{4}
Pt-188	Platinum(78)	0.6	16.2	0.6	16.2	2.5×10^{3}	6.8×10^{4}
Pt-191	-	3	81.1	3	81.1	8.7×10^{3}	2.4×10^{5}
Pt-193m	-	40	1080	9	243	5.8×10^{3}	1.6×10^{5}
Pt-193	-	40	1080	40	1080	1.4	3.7×10^{1}
Pt-195m	-	10	270	2	54.1	6.2×10^{3}	1.7×10^{5}
Pt-197m	-	10	270	0.9	24.3	3.7×10^{5}	1.0×10^{7}
Pt-197	-	20	541	0.5	13.5	3.2×10^{4}	8.7×10^{5}
Pu-236	Plutonium(94)	7	189	7×10^{-4}	1.89×10^{-2}	2.0×10^{1}	5.3×10^{2}
Pu-237	-	20	541	20	541	4.5×10^{2}	1.2×10^{4}

Pu-238	-	2	54.1	2×10^{-4}	5.41×10^{-3}	6.3×10^{-1}	1.7×10^{1}
Pu-239	-	2	54.1	2×10^{-4}	5.41×10^{-3}	2.3×10^{-3}	6.2×10^{-2}
Pu-240	-	2	54.1	2×10^{-4}	5.41×10^{-3}	8.4×10^{-3}	2.3×10^{-1}
Pu-241	-	40	1080	1×10^{-2}	0.270	3.8	1.0×10^{2}
Pu-242	-	2	54.1	2×10^{-4}	5.41×10^{-3}	1.5×10^{-4}	3.9×10^{-3}
Pu-244	-	0.3	8.11	2×10^{-4}	5.41×10^{-3}	6.7×10^{-7}	1.8×10^{-5}
Ra-223	Radium(88)	0.6	16.2	3×10^{-2}	0.811	1.9×10^{3}	5.1×10^{4}
Ra-224	-	0.3	8.11	6×10^{-2}	1.62	5.9×10^{3}	1.6×10^{5}
Ra-225	-	0.6	16.2	2×10^{-2}	0.541	1.5×10^{3}	3.9×10^{4}
Ra-226	-	0.3	8.11	2×10^{-2}	0.541	3.7×10^{-2}	1.0
Ra-228	-	0.6	16.2	4×10^{-2}	1.08	1.0×10^{1}	2.7×10^{2}
Rb-81	Rubidium(37)	2	54.1	0.9	24.3	3.1×10^{5}	8.4×10^{6}
Rb-83	-	2	54.1	2	54.1	6.8×10^{2}	1.8×10^{4}
Rb-84	-	1	27.0	0.9	24.3	1.8×10^{3}	4.7×10^{4}
Rb-86	-	0.3	8.11	0.3	8.11	3.0×10^{3}	8.1×10^{4}
Rb-87	-	Unlimited	Unlimited	Unlimited	Unlimited	3.2×10^{-9}	8.6×10^{-8}
Rb (natural)	-	Unlimited	Unlimited	Unlimited	Unlimited	6.7×10^{6}	1.8×10^{8}
Re-183	Rhenium(75)	5	135	5	135	3.8×10^{2}	1.0×10^{4}
Re-184m	-	3	81.1	3	81.1	1.6×10^{2}	4.3×10^{3}
Re-184	-	1	27.0	1	27.0	6.9×10^{2}	1.9×10^{4}
Re-186	-	4	108	0.5	13.5	6.9×10^{3}	1.9×10^{5}
Re-187	-	Unlimited	Unlimited	Unlimited	Unlimited	1.4×10^{-9}	3.8×10^{-8}
Re-188	-	0.2	5.41	0.2	5.41	3.6×10^{4}	9.8×10^{5}
Re-189	-	4	108	0.5	13.5	2.5×10^{4}	6.8×10^{5}
Re (natural)	-	Unlimited	Unlimited	Unlimited	Unlimited	--	2.4×10^{8}
Rh-99	Rhodium(45)	2	54.1	2	54.1	3.0×10^{3}	8.2×10^{4}
Rh-101	-	4	108	4	108	4.1×10^{1}	1.1×10^{3}
Rh-102m	-	2	54.1	0.9	24.3	2.3×10^{2}	6.2×10^{3}

Rh-102	-	0.5	13.5	0.5	13.5	4.5×10^{1}	1.2×10^{3}
Rh-103m	-	40	1080	40	1080	1.2×10^{6}	3.3×10^{7}
Rh-105	-	10	270	0.9	24.3	3.1×10^{4}	8.4×10^{5}
Rn-222	Radon(86)	0.2	5.41	4×10^{-3}	0.108	5.7×10^{3}	1.5×10^{5}
Ru-97	Ruthenium(44)	4	108	4	108	1.7×10^{4}	4.6×10^{5}
Ru-103	-	2	54.1	0.9	24.3	1.2×10^{3}	3.2×10^{4}
Ru-105	-	0.6	16.2	0.5	13.5	2.5×10^{5}	6.7×10^{6}
Ru-106	-	0.2	5.41	0.2	5.41	1.2×10^{2}	3.3×10^{3}
S-35	Sulfur(16)	40	1080	2	54.1	1.6×10^{3}	4.3×10^{4}
Sb-122	Antimony(51)	0.3	8.11	0.3	8.11	1.5×10^{4}	4.0×10^{5}
Sb-124	-	0.6	16.2	0.5	13.5	6.5×10^{2}	1.7×10^{4}
Sb-125	-	2	54.1	0.9	24.3	3.9×10^{1}	1.0×10^{3}
Sb-126	-	0.4	10.8	0.4	10.8	3.1×10^{3}	8.4×10^{4}
Sc-44	Scandium(21)	0.5	13.5	0.5	13.5	6.7×10^{5}	1.8×10^{7}
Sc-46	-	0.5	13.5	0.5	13.5	1.3×10^{3}	3.4×10^{4}
Sc-47	-	9	243	0.9	24.3	3.1×10^{4}	8.3×10^{5}
Sc-48	-	0.3	8.11	0.3	8.11	5.5×10^{4}	1.5×10^{6}
Se-75	Selenium(34)	3	81.1	3	81.1	5.4×10^{2}	1.5×10^{4}
Se-79	-	40	1080	2	54.1	2.6×10^{-3}	7.0×10^{-2}
Si-31	Silicon(14)	0.6	16.2	0.5	13.5	1.4×10^{6}	3.9×10^{7}
Si-32	-	40	10800	0.2	5.41	3.9	1.1×10^{2}
Sm-145	Samarium(62)	20	541	20	541	9.8×10^{1}	2.610^{3}
Sm-147	-	Unlimited	Unlimited	Unlimited	Unlimited	8.510^{-10}	2.310^{-8}
Sm-151	-	40	1080	4	108	9.710^{-1}	2.6×10^{1}
Sm-153	-	4	108	0.5	13.5	1.6×10^{4}	4.4×10^{5}
Sn-113	Tin(50)	4	108	4	108	3.7×10^{2}	1.0×10^{4}
Sn-117m	-	6	162	2	54.1	3.0×10^{3}	8.2×10^{4}
Sn-119m	-	40	1080	40	1080	1.4×10^{2}	3.7×10^{3}

Sn-121m	-	40	1080	0.9	24.3	2.0	5.4x10^{1}
Sn-123	-	0.6	16.2	0.5	13.5	3.0x10^{2}	8.2x10^{3}
Sn-125	-	0.2	5.41	0.2	5.41	4.0x10^{3}	1.1x10^{5}
Sn-126	-	0.3	8.11	0.3	8.11	1.010-^{3}	2.810-^{2}
Sr-82	Strontium(38)	0.2	5.41	0.2	5.41	2.3x10^{3}	6.2x10^{4}
Sr-85m	-	5	135	5	135	1.2x10^{6}	3.3x10^{7}
Sr-85	-	2	54.1	2	54.1	8.8x10^{2}	2.4x10^{4}
Sr-87m	-	3	81.1	3	81.1	4.8x10^{5}	1.3x10^{7}
Sr-89	-	0.6	16.2	0.5	13.5	1.1x10^{3}	2.9x10^{4}
Sr-90	-	0.2	5.41	0.1	2.70	5.1	1.4x10^{2}
Sr-91	-	0.3	8.11	0.3	8.11	1.3x10^{5}	3.6x10^{6}
Sr-92	-	0.8	21.6	0.5	13.5	4.7x10^{5}	1.3x10^{7}
T	Tritium(1)	40	1080	40	1080	3.6x10^{2}	9.7x10^{3}
Ta-178	Tantalum(73)	1	27.0	1	27.0	4.2x10^{6}	1.1x10^{8}
Ta-179	-	30	811	30	811	4.1x10^{1}	1.1x10^{3}
Ta-182	-	0.8	21.6	0.5	13.5	2.3x10^{2}	6.2x10^{3}
Tb-157	Terbium(65)	40	1080	10	270	5.610-^{1}	1.5x10^{1}
Tb-158	-	1	27.0	0.7	18.9	5.610-^{1}	1.5x10^{1}
Tb-160	-	0.9	24.3	0.5	13.5	4.2x10^{2}	1.1x10^{4}
Tc-95m	Technetium(43)	2	54.1	2	54.1	8.3x10^{2}	2.2x10^{4}
Tc-96m	-	0.4	10.8	0.4	10.8	1.4x10^{6}	3.8x10^{7}
Tc-96	-	0.4	10.8	0.4	10.8	1.2x10^{4}	3.2x10^{5}
Tc-97m	-	40	1080	40	1080	5.6x10^{2}	1.5x10^{4}
Tc-97	-	Unlimited	Unlimited	Unlimited	Unlimited	5.2x10^{-5}	1.4x10^{-3}
Tc-98	-	0.7	18.9	0.7	18.9	3.2x10^{-5}	8.7x10^{-4}
Tc-99m	-	8	216	8	216	1.9x10^{5}	5.3x10^{6}
Tc-99	-	40	1080	0.9	24.3	6.3x10^{-4}	1.7x10^{-2}
Te-118	Tellurium(52)	0.2	5.41	0.2	5.41	6.8x10^{3}	1.8x10^{5}
Te-121m	-	5	135	5	135	2.6x10	7.0x10

						2	3
Te-121	-	2	54.1	2	54.1	2.4×10^{3}	6.4×10^{4}
Te-123m	-	7	189	7	189	3.3×10^{2}	8.9×10^{3}
Te-125m	-	30	811	9	243	6.7×10^{2}	1.8×10^{4}
Te-127m	-	20	541	0.5	13.5	3.5×10^{2}	9.4×10^{3}
Te-127	-	20	541	0.5	13.5	9.8×10^{4}	2.6×10^{6}
Te-129m	-	0.6	16.2	0.5	13.5	1.1×10^{3}	3.0×10^{4}
Te-129	-	0.6	16.2	0.5	13.5	7.7×10^{5}	2.1×10^{7}
Te-131m	-	0.7	18.9	0.5	13.5	3.0×10^{4}	8.0×10^{5}
Te-132	-	0.4	10.8	0.4	10.8	1.1×10^{4}	3.0×10^{5}
Th-227	Thorium(90)	9	243	1×10^{-2}	0.270	1.1×10^{3}	3.1×10^{4}
Th-228	-	0.3	8.11	4×10^{-4}	1.08×10^{-2}	3.0×10^{1}	8.2×10^{2}
Th-229	-	0.3	8.11	3×10^{-5}	8.11×10^{-4}	7.9×10^{-3}	2.1×10^{-1}
Th-230	-	2	54.1	2×10^{-4}	5.41×10^{-3}	7.6×10^{-4}	2.1×10^{-2}
Th-231	-	40	1080	0.9	24.3	2.0×10^{4}	5.3×10^{5}
Th-232	-	Unlimited	Unlimited	Unlimited	Unlimited	4.0×10^{-9}	1.1×10^{-7}
Th-234	-	0.2	5.41	0.2	5.41	8.6×10^{2}	2.3×10^{4}
Th (natural)	-	Unlimited	Unlimited	Unlimited	Unlimited	8.1×10^{-9}	2.2×10^{-7}
Ti-44	Titanium(22)	0.5	13.5	0.2	5.41	6.4	1.7×10^{2}
Tl-200	Thallium(81.1)	0.8	21.6	0.8	21.6	2.2×10^{4}	6.0×10^{5}
Tl-201	-	10	270	10	270	7.9×10^{3}	2.1×10^{5}
Tl-202	-	2	54.1	2	54.1	2.0×10^{3}	5.3×10^{4}
Tl-204	-	4	108	0.5	13.5	1.7×10^{1}	4.6×10^{2}
Tm-167	Thulium(69)	7	189	7	189	3.1×10^{3}	8.5×10^{4}
Tm-168	-	0.8	21.6	0.8	21.6	3.1×10^{2}	8.3×10^{3}
Tm-170	-	4	108	0.5	13.5	2.2×10^{2}	6.0×10^{3}
Tm-171	-	40	1080	10	270	4.0×10^{1}	1.1×10^{3}
U-230	Uranium(92)	40	1080	1×10^{-2}	0.270	1.0×10^{3}	2.7×10^{4}
U-232	-	3	81.1	3×10^{-4}	8.11x	$8.3\times10^{-}$	2.2x10

					10^{-3}	1	1
U-233	-	10	270	1×10^{-3}	2.70×10^{-2}	3.6×10^{-4}	9.7×10^{-3}
U-234	-	10	270	1×10^{-3}	2.70×10^{-2}	2.3×10^{-4}	6.2×10^{-3}
U-235	-	Unlimited	Unlimited	Unlimited	Unlimited	8.0×10^{-8}	2.2×10^{-6}
U-236	-	10	270	1×10^{-3}	2.70×10^{-2}	2.4×10^{-6}	6.5×10^{-5}
U-238	-	Unlimited	Unlimited	Unlimited	Unlimited	1.2×10^{-8}	3.4×10^{-7}
U (natural)	-	Unlimited	Unlimited	Unlimited	Unlimited	2.6×10^{-8}	7.1×10^{-7}
U (enriched 5% or less)	-	Unlimited	Unlimited	Unlimited	Unlimited	---	(see §173.434)
U (enriched more than 5%)	-	10	270	1×10^{-3}	2.70×10^{-2}	--	(see §173.434)
U (depleted)	-	Unlimited	Unlimited	Unlimited	Unlimited	--	(see §173.434)
V-48	Vanadium(23)	0.3	8.11	0.3	8.11	6.3×10^{3}	1.7×10^{5}
V-49	-	40	1080	40	1080	3.0×10^{2}	8.1×10^{3}
W-178	Tungsten(74)	1	27.0	1	27.0	1.3×10^{-3}	3.4×10^{4}
W-181	-	30	811	30	811	2.2×10^{2}	6.0×10^{3}
W-185	-	40	1080	0.9	24.3	3.5×10^{2}	9.4×10^{3}
W-187	-	2	54.1	0.5	13.5	2.6×10^{4}	7.0×10^{5}
W-188	-	0.2	5.41	0.2	5.41	3.7×10^{2}	1.0×10^{4}
Xe-122	Xenon(54)	0.2	5.41	0.2	5.41	4.8×10^{4}	1.3×10^{6}
Xe-123	-	0.2	5.41	0.2	5.41	4.4×10^{5}	1.2×10^{7}
Xe-127	-	4	108	4	108	1.0×10^{3}	2.8×10^{4}
Xe-131m	-	40	1080	40	1080	3.1×10^{3}	8.4×10^{4}
Xe-133	-	20	541	20	541	6.9×10^{3}	1.9×10^{5}
Xe-135	-	4	108	4	108	9.5×10^{4}	2.6×10^{6}
Y-87	Yttrium(39)	2	54.1	2	54.1	1.7×10^{4}	4.5×10^{5}
Y-88	-	0.4	10.8	0.4	10.8	5.2×10^{2}	1.4×10^{4}
Y-90	-	0.2	5.41	0.2	5.41	2.0×10^{4}	5.4×10^{5}
Y-91m	-	2	54.1	2	54.1	1.5×10^{6}	4.2×10^{7}

Y-91	-	0.3	8.11	0.3	8.11	9.1×10^{2}	2.5×10^{4}
Y-92	-	0.2	5.41	0.2	5.41	3.6×10^{5}	9.6×10^{6}
Y-93	-	0.2	5.41	0.2	5.41	1.2×10^{5}	3.3×10^{6}
Yb-169	Ytterbium(70)	3	81.1	3	81.1	8.9×10^{2}	2.4×10^{4}
Yb-175	-	30	811	0.9	24.3	6.6×10^{3}	1.8×10^{5}
Zn-65	Zinc(30)	2	54.1	2	54.1	3.0×10^{2}	8.2×10^{3}
Zn-69m	-	2	54.1	0.5	13.5	1.2×10^{5}	3.3×10^{6}
Zn-69	-	4	108	0.5	13.5	1.8×10^{6}	4.9×10^{7}
Zr-88	Zirconium(40)	3	81.1	3	81.1	6.6×10^{2}	1.8×10^{4}
Zr-93	-	40	1080	0.2	5.41	9.3×10^{-5}	2.5×10^{-3}
Zr-95	-	1	27.0	0.9	24.3	7.9×10^{2}	2.1×10^{4}
Zr-97	-	0.3	8.11	0.3	8.11	7.1×10^{4}	1.9×10^{6}

[a]International shipments of Einsteinium require multilateral approval of A_1 and A_2 values.

[b]International shipments of Fermium require multilateral approval of A_1 and A_2 values.

[c]20 Ci for Mo^{9}9 for domestic use.

MFP: For mixed fission products, use formula for mixtures or table 10 in §173.433.

Note: The activity per gram of radionuclide quantities are technical information that might not provide a direct relationship between the activity and total mass of material contained in a package.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20752, May 8, 1996; Amdt. 173-253, 61 FR 27175, May 30, 1996]

§173.441 Radiation level limitations.

(a) Except as provided in paragraph (b) of this section, each package of Class 7 (radioactive) materials offered for transportation must be designed and prepared for shipment, so that under conditions normally incident to transportation, the radiation level does not exceed 2 mSv/hour (200 mrem/hour) at any point on the external surface of the package, and the transport index does not exceed 10.

(b) A package which exceeds the radiation level limits specified in paragraph (a) of this section must be transported by exclusive use shipment, and the radiation levels for such shipment may not exceed the following during transportation:

(1) 2 mSv/h (200 mrem/h) on the external surface of the package unless the following

conditions are met, in which case the limit is 10 mSv/h (1000 mrem/h):
(i) The shipment is made in a closed transport vehicle;
(ii) The package is secured within the vehicle so that its position remains fixed during transportation; and
(iii) There are no loading or unloading operations between the beginning and end of the transportation;
(2) 2 mSv/h (200 mrem/h) at any point on the outer surfaces of the vehicle, including the top and underside of the vehicle; or in the case of a flat-bed style vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load or enclosure if used, and on the lower external surface of the vehicle;
(3) 0.1 mSv/h (10 mrem/h) at any point 2 meters (6.6 feet) from the outer lateral surfaces of the vehicle (excluding the top and underside of the vehicle); or in the case of a flat-bed style vehicle, at any point 2 meters (6.6 feet) from the vertical planes projected by the outer edges of the vehicle (excluding the top and underside of the vehicle); and
(4) 0.02 mSv/h (2mrem/h) in any normally occupied space, except that this provision does not apply to carriers if they operate under the provisions of a State or federally regulated radiation protection program and if personnel under their control who are in such an occupied space wear radiation dosimetry devices.
(c) For shipments made under the provisions of paragraph (b) of this section, the offeror shall provide specific written instructions for maintenance of the exclusive use shipment controls to the carrier. The instructions must be included with the shipping paper information. The instructions must be sufficient so that, when followed, they will cause the carrier to avoid actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.
(d) Packages exceeding the radiation level or transport index prescribed in paragraph (a) of this section may not be transported by aircraft.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended at 63 FR 48568, Sept. 10, 1998]

§173.442 Thermal limitations.

A package of Class 7 (radioactive) material must be designed, constructed, and loaded so that-
(a) The heat generated within the package by the radioactive contents will not, during conditions normally incident to transport, affect the integrity of the package; and
(b) The temperature of the accessible external surfaces of the loaded package will not, assuming still air in the shade at an ambient temperature of 38 ^{o}C (100 ^{o}F), exceed either-
(1) 50 ^{o}C (122 ^{o}F) in other than an exclusive use shipment; or

(2) 85 ^{o}C (185 ^{o}F) in an exclusive use shipment.

§173.443 Contamination control.

(a) The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for transport must be kept as low as reasonably achievable. The level of non-fixed radioactive contamination may not exceed the limits set forth in table 11 and must be determined by either:
(1) Wiping an area of 300 square centimeters of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. The amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, may not exceed the limits set forth in table 11 at any time during transport; or
(2) Using other methods of assessment of equal or greater efficiency, in which case the efficiency of the method used must be taken into account and the non-fixed contamination on the external surfaces of the package may not exceed ten times the limits set forth in table 11, as follows:

Table 11-Non-Fixed External Radioactive Contamination-Wipe Limits

Contaminant	Maximum permissible limits		
-	Bq/cm	uCi/cm	dpm/cm
Beta and gamma emitters and low toxicity alpha emitters	0.4	10^{-5}	22
All other alpha emitting radionuclides	0.04	10^{-6}	2.2

(b) Except as provided in paragraph (d) of this section, in the case of packages transported as exclusive use shipments by rail or public highway only, the removable (non-fixed) radioactive contamination on any package at any time during transport may not exceed ten times the levels prescribed in paragraph (a) of this section. The levels at the beginning of transport may not exceed the levels prescribed in paragraph (a) of this section.

(c) Except as provided in paragraph (d) of this section, each transport vehicle used for transporting Class 7 (radioactive) materials as an exclusive use shipment that utilizes the provisions of paragraph (b) of this section must be surveyed with appropriate radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.005 mSv per hour (0.5 mrem per hour) or less, and there is no significant removable (non-fixed) radioactive surface contamination as specified in paragraph (a) of this section.

(d) Paragraphs (b) and (c) of this section do not apply to any closed transport vehicle used solely for the transportation by highway or rail of Class 7 (radioactive) material packages with contamination levels that do not exceed 10 times the levels prescribed in paragraph (a) of this section if-

(1) A survey of the interior surfaces of the empty vehicle shows that the radiation dose rate at any point does not exceed 0.1 mSv per hour (10 mrem per hour) at the surface or 0.02 mSv per hour (2 mrem per hour) at 1 meter (3.3 feet) from the surface;

(2) Each vehicle is stenciled with the words "For Radioactive Materials Use Only" in letters at least 76 millimeters (3 inches) high in a conspicuous place on both sides of the exterior of the vehicle; and

(3) Each vehicle is kept closed except for loading or unloading.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20753, May 8, 1996]

§173.447 Storage incident to transportation-general requirements.

The following requirements apply to temporary storage during the course of transportation but not to Nuclear Regulatory Commission or Agreement State-licensed facilities or U.S. Government-owned or contracted facilities.

(a) The number of packages bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels stored in any one storage area, such as a transit area, terminal building, storeroom, waterfront pier, or assembly yard, must be limited so that the sum of the transport indexes in any individual group of packages does not exceed 50. Groups of these packages must be stored so as to maintain a spacing of at least 6 meters (20 feet) from other groups of packages containing Class 7 (radioactive) materials.

(b) Mixing of different kinds of Class 7 (radioactive) materials packages that include fissile materials packages is authorized only in accordance with §173.459.

§173.448 General transportation requirements.

(a) Each shipment of Class 7 (radioactive) materials must be secured to prevent shifting during normal transportation conditions.

(b) Except as provided in §§174.81, 176.83, and 177.848 of this subchapter, or as otherwise required by the competent authority in the applicable certificate, a package of Class 7 (radioactive) materials may be carried among packaged general cargo without special stowage provisions, if-

(1) The heat output in watts does not exceed 0.1 times the minimum package dimension in centimeters; or

(2) The average surface heat flux of the package does not exceed 15 watts per square meter and the immediately surrounding cargo is not in sacks or bags or otherwise in a form that would seriously impede air circulation for heat removal.

(c) Packages bearing labels prescribed in §172.403 of this subchapter may not be

carried in compartments occupied by passengers, except in those compartments exclusively reserved for couriers accompanying those packages.
(d) Mixing of different kinds of packages that include fissile packages is authorized only in accordance with §173.459.
(e) No person shall offer for transportation or transport aboard a passenger-carrying aircraft any single package with a transport index greater than 3.0 or an overpack with a transport index greater than 3.0.
(f) No person shall offer for transportation or transport aboard a passenger-carrying aircraft any Class 7 (radioactive) material unless that material is intended for use in, or incident to, research, medical diagnosis or treatment.
(g) If an overpack is used to consolidate individual packages of Class 7 (radioactive) materials, the packages must comply with the packaging, marking, and labeling requirements of this subchapter, and the following:
(1) The overpack must be labeled as prescribed in §172.403 of this subchapter, except as follows:
(i) The "contents" entry on the label may state "mixed" unless each inside package contains the same radionuclide(s);
(ii) The "activity" entry on the label must be determined by adding together the number of Becquerels (curies) of the Class 7 (radioactive) materials packages contained therein;
(iii) For a non-rigid overpack, the required label together with required package markings must be affixed to the overpack by means of a securely attached, durable tag. The transport index must be determined by adding together the transport indexes of the Class 7 (radioactive) materials packages contained therein; and
(iv) For a rigid overpack, the transport index must be determined by:
(A) Adding together the transport indexes of the Class 7 (radioactive) materials packages contained in the overpack; or
(B) Except for fissile Class 7 (radioactive) materials, direct measurements as prescribed in §173.403 for transport index, taken by the person initially offering the packages contained within the overpack for shipment.
(2) The overpack must be marked as prescribed in subpart D of part 172 of this subchapter and §173.25(a).
(3) The transport index of the overpack may not exceed 3.0 for passenger-carrying aircraft shipments, or 10.0 for cargo-aircraft only shipments.

§173.453 Fissile materials-exceptions.
The requirements of §§173.457 and 173.459 do not apply to:
(a) A package containing 15 grams or less of fissile radionuclides. If the material is transported in bulk, the quantity limitation applies to the conveyance.
(b) A package containing homogeneous solutions or mixtures where:
(1) The minimum ratio of the number of hydrogen atoms to the number of atoms of fissile radionuclides (H/X) is 5200;

(2) The maximum concentration of fissile radionuclides is 5 grams per liter; and
(3) The maximum mass of fissile radionuclides in the package is 500 grams, except that for a mixture in which the total mass of plutonium and uranium-233 does not exceed 1% of the mass of uranium-235, the limit is 800 grams of uranium-235. If the material is transported in bulk, the quantity limitations apply to the conveyance.
(c) A package containing uranium enriched in uranium-235 to a maximum of 1% by mass, and mixed with a total plutonium and uranium-233 content of up to 1% of the mass of uranium-235, if the fissile radionuclides are distributed homogeneously throughout the package contents, and do not form a lattice arrangement within the package.
(d) A package containing not more than 5 grams of fissile radionuclides in any 10 liter volume, provided that the material is contained in packages that will maintain the limitation on fissile radionuclide distribution during normal conditions of transport.
(e) A package containing one kilogram or less of plutonium of which 20% or less by mass may consist of plutonium-239, plutonium-241, or any combination of those radionuclides.
(f) A package containing liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2% by mass, with total plutonium and uranium-233 content not exceeding 0.1% of the mass of uranium-235 with a nitrogen-to-uranium atomic ratio (N/U) of 2.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-248, 61 FR 18933, Apr. 29, 1996]

§173.457 Transportation of fissile material, controlled shipments-specific requirements.

Shipments of fissile material packages that have been assigned a transport index of greater than 10 for criticality control purposes in accordance with 10 CFR 71.59 must meet the requirements of this section and §173.441(a) or (b).

(a) For fissile material, controlled shipments, the offeror or carrier, as appropriate, must incorporate transportation controls which:

(1) Provide nuclear criticality safety;

(2) Protect against loading, storing, or transporting that shipment with any other fissile material; and

(3) Include in the shipping papers the description required by §172.203(d) of this subchapter.

(b) Fissile material, controlled shipments must be transported:

(1) In an exclusive use conveyance;

(2) Except for shipments by aircraft, in a conveyance with an escort having the capability, equipment, authority, and instructions to provide administrative controls necessary to assure compliance with this section;

(3) In a conveyance containing no other packages of any Class 7 (radioactive) material required to bear one of the labels prescribed in §172.403 of this subchapter.

Specific arrangements must be made between the offeror and the carrier, with instructions to that effect issued with the shipping papers; or

(4) Under any other procedure approved by the Associate Administrator for Hazardous Materials Safety in accordance with part 107 of this subchapter.

§173.459 Mixing of fissile material packages.

(a) Mixing of fissile material packages with other types of Class 7 (radioactive) materials is authorized only if the transport index of any single package does not exceed 10 and the total transport index in any conveyance or storage location does not exceed 50.

(b) Fissile packages may be shipped with an external radiation level greater than 0.1 mSv/hr (10 mrem per hour) at 1 meter (3.3 feet), and combined with other packages of the same or different designs in a fissile material, controlled shipment, under the conditions prescribed in §173.457, if:

(1) Each package in the shipment has been assigned a transport index for criticality control purposes in accordance with the 10 CFR 71.59;

(2) The nuclear criticality control transport index does not exceed 10 for any single package;

(3) The total nuclear criticality control transport index does not exceed 100 for all packages in the shipment; and

(4) Except as provided in §176.704(e) of this subchapter, the shipment is not transported by vessel.

(c) A fissile material, controlled shipment of packages may be combined with other packages of the same or different design when each package has been assigned a nuclear criticality control transport index in accordance with 10 CFR 71.59, and may be combined with other fissile packages into a fissile material, controlled shipment under the conditions prescribed in §173.457, if:

(1) The nuclear criticality control transport index which has been assigned in the package approval does not exceed 50 for any single package;

(2) The total nuclear criticality control transport index for all packages in the shipment does not exceed 100; and

(3) Except as provided in §176.704(e) of this subchapter, the shipment is not transported by vessel.

§173.461 Demonstration of compliance with tests.

(a) Compliance with the design requirements in §173.412 and the test requirements in §§173.465 through 173.469 must be shown by any of the methods prescribed in this paragraph, or by a combination of these methods appropriate for the particular feature being evaluated:

(1) Performance of tests with prototypes or samples of the specimens representing LSA-III, special form Class 7 (radioactive) material, or packaging, in which case the

contents of the packaging for the test must simulate as closely as practicable the expected range of physical properties of the radioactive contents or packaging to be tested, must be prepared as normally presented for transport. The use of non-radioactive substitute contents is encouraged provided that the results of the testing take into account the radioactive characteristics of the contents for which the package is being tested;
(2) Reference to a previous, satisfactory demonstration of compliance of a sufficiently similar nature;
(3) Performance of tests with models of appropriate scale incorporating those features that are significant with respect to the item under investigation, when engineering experience has shown results of those tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as the penetrator diameter or the compressive load, must be taken into account; or
(4) Calculations or reasoned evaluation, using reliable and conservative procedures and parameters.
(b) With respect to the initial conditions for the tests under §§173.465 through 173.469, except for the water immersion tests, compliance must be based upon the assumption that the package is in equilibrium at an ambient temperature of 38 ^{o}C (100 ^{o}F).

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by 63 FR 52850, Oct. 1, 1998]

§173.462 Preparation of specimens for testing.

(a) Each specimen (i.e., sample, prototype or scale model) must be examined before testing to identify and record faults or damage, including:

(1) Divergence from the specifications or drawings;

(2) Defects in construction;

(3) Corrosion or other deterioration; and

(4) Distortion of features.

(b) Any deviation found under paragraph (a) of this section from the specified design must be corrected or appropriately taken into account in the subsequent evaluation.

(c) The containment system of the packaging must be clearly specified.

(d) The external features of the specimen must be clearly identified so that reference may be made to any part of it.

§173.465 Type A packaging tests.

(a) The packaging, with contents, must be capable of withstanding the water spray, free drop, stacking and penetration tests prescribed in this section. One prototype may be used for all tests if the requirements of paragraph (b) of this section are met.
(b) *Water spray test. The water spray test must precede each test or test sequence*

prescribed in this section. The water spray test must simulate exposure to rainfall of approximately 5 centimeters (2 inches) per hour for at least one hour. The time interval between the end of the water spray test and the beginning of the next test must be such that the water has soaked in to the maximum extent without appreciable drying of the exterior of the specimen. In the absence of evidence to the contrary, this interval may be assumed to be two hours if the water spray is applied from four different directions simultaneously. However, no time interval may elapse if the water spray is applied from each of the four directions consecutively.

(c) Free drop test. The specimen must drop onto the target so as to suffer maximum damage to the safety features being tested, and:

(1) The height of the drop measured from the lowest point of the specimen to the upper surface of the target may not be less than the distance specified in table 12, for the applicable package mass. The target must be as specified in §173.465(c)(5). Table 12 is as follows:

Table 12-Free Drop Distance for Testing Packages to Normal Conditions of Transport

Packaging mass Kilograms (pounds)	Free drop distance	
	Meters	(Feet)
< Mass 5000 (11,000)	1.2	(4)
5,000 (11,000) Mass to 10,000 (22,000)	0.9	(3)
10,000 (22,000) Mass to 15,000 (33,000)	0.6	(2)
> 15,000 (33,000) Mass	0.3	(1)

(2) For packages containing fissile material, the free drop test specified in paragraph (c)(1) of this section must be preceded by a free drop from a height of 0.3 meter (1 foot) on each corner, or in the case of cylindrical packages, onto each of the quarters of each rim.

(3) For fiberboard or wood rectangular packages with a mass of 50 kilograms (110 pounds) or less, a separate specimen must be subjected to a free drop onto each corner from a height of 0.3 meter (1 foot).

(4) For cylindrical fiberboard packages with a mass of 100 kilograms (220 pounds) or less, a separate specimen must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 meter (1 foot).

(5) The target for the free drop test must be a flat, horizontal surface of such mass and rigidity that any increase in its resistance to displacement or deformation upon impact by the specimen would not significantly increase the damage to the specimen.

(d) *Stacking test. (1) The specimen must be subjected for a period of at least 24 hours to a compressive load equivalent to the greater of the following:*

(i) Five times the mass of the actual package; or

(ii) The equivalent of 13 kilopascals (1.9 pounds per square inch) multiplied by the vertically projected area of the package.

(2) The compressive load must be applied uniformly to two opposite sides of the

specimen, one of which must be the base on which the package would normally rest.

(e) *Penetration test. For the penetration test, the specimen must be placed on a rigid, flat, horizontal surface that will not move significantly while the test is being performed.*

(1) A bar of 3.2 centimeters (1.25 inches) in diameter with a hemispherical end and a mass of 6 kilograms (13.2 pounds) must be dropped and directed to fall with its longitudinal axis vertical, onto the center of the weakest part of the specimen, so that, if it penetrates far enough, it will hit the containment system. The bar may not be significantly deformed by the test; and

(2) The height of the drop of the bar measured from its lower end to the intended point of impact on the upper surface of the specimen must be 1 meter (3.3 feet) or greater.

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended by Amdt. 173-244, 61 FR 20753, May 8, 1996]

§173.466 Additional tests for Type A packagings designed for liquids and gases.

(a) In addition to the tests prescribed in §173.465, Type A packagings designed for liquids and gases must be capable of withstanding the following tests:

(1) *Free drop test. The packaging specimen must drop onto the target so as to suffer the maximum damage to its containment. The height of the drop measured from the lowest part of the packaging specimen to the upper surface of the target must be 9 meters (30 feet) or greater. The target must be as specified in §173.465(c)(5).*

(2) Penetration test. The specimen must be subjected to the test specified in §173.465(e) except that the height of the drop must be 1.7 meters (5.5 feet).

(b) [Reserved]

§173.467 Tests for demonstrating the ability of Type B and fissile materials packagings to withstand accident conditions in transportation.

Each Type B packaging or packaging for fissile material must meet the test requirements prescribed in 10 CFR part 71 for ability to withstand accident conditions in transportation.

§173.468 Test for LSA-III material.

(a) LSA-III Class 7 (radioactive) material must meet the test requirement of paragraph (b) of this section. Any differences between the material to be transported and the test material must be taken into account in determining whether the test requirements have been met.

(b) *Test method. (1) The specimen representing no less than the entire contents of the*

package must be immersed for 7 days in water at ambient temperature.
(2) The volume of water to be used in the test must be sufficient to ensure that at the end of the test period the free volume of the unabsorbed and unreacted water remaining will be at least 10% of the volume of the specimen itself.
(3) The water must have an initial pH of 6-8 and a maximum conductivity of 10 micromho/cm at 20 °C (68 °F).
(4) The total activity of the free volume of water must be measured following the 7 day immersion test and must not exceed 0.1 A_2.

§173.469 Tests for special form Class 7 (radioactive) materials.
(a) Special form Class 7 (radioactive) materials must meet the test requirements of paragraph (b) of this section. Each solid Class 7 (radioactive) material or capsule specimen to be tested must be manufactured or fabricated so that it is representative of the actual solid material or capsule that will be transported with the proposed radioactive content duplicated as closely as practicable. Any differences between the material to be transported and the test material, such as the use of non-radioactive contents, must be taken into account in determining whether the test requirements have been met. The following additional conditions apply:
(1) A different specimen may be used for each of the tests;
(2) The specimen may not break or shatter when subjected to the impact, percussion, or bending tests;
(3) The specimen may not melt or disperse when subjected to the heat test; and
(4) After each test, leaktightness or indispersibility of the specimen must be determined by-
(i) A method no less sensitive than the leaching assessment prescribed in paragraph (c) of this section. For a capsule resistant to corrosion by water, and which has an internal void volume greater than 0.1 milliliter, an alternative to the leaching assessment is a demonstration of leaktightness of 10^{-4} torr-1/s (1.3 x 10^{-4} atm-cm^3/s) based on air at 25 °C (77 °F) and one atmosphere differential pressure for solid radioactive content, or 10^{-6} torr-1/s (1.3 x 10^{-6} atm-cm^3/s) for liquid or gaseous radioactive content; or
(ii) A specimen that comprises or simulates Class 7 (radioactive) material contained in a sealed capsule need not be subjected to the leaktightness procedure specified in this section provided it is alternatively subjected to any of the tests prescribed in ISO/TR4826-1979(E), "Sealed Radioactive Sources Leak Test Methods."
(b) *Test methods.-(1) Impact Test. The specimen must fall onto the target from a height of 9 meters (30 feet) or greater. The target must be as specified in §173.465(c)(5).*
(2) Percussion Test. (i) The specimen must be placed on a sheet of lead that is supported by a smooth solid surface, and struck by the flat face of a steel billet so as to produce an impact equivalent to that resulting from a free drop of 1.4 kilograms (3 pounds) through 1 meter (3.3 feet).
(ii) The flat face of the billet must be 2.5 centimeters (1 inch) in diameter with the edges rounded off to a radius of 3 millimeters +0.3 millimeters (0.12 inch +0.012 inch).

(iii) The lead must be of hardness number 3.5 to 4.5 on the Vickers scale and thickness 2.5 centimeters (1 inch) or greater, and must cover an area greater than that covered by the specimen.
(iv) A fresh surface of lead must be used for each impact.
(v) The billet must strike the specimen so as to cause maximum damage.
(3) *Bending test. (i) This test applies only to long, slender sources with a length of 10 centimeters (4 inches) or greater and a length to width ratio of 10 or greater.*
(ii) The specimen must be rigidly clamped in a horizontal position so that one half of its length protrudes from the face of the clamp.
(iii) The orientation of the specimen must be such that the specimen will suffer maximum damage when its free end is struck by the flat face of a steel billet.
(iv) The billet must strike the specimen so as to produce an impact equivalent to that resulting from a free vertical drop of 1.4 kilograms (3 pounds) through 1 meter (3.3 feet).
(v) The flat face of the billet must be 2.5 centimeters (1 inch) in diameter with the edges rounded off to a radius of 3 millimeters +0.3 millimeters (.12 inch +0.012 inch).
(4) *Heat test. The specimen must be heated in air to a temperature of not less than 800 ^{o}C (1475 ^{o}F), held at that temperature for a period of 10 minutes, and then allowed to cool.*
(c) Leaching assessment methods. (1) For indispersible solid material-
(i) The specimen must be immersed for seven days in water at ambient temperature. The water must have a pH range of 6 to 8 and a maximum conductivity of 10 micromho per centimeter at 20 ^{o}C (68 ^{o}F).
(ii) The water with specimen must then be heated to a temperature of 50 ^{o}C +5^{o} (122 ^{o}F +9^{o}) and maintained at this temperature for four hours.
(iii) The activity of the water must then be determined.
(iv) The specimen must then be stored for at least seven days in still air of relative humidity not less than 90 percent at 30 ^{o}C (86 ^{o}F).
(v) The specimen must then be immersed in water under the same conditions as in paragraph (c)(1)(i) of this section, and the water with specimen must be heated to 50 ^{o}C +5 (122 ^{o}F +9^{o}) and maintained at that temperature for four hours.
(vi) The activity of the water must then be determined. The activities determined in paragraph (c)(1)(iii) of this section and this paragraph, (c)(1)(vi), may not exceed 2 kilobecquerels (0.05 microcurie).
(2) For encapsulated material-
(i) The specimen must be immersed in water at ambient temperature. The water must have a pH of 6-8 and a maximum conductivity of 10 micromho per centimeter.
(ii) The water and specimen must be heated to a temperature of 50 ^{o}C +5^{o} (122 ^{o}F +9^{o}) and maintained at this temperature for four hours.
(iii) The activity of the water must then be determined.
(iv) The specimen must then be stored for at least seven days in still air at a temperature of 30 ^{o}C (86 ^{o}F) or greater.
(v) The process in paragraphs (c)(2)(i), (c)(2)(ii), and (c)(2)(iii) of this section must be repeated.
(vi) The activity determined in paragraph (c)(2)(iii) of this section may not exceed 2

kilobecquerels (0.05 microcurie).
(d) A specimen that comprises or simulates Class 7 (radioactive) material contained in a sealed capsule need not be subjected to-
(1) The impact test and the percussion test of this section provided that the specimen is alternatively subjected to the Class 4 impact test prescribed in ISO 2919-1980(e), "Sealed Radioactive Sources Classification"; and
(2) The heat test of this section, provided the specimen is alternatively subjected to the Class 6 temperature test specified in the International Organization for Standardization document ISO 2919-1980(e), "Sealed Radioactive Sources Classification."

[Amdt. 173-244, 60 FR 50307, Sept. 28, 1995, as amended at 63 FR 37461, July 10, 1998; 64 FR 51919, Sept. 27, 1999]

§173.471 Requirements for U.S. Nuclear Regulatory Commission approved packages.

In addition to the applicable requirements of the U.S. Nuclear Regulatory Commission (USNRC) and other requirements of this subchapter, any offeror of a Type B, Type B(U), Type B(M), or fissile material package that has been approved by the USNRC in accordance with 10 CFR part 71 must also comply with the following requirements:

(a) The offeror shall be registered with the USNRC as a party to the packaging approval, and make the shipment in compliance with the terms of the packaging approval;

(b) The outside of each package must be durably and legibly marked with the package identification marking indicated in the USNRC packaging approval;

(c) Each shipping paper related to the shipment of the package must bear the package identification marking indicated in the USNRC packaging approval;

(d) Before export shipment of the package, the offeror shall obtain a U.S. Competent Authority Certificate for that package design or if one has already been issued, the offeror shall register, in writing (including a description of the quality assurance program required by 10 CFR part 71) with the U.S. Competent Authority as a user of the certificate. (Note: The person who originally applies for a U.S. Competent Authority Certificate will be registered automatically.) Upon registration, the offeror will be furnished with a copy of the certificate. The offeror shall then submit a copy of the U.S. Competent Authority Certificate applying to that package design to the national competent authority of each country into or through which the package will be transported, unless the offeror has documentary evidence that a copy has already been furnished; and

(e) Each request for a U.S. Competent Authority Certificate as required by the IAEA regulations must be submitted in writing to the Associate Administrator for Hazardous Materials Safety. The request must be in triplicate and include copies of the applicable USNRC packaging approval, USNRC Quality Assurance Program approval number, and a reproducible 22 cm x 30 cm (8.5" x 11") drawing showing the make-up of the package. Each request is considered in the order in which it is received. To allow sufficient time for consideration, requests must be received at least 90 days before the requested effective date.

§173.472 Requirements for exporting DOT Specification Type B and fissile packages.

(a) Any offeror who exports a DOT Specification Type B or fissile material package authorized by §173.416 or §173.417 shall comply with paragraphs (b) through (f) of this section.
(b) The shipment must be made in accordance with the conditions of the U.S. Certificate of Competent Authority.
(c) The outside of each package must be durably and legibly marked with the package identification marking indicated in the U.S. Competent Authority Certificate.
(d) Each shipping paper related to the shipment of the package must bear the package identification marking indicated in the U.S. Competent Authority Certificate.
(e) Before export of the package, the offeror shall obtain a U.S. Competent Authority Certificate for that package design, or if one has already been issued, the offeror shall register in writing (including a description of the quality assurance program required by 10 CFR part 71, subpart H, or 49 CFR 173.474 and 173.475) with the U.S. Competent Authority as a user of the certificate. Upon registration, the offeror will be furnished with a copy of the certificate. The offeror shall then submit a copy of the U.S. Competent Authority Certificate applying to that package design to the national competent authority of each country into or through which the package will be transported, unless the offeror has documentary evidence that a copy has already been furnished.
(f) Each request for a U.S. Competent Authority Certificate as required by IAEA regulations must be submitted in writing to the Associate Administrator for Hazardous Materials Safety. The request must be submitted in triplicate and must include a description of the quality assurance program required by 10 CFR part 71, subpart H, or 49 CFR 173.474 and 173.475, and a reproducible 22 cm x 30 cm (8.5" x 11") drawing showing the make-up of the package. A copy of the USNRC quality assurance program approval will satisfy the requirement for describing the quality assurance program. Each request is considered in the order in which it is received. To allow sufficient time for consideration, requests must be received at least 90 days before the requested effective date.

§173.473 Requirements for foreign-made packages.

In addition to other applicable requirements of this subchapter, each offeror of a foreign-made Type B, Type B(U), Type B(M), or fissile material package for which a Competent Authority Certificate is required by IAEA's "Regulations for the Safe Transport of

Radioactive Materials, Safety Series No. 6," shall also comply with the following requirements:

(a) Prior to the shipment of such a package of Class 7 (radioactive) materials into or from the U.S., the offeror shall-

(1) Have the foreign competent authority certificate revalidated by the U.S. Competent Authority, unless this has been done previously. Each request for revalidation must be submitted in writing to the Associate Administrator for Hazardous Materials Safety. The request must be in triplicate, contain all the information required by Section VII of the IAEA regulations in Safety Series No. 6, and include a copy in English of the foreign competent authority certificate. Each request is considered in the order in which it is received. To allow sufficient time for consideration, requests must be received at least 90 days before the requested effective date;

(2) Register in writing with the U.S. Competent Authority as a user of the package covered by the foreign competent authority certificate and its U.S. revalidation. If the offeror is requesting the revalidation, registration is automatic; and

(3) Supply to the carrier, upon request, the applicable competent authority certificates. However, the competent authority certificates are not required to accompany the packages to which they apply.

(b) The outside of each package must be durably and legibly marked with the competent authority identification marking indicated on the Competent Authority Certificate and revalidation.

(c) Each shipping paper for a shipment of Class 7 (radioactive) materials must bear a notation of the package identification marking indicated on the competent authority certificate or revalidation.

(d) All requirements of the foreign competent authority certificate and the U.S. Competent Authority revalidation must be fulfilled.

§173.474 Quality control for construction of packaging.

Prior to the first use of any packaging for the shipment of Class 7 (radioactive) material, the offeror shall determine that-

(a) The packaging meets the quality of design and construction requirements as specified in this subchapter; and

(b) The effectiveness of the shielding, containment and, when required, the heat transfer characteristics of the package, are within the limits specified for the package design.

§173.475 Quality control requirements prior to each shipment of Class 7 (radioactive) materials.

Before each shipment of any Class 7 (radioactive) materials package, the offeror must ensure, by examination or appropriate tests, that-

(a) The packaging is proper for the contents to be shipped;
(b) The packaging is in unimpaired physical condition, except for superficial marks;
(c) Each closure device of the packaging, including any required gasket, is properly installed, secured, and free of defects;
(d) For fissile material, each moderator and neutron absorber, if required, is present and in proper condition;
(e) Each special instruction for filling, closing, and preparation of the packaging for shipment has been followed;
(f) Each closure, valve, or other opening of the containment system through which the radioactive content might escape is properly closed and sealed;
(g) Each packaging containing liquid in excess of an A_2 quantity and intended for air shipment has been tested to show that it will not leak under an ambient atmospheric pressure of not more than 25 kPa, absolute (3.6 psia). The test must be conducted on the entire containment system, or on any receptacle or vessel within the containment system, to determine compliance with this requirement;
(h) The internal pressure of the containment system will not exceed the design pressure during transportation; and
(i) External radiation and contamination levels are within the allowable limits specified in this subchapter.

§173.476 Approval of special form Class 7 (radioactive) materials.
(a) Each offeror of special form Class 7 (radioactive) materials must maintain on file for at least one year after the latest shipment, and provide to the Associate Administrator for Hazardous Materials Safety on request, a complete safety analysis, including documentation of any tests, demonstrating that the special form material meets the requirements of §173.469. An IAEA Certificate of Competent Authority issued for the special form material may be used to satisfy this requirement.
(b) Prior to the first export shipment of a special form Class 7 (radioactive) material from the United States, each offeror shall obtain a U.S. Competent Authority Certificate for the specific material. For special form material manufactured outside the United States, an IAEA Certificate of Competent Authority from the country of origin may be used to meet this requirement.
(c) Each request for a U.S. Competent Authority Certificate as required by the IAEA regulations must be submitted in writing, in triplicate, to the Associate Administrator for Hazardous Materials Safety. Each request is considered in the order in which it is received. To allow sufficient time for consideration, requests must be received at least 90 days before the requested effective date. Each petition for a U.S. Competent Authority Certificate must include the following information:
(1) A detailed description of the material, or if a capsule, a detailed description of the contents. Particular reference must be made to both physical and chemical states;
(2) A detailed statement of the capsule design and dimensions, including complete engineering drawings [22cm x 30cm ($8^{1/2}$ inches x 11 inches)] and schedules of

material, and methods of construction;
(3) A statement of the tests that have been made and their results; or evidence based on calculative methods to show that the material is able to pass the tests; or other evidence that the special form Class 7 (radioactive) material complies with §173.469; and
(4) For the original request for a Competent Authority Certificate, evidence of a quality assurance program.
(d) Paragraphs (a) and (b) of this section do not apply in those cases where A_1 equals A_2 and the material is not required to be described on the shipping papers as "Radioactive Material, Special Form, n.o.s."

[CFR] PART 173 SUBPART J - [Reserved]

[TITLE 49] [SUBTITLE B] [PART 173] [SUBPART J]

Subpart J - [Reserved]

to Part 173 [Reserved]

Pt. 173, App. B

to Part 173-Procedure for Testing Chemical Compatibility and Rate of Permeation in Plastic Packaging and Receptacles

1. The purpose of this procedure is to determine the chemical compatibility and permeability of liquid hazardous materials packaged in plastic packaging and receptacles. Alternatives for this procedure are permitted as specified in §173.24(e)(3)(iii) of this subchapter.

2. Compatibility and rate of permeation are determined by subjecting full size plastic containers (or smaller containers as permitted in paragraph 4 of this appendix) and hazardous material lading to one of the following combinations of time and temperature:

a. Test Method 1: 180 days at a temperature no lower than 18 °C. (64 °F.)
b. Test Method 2: 28 days at a temperature no lower than 50 °C. (122 °F.)
c. Test Method 3: 14 days at a temperature no lower than 60 °C. (140 °F.)

3. Regardless of which test method is used, at least three sample containers shall be tested for each combination of hazardous material and size and design of container. Fill containers to rated capacity with the specific hazardous material (at the concentration to be transported) and close as for shipment. For the first and last 24 hours of storage under the selected test method, place the containers with closures downward, except that containers fitted with a vent are so placed on each occasion for five minutes only.

4. For testing under Test Method 2 or 3 in those instances where it is not practicable to use full size containers, smaller containers may be used. The small container shall be manufactured by the same process as the larger container (for example, using the same method of molding and processing temperatures) and be made of identical resins,

pigments and additives.

5. Determine filled container weight or net weight of contents both before and after storage under the selected test method. Rate of permeation is determined from loss of hazardous materials contents, during the conduct of the test, expressed as a percentage of the original weight.

6. After storage under the selected test method, the container shall be drained, rinsed, filled to rated capacity with water and, with filled container at ambient temperature, dropped from a height determined in accordance with §178.603(e) of this subchapter onto a rigid non-resilient, flat and horizontal surface.

7. Each of the following constitute test failure:

a. Visible evidence of permanent deformation due to vapor pressure build-up or collapse of walls, deterioration, swelling, crazing, cracking, excessive corrosion, oxidization, embrittlement, leakage, rupture or other defects likely to cause premature failure or a hazardous condition.

b. For materials meeting the definition of a poison according to this subchapter, a rate of permeation in excess of 0.5% determined over the test period. For all other hazardous materials, a rate of permeation in excess of 2.0% determined over the test period.

[Amdt. 173-176, 49 FR 24691, June 14, 1984, as amended by Amdt. 173-224, 55 FR 52670 Dec. 21, 1990; 56 FR 66279, Dec. 20, 1991; Amdt. 173-234, 58 FR 51533, Oct. 1, 1993]

Pt. 173, App. C

to Part 173-Procedure for Base-level Vibration Testing

Base-level vibration testing shall be conducted as follows:

1. Three sample packagings, selected at random, must be filled and closed as for shipment. A non-hazardous material may be used in place of the hazardous material if it has essentially the same physical characteristics.

2. The three packages must be placed on a vibrating platform that has a vertical double-amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform, but must be left free to move vertically, bounce and rotate.

3. The test must be performed continuously for one hour at a frequency that causes each package to be raised from the vibrating platform to such a degree that a piece of material of approximately 1.6 mm (0.063 inch) thickness (such as steel strapping or paperboard) can be passed between the bottom of any package and the platform.

4. Immediately following the period of vibration, each package shall be removed from the platform, turned on its side and observed for any evidence of leakage.

5. Rupture or leakage from any of the packages constitutes failure of the test.

[Amdt. 173-224, 55 FR 52671, Dec. 21, 1990]

Pt. 173, App. D

to Part 173-Test Methods for Dynamite (Explosive, Blasting, Type A)

1. Test method D-1-Leakage Test

A wooden stick, 114 mm (4.5 inches) long and 4.8 mm (0.2 inch) inch in diameter, with a sharpened end is used to punch 5 holes in one end of the wrapper of a dynamite cartridge. A cork stopper is placed on the bottom of a glass volumetric cylinder. The dynamite cartridge is placed, perforated end down, resting on the cork stopper in the cylinder. The entire assembly is placed in an oven at 38 ^{o}C (100 ^{o}F) for 48 hours and then examined visually for evidence of leakage.

2. Test method D-2-*Centrifugal Exudation Test*

The test apparatus consists of a glass tube, 135 mm (5.3 inches) long and one inch in diameter, with both ends open, and is assembled in the following manner:

(a) Close the bottom with a plastic plug of diameter equal to the inner diameter of the glass tube;

(b) Place a small amount of absorbent cotton on top of the plug;

(c) Place a plastic disk that matches the inner diameter to the glass tube and has seven small perforations on top of the cotton; and

(d) Place 10 g (0.35 ounce) of the dynamite sample on top of the disk.

The assembled glass tube is then placed in a hand-operated centrifuge and spun for one minute at 600 rpm (revolutions per minute). The dynamite sample is then removed from the glass tube and weighed to determine the percent of weight loss.

3. Test method D-3-*Compression Exudation Test*

The entire apparatus for this test is shown in Figure 1 of this appendix. The test is conducted using the following procedures:

(a) A glass tube, 135 mm (5.3 inches) long and one inch in diameter, is held on a wooden base;

(b) A small amount of absorbent cotton is placed into the bottom of the glass tube;

(c) Ten g (0.35 ounce) of dynamite sample are placed on top of the cotton in the glass tube;

(d) A small amount of absorbent cotton is placed on top of the dynamite sample;

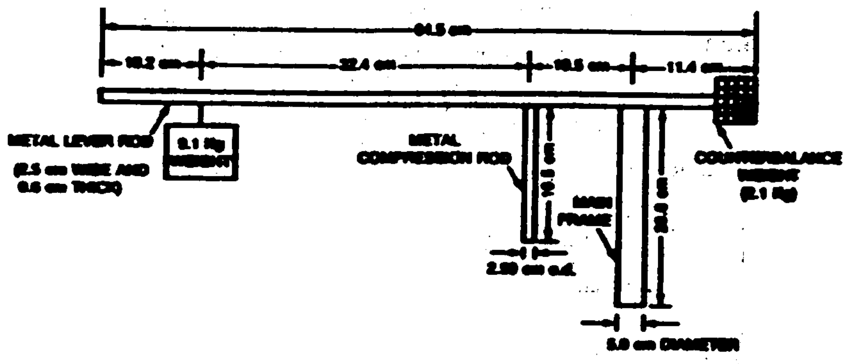
(e) A plastic disk that matches the inner diameter of the glass tube and has seven small perforations is placed on top of the cotton;

(f) A plastic plug matching the inner diameter of the glass tube is then placed on top of the disk;

(g) The glass tube assembly is placed under the compression rod, and compression is applied by means of the weight on the metal lever rod. The sample is compressed for one minute; and

(h) The dynamite sample is then removed from the glass tube and weighed to determine the percent of weight loss.

FIGURE 1
COMPRESSION APPARATUS



E-G to Part 173 [Reserved]

Pt. 173, App. H

to Part 173-Method of Testing for Sustained Combustibility

1. Method

The method describes a procedure for determining if the material when heated under the test conditions and exposed to an external source of flame applied in a standard manner sustains combustion.

2. Principle of the method

A metal block with a concave depression (test portion well) is heated to a specified temperature. A specified volume of the material under test is transferred to the well, and its ability to sustain combustion is noted after application and subsequent removal of a standard flame under specified conditions.

3. Apparatus

A combustibility tester consisting of a block of aluminum alloy or other corrosion-resistant metal of high thermal conductivity is used. The block has a concave well and a pocket drilled to take a thermometer. A small gas jet assembly on a swivel is attached to the block. The handle and gas inlet for the gas jet may be fitted at any convenient angle to the gas jet. A suitable apparatus is shown in Figure 5.1 of the UN Recommendations, and the essential dimensions are given in Figures 5.1 and 5.2 of the UN Recommendations. The following equipment is needed:

(a) *Gauge, for checking that the height of the center of the gas jet above the top of the test portion well is 2.2 mm (see Figure 5.1);*

(b) Thermometer, mercury in glass, for horizontal operation, with a sensitivity not less than 1 mm/ ^{o}C, or other measuring device of equivalent sensitivity permitting reading at 0.5 ^{o}C intervals. When in position in the block, the thermometer bulb must be surrounded with thermally conducting thermoplastic compound;

(c) Hotplate, fitted with a temperature-control device. (Other types of apparatus with suitable temperature-control facilities may be employed to heat the metal block);

(d) Stopwatch, or other suitable timing device;

(e) Syringe, capable of delivering 2 ml to an accuracy of +0.1 ml; and

(f) Fuel source, butane test fuel.

4. Sampling

The sample must be representative of the material to be tested and must be supplied and kept in a tightly closed container prior to test. Because of the possibility of loss of volatile constituents, the sample must receive only the minimum treatment necessary to ensure its homogeneity. After removing each test portion, the sample container must be immediately closed tightly to ensure that no volatile components escape from the container; if this closure is incomplete, an entirely new sample must be taken.

5. Procedure

Carry out the determination in triplicate.

WARNING-DO NOT CARRY OUT THE TEST IN A SMALL CONFINED AREA (FOR EXAMPLE A GLOVE BOX) BECAUSE OF THE HAZARD OF EXPLOSIONS.

(a) It is essential that the apparatus be set up in a completely draft-free area (see warning) and in the absence of strong light to facilitate observation of flash, flame, etc.

(b) Place the metal block on the hotplate or heat the metal block by other suitable means so that its temperature, as indicated by the thermometer placed in the metal block, is maintained at the specified temperature within a tolerance of +1 ^{o}C. For the appropriate test temperature, see paragraph 5.(h) of this appendix. Correct this temperature for the difference in barometric pressure from the standard atmospheric pressure (101.3 kPa) by raising the test temperature for a higher pressure or lowering the test temperature for a lower pressure by 1.0 ^{o}C for each 4 kPa difference. Ensure that the top of the metal block is exactly horizontal. Use the gauge to check that the jet is 2.2 mm above the top of the well when in the test position.

(c) Light the butane test fuel with the jet away from the test position (i.e. in the "off" position, away from the well). Adjust the size of the flame so that it is 8 mm to 9 mm high and approximately 5 mm wide.

(d) Using the syringe, take from the sample container at least 2 ml of the sample and rapidly transfer a test portion of 2 ml +0.1 ml to the well of the combustibility tester and immediately start the timing device.

(e) After a heating time of 60 seconds (s), by which time the test portion is deemed to have reached its equilibrium temperature, and if the test fluid has not ignited, swing the test flame into the test position over the edge of the pool of liquid. Maintain it in this position for 15 s and then return it to the "off" position while observing the behavior of the test portion. The test flame must remain lighted throughout the test.

(f) For each test observe and record:

(i) whether there is ignition and sustained combustion or flashing, or neither, of the test portion before the test flame is moved into the test position;

(ii) whether the test portion ignites while the test flame is in the test position, and, if so, how long combustion is sustained after the test flame is returned to the "off" position.

(g) If sustained combustion interpreted in accordance with paragraph 6. of this appendix is not found, repeat the complete procedure with new test portions, but with a heating time of 30 s.

(h) If sustained combustion interpreted in accordance with paragraph 6. of this appendix is not found at a test temperature of 60.5 ^{o}C (141 ^{o}F), repeat the complete procedure with new test portions, but at a test temperature of 75 ^{o}C (167 ^{o}F). In the case of a material which has a flash point above 60.5 ^{o}C (141 ^{o}F) and below 93 ^{o}C (200 ^{o}F), if sustained combustion interpreted in accordance with paragraph 6. of this appendix is not found at a test temperature of 5 ^{o}C (9 ^{o}F) above its flash point, repeat the complete procedure with new test portions, but at a test temperature of 20 ^{o}C (36 ^{o}F) above its flash point.

6. Interpretation of observations

The material must be assessed either as not sustaining combustion or as sustaining combustion. Sustained combustion must be reported at either of the heating times if one of the following occurs with either of the test portions:

(a) When the test flame is in the "off" position, the test portion ignites and sustains combustion;

(b) The test portion ignites while the test flame is in the test position for 15 s, and sustains combustion for more than 15 s after the test flame has been returned to the "off" position.

Note to paragraph 6 of this appendix: Intermittent flashing may not be interpreted as sustained combustion. Normally, at the end of 15 s, the combustion has either clearly ceased or continues. In cases of doubt, the material must be deemed to sustain combustion.

[Amdt. 173-241, 59 FR 67517, Dec. 29, 1994, as amended by Amdt. 173-255, 61 FR 50627, Sept. 26, 1996]

Pt. 174

[CFR] PART 174 - CARRIAGE BY RAIL

[TITLE 49] [SUBTITLE B] [PART 174]

Subpart A-General Requirements

Subpart B-General Operating Requirements

Subpart C-General Handling and Loading Requirements

Subpart D-Handling of Placarded Rail Cars, Transport Vehicles and Freight Containers

Subpart E-Class I (Explosive) Materials

174.101 Loading Class 1 (explosive) materials.
174.102 Forbidden mixed loading and storage.
174.103 Disposition of damaged or astray shipments.
174.104 Division 1.1 or 1.2 (Class A explosive) materials; car selection, preparation, inspection, and certification.
174.105 Routing shipments, Division 1.1 or 1.2 (Class A explosive) materials.
174.106 "Order-Notify" or "C.O.D." shipments, Division 1.1 or 1.2 (Class A explosive) materials.
174.110 Car magazine.
174.112 Loading Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials (Also see §174.101).
174.114 Record to be made of change of seals on "Cars loaded with Division 1.1 or 1.2 (explosive) materials".
174.115 Loading Division 1.4 (Class C explosive) materials.

Subpart F-Detailed Requirements for Class 2 (Gases) Materials

174.200 Special handling requirements.
174.201 Class 2 (gases) material cylinders.
174.204 Tank car delivery of gases, including cryogenic liquids.
174.290 Materials extremely poisonous by inhalation shipped by, for, or to the Department of Defense.

Subpart G-Detailed Requirements for Class 3 (Flammable Liquid) Materials

174.300 Special handling requirements.
174.304 Class 3 (flammable liquid) materials in tank cars.

Subparts H-I [Reserved]

Subpart J-Detailed Requirements for Division 6.1 (Poisonous) Materials

174.600 Special handling requirements for materials extremely poisonous by inhalation.
174.615 Cleaning cars.
174.680 Division 6.1 (poisonous) materials with foodstuffs.

Subpart K-Detailed Requirements for Class 7 (Radioactive) Materials

174.700 Special handling requirements for Class 7 (radioactive) materials.
174.715 Cleanliness of transport vehicles after use.
174.750 Incidents involving leakage.

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Subpart A - General Requirements

§174.1 Purpose and scope.

This part prescribes requirements in addition to those contained in parts 171, 172, 173, and 179 of this subchapter, to be observed with respect to the transportation of hazardous materials in or on rail cars.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-74, 58 FR 51533, Oct. 1, 1993]

§174.3 Unacceptable hazardous materials shipments.

No person may accept for transportation or transport by rail any shipment of hazardous material that is not in conformance with the requirements of this subchapter.

[Amdt. 174-83, 61 FR 28677, June 5, 1996]

§174.5 Carrier's materials and supplies.

This subchapter applies to the transportation of a carrier's materials and supplies moving by rail, except that the shipper's certification is not required when these materials and supplies are being transported by the carrier who owns them. The requirements of this subchapter do not apply to railway torpedoes or fusees when carried in engines or rail cars. Railway torpedoes must be in closed metal boxes when not in use.

[Amdt. 174-26B, 41 FR 57071, Dec. 30, 1976]

§174.9 Inspection and acceptance.

At each location where a hazardous material is accepted for transportation or placed in a train, the carrier shall inspect each rail car containing the hazardous material, at ground level, for required markings, labels, placards, securement of closures and leakage. This inspection may be performed in conjunction with inspections required under parts 215 and 232 of this title.

[Amdt. 174-83, 61 FR 28677, June 5, 1996]

§174.14 Movements to be expedited.

(a) A carrier must forward each shipment of hazardous materials promptly and within 48 hours (Saturdays, Sundays, and holidays excluded), after acceptance at the originating point or receipt at any yard, transfer station, or interchange point, except that where biweekly or weekly service only is performed, a shipment of hazardous materials must be forwarded on the first available train.

(b) A tank car loaded with any Division 2.1 (flammable gas), Division 2.3 (poisonous gas) or Class 3 (flammable liquid) material, may not be received and held at any point, subject to forwarding orders, so as to defeat the purpose of this section or of §174.204 of this subchapter.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52677, Dec. 21, 1990]

§174.16 Removal and disposition of hazardous materials at destination.

(a) *Delivery at non-agency stations. A shipment of Class 1 (explosive) materials may not be unloaded at non-agency stations unless the consignee is there to receive it or unless properly locked and secure storage facilities are provided at that point for its protection. If delivery cannot be so made, the shipment must be taken to next or nearest agency station for delivery.*

(b) Delivery at agency stations. A carrier shall require the consignee of each shipment of hazardous materials to remove the shipment from carrier's property within 48 hours (exclusive of Saturdays, Sundays, and holidays) after notice of arrival has been sent or given. If not so removed, the carrier shall immediately dispose of the shipments as follows:

(1) Division 1.1 or 1.2 (Class A explosive) materials: If safe storage is available, by storage at the owner's expense; if safe storage is not available, by return to the shipper, sale, or destruction under supervision of a competent person; or if safety requires, by destruction under supervision of a competent person.

(2) Hazardous materials, except Division 1.1 or 1.2 (Class A explosive) materials, in carload shipments: By storage on the carrier's property; by storage on other than the carrier's property, if safe storage on the carrier's property is not available; or by sale at expiration of 15 calendar days after notice of arrival has been sent or given to the consignee, provided the consignor has been notified of the non-delivery at the

expiration of a 48-hour period and orders for disposition have not been received.

(3) Hazardous materials, except Division 1.1 or 1.2 (Class A explosive) materials, in less-than-carload shipments: By return to the shipper if notice of non-delivery was requested and given the consignor as prescribed by the carrier's tariff, and orders for return to shipper have been received; by storage on the carrier's property; by storage on other than the carrier's property, if safe storage on carrier's property is not available; or by sale at expiration of 15 calendar days after notice of arrival has been sent or given to the consignee, provided the consignor has been notified of non-delivery at expiration of a 48-hour period and orders for disposition have not been received.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52677, Dec. 21, 1990]

§174.20 Local or carrier restrictions.

(a) When local conditions make the acceptance, transportation, or delivery of hazardous materials unusually hazardous, local restrictions may be imposed by the carrier.

(b) Each carrier must report to the Bureau of Explosives for publication the full information as to any restrictions which it imposes against the acceptance, delivery, or transportation of hazardous materials, over any portion of its lines under this section.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976]

Subpart B - General Operating Requirements

§174.24 Shipping papers.

A person may not accept or transport a hazardous material by rail unless that person receives a shipping paper that properly conveys the information required by part 172 of this subchapter. Only an initial carrier within the United States must receive and retain a copy of the shipper's certification as required by §172.204 of this subchapter. This section does not apply to a material that is excepted from shipping paper requirements as specified in §172.200 of this subchapter.

[Amdt. 174-83, 61 FR 28677, June 5, 1996, as amended by Amdt. 174-83, 61 FR 50255, Sept. 25, 1996]

§174.26 Notice to train crews of placarded cars.

(a) The train crew must have a document that reflects the current position in the train of each rail car containing a hazardous material. The train crew must update the document to indicate changes in the placement of a rail car within the train. For example, the train crew may update the document by handwriting on it or by appending or attaching another document to it.

(b) A member of the crew of a train transporting a hazardous material must have a copy of a document for the hazardous material being transported showing the information required by part 172 of this subchapter.

[Amdt. 174-84, 62 FR 1236, Jan. 8, 1997]

§174.50 Nonconforming or leaking packages.

Leaking packages other than tank cars may not be forwarded until repaired, reconditioned, or overpacked in accordance with §173.3 of this subchapter. Except as otherwise provided in this section, a tank car that no longer conforms to this subchapter may not be forwarded unless repaired or approved for movement by the Associate Administrator for Safety, Federal Railroad Administration. Notification and approval must be furnished in writing, or through telephonic or electronic means with subsequent written confirmation provided within two weeks. For the applicable address and telephone number, see part 107, subpart B, appendix A, of this chapter. A leaking tank car containing a hazardous material may be moved without repair or approval only so far as necessary to reduce or eliminate an immediate threat of harm to human health or the environment when it is determined its movement would provide greater safety than allowing the car to remain in place. In the case of a liquid leak, measures must be taken to prevent the spread of the liquid.

[Amdt. 174-83, 61 FR 28677, June 5, 1996]

Subpart C - General Handling and Loading Requirements

§174.55 General requirements.

(a) Each package containing a hazardous material being transported by rail in a freight container or transport vehicle must be loaded so that it cannot fall or slide and must be safeguarded in such a manner that other freight cannot fall onto or slide into it under conditions normally incident to transportation. When this protection cannot be provided by using other freight, it must be provided by blocking and bracing. For examples of blocking and bracing in freight containers and transport vehicles, see Bureau of Explosives Pamphlet Nos. 6 and 6C.

(b) Each package containing a hazardous material bearing package orientation markings prescribed in §172.312 of this subchapter must be loaded within a transport vehicle or freight container to remain in the correct position indicated by those markings during transportation.

(c) The doors of a freight container or transport vehicle may not be used to secure a load that includes a package containing a hazardous material unless the doors meet the design strength requirements of Specification M-930 (for freight containers) and M-931 (for trailers) in the AAR's Manual of Standards and Recommended Practices and the load is also within the limits of the design strength requirements for the doors.

[Amdt. 174-83, 61 FR 28677, June 5, 1996]

§174.57 Cleaning cars.

All hazardous material which has leaked from a package in any rail car or on other railroad property must be carefully removed.

§174.59 Marking and placarding of rail cars.

No person may transport a rail car carrying hazardous materials unless it is marked and placarded as required by this subchapter. Placards and car certificates lost in transit must be replaced at the next inspection point, and those not required must be removed at the next terminal where the train is classified. For Canadian shipments, required placards lost in transit, must be replaced either by those required by part 172 of this subchapter or by those authorized under §171.12a.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-48, 50 FR 41521, Oct. 11, 1985]

§174.61 Transport vehicles and freight containers on flat cars.

(a) A transport vehicle, freight container, or package containing a hazardous material must be designed and loaded so that it will not become damaged to an extent that would affect its integrity under conditions normally incident to transportation. Each unit must be secured on a flatcar so that it cannot permanently change position during transit. Packages of hazardous materials contained therein must be loaded and braced as provided by §§174.101, 174.112, 174.115 and 174.55. Placards must be applied when prescribed by part 172 of this subchapter and part 174.

(b) Except as specified in §173.21, a truck body, trailer, or freight container equipped with heating or refrigerating equipment which has fuel or any article classed as a hazardous material may be loaded and transported on a flat car as part of a joint rail highway movement. The heating or refrigerating equipment is considered to be a part of the truck body or trailer and is not subject to any other requirements of this subchapter. The truck body, trailer, or freight container must be secured on the flatcar so that it cannot change position during transit.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-38, 45 FR 32698, May 19, 1980; Amdt. 174-39, 45 FR 81572, Dec. 11, 1980; Amdt. 174-59, 51 FR 5974, Feb. 18, 1986; Amdt. 174-68, 57 FR 45464, Oct. 1, 1992; Amdt. 174-79, 59 FR 64744, Dec. 15, 1994]

§174.63 Portable tanks, IM portable tanks, intermediate bulk containers, cargo tanks, and multi-unit tank car tanks.

(a) A carrier may not transport a bulk packaging (e.g., portable tank, IM portable tank, intermediate bulk container, cargo tank, or multi-unit tank car tank) containing a hazardous material in container-on-flatcar (COFC) or trailer-on-flatcar (TOFC) service except as authorized by this section or unless approved for transportation by the Associate Administrator for Safety, FRA.

(b) A bulk packaging containing a hazardous material (including IM 101 and IM 102 when appropriate according to dimensions and weight distribution) may be transported inside a fully closed transport vehicle or fully closed freight container provided it is properly secured with a restraint system that will prevent it from changing position, sliding into other packages, or contacting the side or end walls (including doors) under conditions normally incident to transportation.

(c) When not transported in conformance with and subject to paragraph (b) of this section, a bulk packaging may be transported in COFC service or TOFC service subject to the following conditions as applicable:

(1) The bulk packaging contains a material packaged in accordance with §173.240, 173.241, 173.242, or 173.243 of this subchapter;

(2) The tank and flatcar conform to requirements in AAR 600 of the AAR Specifications for Tank Cars, Specification M-1002, entitled "Specifications for Acceptability of Tank Containers";

(3) For TOFC service, the trailer chassis conforms to requirements in paragraphs 3, 4, 5, and 6 of AAR Specification M-943 "Container Chassis For TOFC Service" of the AAR specification for "Specially Equipped Freight Car and Intermodal Equipment";

(4) For COFC service, the container support and securement systems conform to requirements in Specification M-952 "Intermodal Container Support and Securement Systems for Freight Cars", of the AAR specification for "Specially Equipped Freight Car and Intermodal Equipment";

(5) If transported in a well car-

(i) The tank is not in a double-stacked configuration (i.e., no freight container or portable tank is placed above or below the tank); and

(ii) The tank is transported in the well with its outlet valve facing outward towards the end of the well and away from any adjacent tank or container; and

(6) All securement fittings shall be fully engaged and in the locked position, provided; however, if the tank is transported in a well car, it must be loaded into a well appropriate for the length of the container and any void filling device present must be secured in its designed appropriate position.

(d) An approval in effect on February 28, 1991 for the transportation of portable tanks or IM portable tanks in TOFC or COFC service expires on the date stated in the approval letter or June 15, 1995, whichever is later.

(e) A carrier may not transport a cargo tank or multi-unit tank car tank containing a hazardous material in TOFC or COFC service unless approved for such service by the Associate Administrator for Safety, FRA. However, in the event of an accident or incident, no such approval is necessary for the transportation of a cargo tank containing a hazardous material in TOFC service under the following condition(s):

(1) There is an emergency need for the cargo tank in order to mitigate the consequences of an incident; and

(2) Movement of the cargo tank is limited to transportation necessary for emergency purposes.

[Amdt. 174-79, 59 FR 64744, Dec. 15, 1994]

§174.67 Tank car unloading.

(a) In unloading tank cars, the following rules must be observed (see subpart F of this part for gases):

(1) Unloading operations must be performed only by reliable persons properly instructed in unloading hazardous materials and made responsible for careful compliance with this part.

(2) Brakes must be set and wheels blocked on all cars being unloaded.

(3) Caution signs must be so placed on the track or cars to give necessary warning to persons approaching the cars from the open end of a siding and must be left up until after the cars are unloaded and disconnected from the discharge connection. The signs must be of metal or other comparable material, at least 30 cm (12 inches) high by 38 cm (15 inches) wide in size, and bear the words, "STOP-Tank Car Connected", or "STOP-Men at Work", the word "STOP" being in letters at least 10 cm (3.9 inches) high and the other words in letters at least 5 cm (2 inches) high. The letters must be white on a blue background.

(4) Before a manhole cover or outlet valve cap is removed from a tank car, the car must be relieved of all interior pressure by cooling the tank with water or by venting the tank by raising the safety valve or opening the dome vent at short intervals. However, if venting to relieve pressure will cause a dangerous amount of vapor to collect outside

the car, venting and unloading must be deferred until the pressure is reduced by allowing the car to stand overnight or otherwise cooling the contents. These precautions are not necessary when the car is equipped with a manhole cover which hinges inward or with an inner manhole cover which does not have to be removed to unload the car, and when pressure is relieved by piping vapor into a condenser or storage tank.

(b) After the pressure is released, the seal must be broken and the manhole cover removed as follows:

(1) *Screw type. The cover must be loosened by placing a bar between the manhole cover lug and knob. After two complete turns, so that vent openings are exposed, the operation must be stopped, and if there is any sound of escaping vapor, the cover must be screwed down tightly and the interior pressure relieved as prescribed in paragraph (a)(4) of this section, before again attempting to remove the cover.*

(2) Hinged and bolted type. All nuts must be unscrewed one complete turn, after which same precautions as prescribed for screw type cover must be observed.

(3) Interior type. All dirt and cinders must be carefully removed from around the cover before the yoke is unscrewed.

(c) When the car is unloaded through a bottom outlet valve, the manhole cover must be adjusted as follows:

(1) *Screw type. The cover must be put in place, but not entirely screwed down, so that air may enter the tank through the vent holes in threaded flange of the cover.*

(2) Hinged and bolted type. A non-metallic block must be placed under one edge of the cover.

(3) Interior type. The screw must be tightened up in the yoke so that the cover is brought up within one-half inch of the closed position.

(d) When unloading through the bottom outlet of a car equipped with an interior manhole type cover, and in each case where unloading is done through the manhole (unless a special cover with a safety vent opening and a tight connection for the discharge outlet is used), the manhole must be protected by asbestos or metal covers against the entrance of sparks or other sources of ignition of vapor, or by being covered and surrounded with wet burlap or similar cloth material. The burlap or other cloth must be kept damp by the replacement or the application of water as needed.

(e) Seals or other substances must not be thrown into the tank and the contents may not be spilled over the car or tank.

(f) The valve rod handle or control in the dome must be operated several times to see that outlet valve in bottom of tank is on its seat before valve cap is removed.

(g) The valve cap, or the reducer when a large outlet is to be used, must be removed with a suitable wrench after the set screws are loosened and a pail must be placed in position to catch any liquid that may be in the outlet chamber. If the valve cap or reducer does not unscrew easily, it may be tapped lightly with a mallet or wooden block in an upward direction. If leakage shows upon starting the removal, the cap or reducer may not be entirely unscrewed. Sufficient threads must be left engaged and sufficient time allowed to permit controlled escape of any accumulation of liquid in the outlet chamber. If the leakage stops or the rate of leakage diminishes materially, the cap or reducer may be entirely removed. If the initial rate of leakage continues, further efforts must be made to seat the outlet valve (see paragraph (f) of this section). If this fails, the cap or reducer must be screwed up tight and the tank must be unloaded through the dome. If upon removal of the outlet cap the outlet chamber is found to be blocked with frozen liquid or any other matter, the cap must be replaced immediately and a careful examination must be made to determine whether the outlet casting has been cracked. If the obstruction is not frozen liquid, the car must be unloaded through the dome. If the obstruction is frozen liquid and no crack has been found in the outlet casting, the car may, if circumstances require it, be unloaded from the bottom by removing the cap and attaching unloading connections immediately. Before opening the valve inside the tank car, steam must be applied to the outside of the outlet casting or wrap casting with burlap or other rags and hot water must be applied to melt the frozen liquid.

(h) Unloading connections must be securely attached to unloading pipes on the dome or to the bottom discharge outlets before any discharge valves are opened.

(i) Tank cars may not be allowed to stand with unloading connections attached after unloading is completed. Throughout the entire period of unloading, and while car is connected to unloading device, the car must be attended by the unloader.

(j) If necessary to discontinue unloading a tank car for any reason, all unloading connections must be disconnected. All valves must first be tightly closed, and the closures of all other openings securely applied.

(k) As soon as a tank car is completely unloaded, all valves must be made tight by the use of a bar, wrench or other suitable tool, the unloading connections must be removed and all other closures made tight.

(l) Railroad defect cards may not be removed.

(m) If oil or gasoline has been spilled on the ground around connections, it must be covered with fresh, dry sand or dirt.

(n) All tools and implements used in connection with unloading must be kept free of oil, dirt, and grit.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-43, 48 FR 27699, June 16, 1983; Amdt. 174-68, 55 FR 52678, Dec. 21, 1990; 56 FR 66280, Dec. 20, 1991; Amdt. 174-81, 60 FR 49111, Sept. 21, 1995; Amdt. 174-83, 61 FR 28678, June 5, 1996]

§174.81 Segregation of hazardous materials.

(a) This section applies to materials which meet one or more of the hazard classes defined in this subchapter and are in packages which are required to be labeled or placarded under the provisions of part 172 of this subchapter.

(b) When a rail car is to be transported by vessel, other than a ferry vessel, hazardous materials on or within that rail car must be stowed and segregated in accordance with §176.83(b) of this subchapter.

(c) In addition to the provisions of paragraph (d) of this section, cyanides or cyanide mixtures may not be loaded or stored with acids.

(d) Hazardous materials may not be loaded, transported, or stored together, except as provided in this section, and in accordance with the following table:

Segregation Table for Hazardous Materials

Class or Division		Notes	1.1, 1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas Zone A	2.3 gas Zone B	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG I Zone A	7	8 liquids only
Explosives	1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives	1.3	-	*	*	*	*	*	X	-	X	X	X	-	X	X	X	X	X	-	X
Explosives	1.4	-	*	*	*	*	*	O	-	O	O	O	-	O	-	-	-	O	-	O
Very insensitive explosives	1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives	1.6	-	*	*	*	*	*	-	-	-	-	-	-	-	-	-	-	-	-	-
Flammable gases	2.1	-	X	X	O	X	-	-	-	X	O	-	-	-	-	-	-	O	O	-
Non-toxic, non-flammable gases	2.2	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poisonous gas Zone A	2.3	-	X	X	O	X	-	X	-	-	-	X	X	X	X	X	X	-	-	X
Poisonous gas Zone B	2.3	-	X	X	O	X	-	O	-	-	-	O	O	O	O	O	O	-	-	O
Flammable liquids	3	-	X	X	O	X	-	-	-	X	O	-	-	-	-	O	-	X	-	-
Flammable solids	4.1	-	X	-	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Spontaneously combustible materials	4.2	-	X	X	O	X	-	-	-	X	O	-	-	-	-	-	-	X	-	X
Dangerous when wet materials	4.3	-	X	X	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Oxidizers	5.1	A	X	X	-	X	-	-	-	X	O	O	-	-	-	-	-	X	-	O
Organic peroxides	5.2	-	X	X	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Poisonous liquids PG I Zone A	6.1	-	X	X	O	X	-	O	-	-	-	X	X	X	X	X	X	-	-	X
Radioactive materials	7	-	X	-	-	X	-	O	-	-	-	-	-	-	-	-	-	-	-	-
Corrosive liquids	8	-	X	X	O	X	-	-	-	X	O	-	O	X	O	O	O	X	-	-

(e) Instructions for using the segregation table for hazardous materials in paragraph (d) of this section are as follows:

(1) The absence of any hazard class or division, or a blank space in the table indicates that no restrictions apply.

(2) The letter "X" in the table indicates that these materials may not be loaded, transported, or stored together in the same rail car or storage facility during the course of transportation.

(3) The letter "O" in the table indicates that these materials may not be loaded, transported, or stored together in the same rail car or storage facility during the course of transportation unless separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials would not occur. Notwithstanding the methods of separation employed, Class 8 (corrosive) liquids may not be loaded above or adjacent to Class 4 (flammable) or Class 5 (oxidizing) materials; except that shippers may load carload shipments of such materials together when it is known that the mixture of contents

would not cause a fire or a dangerous evolution of heat or gas.

(4) The "*" in the table indicates that segregation among different Class 1 (explosive) materials is governed by the compatibility table in paragraph (f) of this section.

(5) The note "A" in the second column of the table means that, notwithstanding the requirements of the letter "X", ammonium nitrate fertilizer may be loaded or stored with Division 1.1 (Class A explosive) or Division 1.5 (blasting agents) materials.

(6) When the §172.101 table or §172.402 of this subchapter requires a package to bear a subsidiary hazard label, segregation appropriate to the subsidiary hazard must be applied when that segregation is more restrictive than that required by the primary hazard. However, hazardous materials of the same class may be stowed together without regard to segregation required by any secondary hazard if the materials are not capable of reacting dangerously with each other and causing combustion or dangerous evolution of heat, evolution of flammable, poisonous, or asphyxiant gases, or formation of corrosive or unstable materials.

(f) Class 1 (explosive) materials may not be loaded, transported, or stored together, except as provided in this section, and in accordance with the following table:

Compatibility Table For Class 1 (Explosive) Materials

Compatibility group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	-	X	X	X	X	X	X	X	X	X	X	X	X
B	X	-	X	4	X	X	X	X	X	X	X	X	4/5
C	X	X	-	2	2	X	6	X	X	X	X	3	4/5
D	X	4	2	-	2	X	6	X	X	X	X	3	4/5
E	X	X	2	2	-	X	6	X	X	X	X	3	4/5
F	X	X	X	X	X	-	X	X	X	X	X	X	4/5
G	X	X	6	6	6	X	-	X	X	X	X	X	4/5
H	X	X	X	X	X	X	X	-	X	X	X	X	4/5
J	X	X	X	X	X	X	X	X	-	X	X	X	4/5
K	X	X	X	X	X	X	X	X	X	-	X	X	4/5
L	X	X	X	X	X	X	X	X	X	X	1	X	X
N	X	X	3	3	3	X	X	X	X	X	X	-	4/5
S	X	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	X	4/5	-

(g) Instructions for using the compatibility table for Class 1 (explosive) materials in paragraph (f) of this section are as follows:

(1) A blank space in the table indicates that no restrictions apply.

(2) The letter "X" in the table indicates that explosives of different compatibility groups may not be carried on the same rail car, unless packed in separate freight containers (e.g., two or more freight containers mounted upon the same rail car).

(3) The numbers in the table mean the following:

(i) "1" means explosives from compatibility group L may only be carried on the same rail car with an identical explosive.

(ii) "2" means any combination of explosives from compatibility group C, D, or E is assigned to compatibility group E.

(iii) "3" means any combination of explosives from compatibility group C, D, or E with those in compatibility group N is assigned to compatibility group D.

(iv) "4" means detonators and detonating primers, Division 1.4S (Class C explosives), may not be loaded in the same car with Division 1.1 and 1.2 (Class A explosive) materials.

(v) "5" means Division 1.4S fireworks may not be loaded in the same car with Division 1.1 or 1.2 (Class A explosive) materials.

(vi) "6" means explosive articles in compatibility group G, other than fireworks and those requiring special stowage, may be stowed with articles of compatibility groups C, D and E, provided no explosive substances are carried in the same rail car.

(h) Except as provided in paragraph (i) of this section, explosives of the same compatibility group but of different divisions may be transported together provided that the whole shipment is transported as though its entire contents were of the lower numerical division (i.e., Division 1.1 being lower than Division 1.2). For example, a mixed shipment of Division 1.2 (Class A explosive) materials and Division 1.4 (Class C explosive) materials, compatibility group D, must be transported as Division 1.2 (Class A explosive) materials.

(i) When Division 1.5 (blasting agent) materials, compatibility group D are transported in the same freight container as Division 1.2 (Class A explosive) materials, compatibility group D, the shipment must be transported as Division 1.1 (Class A explosive) materials, compatibility group D.

[Amdt. 174-68, 55 FR 52678, Dec. 21, 1990, as amended at 56 FR 66280-66281, Dec. 20, 1991; 57 FR 45464, Oct. 1, 1992; Amdt. 174-68, 57 FR 59310, Dec. 15, 1992; Amdt. 174-75, 58 FR 50237, Sept. 24, 1993; Amdt. 174-83, 61 FR 51339, Oct. 1, 1996; 64 FR 10781, Mar. 5, 1999]

Subpart D - Handling of Placarded Rail Cars, Transport Vehicles and Freight Containers

§174.82 General requirements for the handling of placarded rail cars, transport vehicles, freight containers, and bulk packages.

(a) Unless otherwise specified, this subpart does not apply to the handling of rail cars, transport vehicles, freight containers, or bulk packagings, which contain Division 1.6, combustible liquids, Division 6.1 PG III materials, Class 9 materials, or ORM-D materials.

(b) A placarded rail car, transport vehicle, freight container, or bulk package may not be transported in a passenger train.

[Amdt. 174-68, 55 FR 52680, Dec. 21, 1990, as amended at 56 FR 66281, Dec. 20, 1991; 57 FR 45464, Oct. 1, 1992; Amdt. 174-74, 58 FR 51533, Oct. 1, 1993]

§174.83 Switching placarded rail cars, transport vehicles, freight containers, and bulk packagings.

(a) In switching operations where the use of hand brakes is necessary-

(1) It must be determined by trial whether a loaded, placarded car, or a car occupied by a rider in a draft containing a placarded car, has its hand brakes in proper working condition before it is cut off;

(2) A loaded, placarded tank car or a draft which includes a loaded placarded tank car may not be cut off until the preceeding rail car clears the ladder track; and

(3) A loaded, placarded tank car or a draft which includes a loaded placarded tank car must clear the ladder track before another rail car is allowed to follow.

(b) Any loaded rail car placarded for a Division 1.1 or Division 1.2 explosive, a Division 2.3 Hazard Zone A gas or a Division 6.1 PG I Hazard Zone A material, or a Class DOT 113 tank car displaying a Division 2.1 (flammable gas) placard, including a Class DOT 113 tank car containing only a residue of a Division 2.1 material, may not be:

(1) Cut off while in motion;

(2) Coupled into with more force than is necessary to complete the coupling; or

(3) Struck by any car moving under its own momentum.

(c) A placarded flatcar, or a flatcar carrying a placarded transport vehicle, freight container, or bulk packaging under this subchapter may not be cut off while in motion.

(d) No rail car moving under its own momentum may be permitted to strike any placarded flatcar or any flatcar carrying a placarded transport vehicle, freight container, or bulk packaging.

(e) No placarded flatcar or any flatcar carrying a placarded transport vehicle, freight container, or bulk packaging may be coupled into with more force than is necessary to complete the coupling.

(f) When transporting a rail car, transport vehicle, or freight container placarded for Division 1.1 or 1.2 (Class A explosive) materials in a terminal, yard, or on a side track or siding, the placarded rail car must be separated from the engine by at least one non-placarded rail car and must be placed in a location so that it will be safe from danger of fire. A rail car, transport vehicle, or freight container placarded for Division 1.1 or 1.2 (Class A explosive) materials may not be placed under a bridge or overhead crossing, or in or alongside a passenger shed or station, except during transfer operations.

[Amdt. 174-68, 55 FR 52680, Dec. 21, 1990, as amended at 56 FR 66281, Dec. 20, 1991; Amdt. 174-75, 58 FR 50237, Sept. 24, 1993; Amdt. 174-77, 59 FR 48549, Sept. 21, 1994; Amdt. 174-83, 61 FR 51339, Oct. 1, 1996]

§174.84 Position in train of loaded placarded rail cars, transport vehicles, freight containers or bulk packagings when accompanied by guards or technical escorts.

A rail car placarded in Division 1.1 or 1.2 (Class A explosive); Division 2.3 (Hazard Zone A; poisonous gas); or Division 6.1 (PG I, Hazard Zone A; poisonous liquid) in a moving or standing train must be next to and ahead of any car occupied by the guards or technical escorts accompanying the placarded rail car. However, if a rail car occupied by the guards or technical escorts has temperature control equipment in operation, it must be the fourth car behind any car requiring Division 1.1 or 1.2 (Class A explosive) placards.

[Amdt. 174-68, 55 FR 52680, Dec. 21, 1990, as amended at 56 FR 66281, Dec. 20, 1991]

§174.85 Position in train of placarded cars, transport vehicles, freight containers, and bulk packagings.

(a) Except as provided in paragraphs (b) and (c) of this section, the position in a train of each loaded placarded car, transport vehicle, freight container, and bulk packaging must conform to the provisions of this section.

(b) A car placarded "RADIOACTIVE" must comply with train positioning requirements of paragraph (d) of this section and must be separated from a locomotive, occupied caboose, or carload of undeveloped film by at least one non-placarded car.

(c) A tank car containing the residue of a hazardous material must be separated from a locomotive or occupied caboose by at least one rail car other than a placarded tank car.

(d) Position of rail cars in a train. In the following table:

Position in Train of Placarded Cars Transporting Hazardous Materials

RESTRICTIONS	Placard Group 1	Placard Group 2		Placard Group 3		Placard Group 4
-	Rail Car	Tank Car	Rail Car	Tank Car	Rail Car	Rail Car
1. When train length permits, placarded car may not be nearer than the sixth car from the engine or occupied caboose	X	X	-	X	-	-
2. When train length does not permit, placarded car must be placed near the	X	X	-	X	-	-

middle of the train, but not nearer than the second car from an engine or occupied caboose						
3. A placarded car may not be placed next to an open-top car when any of the lading in the open top car protrudes beyond the car ends, or if the lading shifted, would protrude beyond the car ends.	X	X	-	X	-	-
4. A placarded car may not be placed next to a loaded flat car, except closed TOFC/COFC equipment, auto carriers, and other specially equipped cars with tie-down devices for securing vehicles. Permanent bulk head flat cars are considered the same as open-top cars	X	X	-	X	-	-
5. A placarded car may not be placed next to any transport vehicle or freight container having an internal combustion engine or an open-flame device in operation.	X	X	-	X	-	-
6. Placarded cars may not be placed next to each other based on the following:	-	-	-	-	-	-
Placard Group 1	-	X	X	X	X	X
Placard Group 2	X	-	-	X	X	X
Placard Group 3	X	X	X	-	-	X
Placard Group 4	X	X	X	X	X	-

PLACARD GROUP:

Group 1-Divisions 1.1 and 1.2 (Class A explosive) materials.

Group 2-Divisions 1.3, 1.4, 1.5 (Class B and C explosive), Class 2 (compressed gas; other than Div 2.3, PG I, Zone A), Class 3 (flammable liquid), Class 4 (flammable solid), Class 5 (oxidizing), Class 6 (poisonous liquid; other than Div 6.1, PG I, Zone A), and Class 8 (corrosive) materials.

Group 3-Divisions 2.3 (Zone A; poisonous gas) and 6.1 (PG I, Zone A; poisonous liquid) materials.

Group 4-Class 7 (radioactive) materials.

(1) Where an "X" appears at the intersection of a Placard Group column and a Restriction row, the corresponding restriction applies.

(2) "Rail Car" means a car other than a tank car.

(3) For purposes of this subpart, each unit of an articulated intermodal rail car shall

be considered as one car.

[Amdt. 174-68, 55 FR 52680, Dec. 21, 1990, as amended at 57 FR 45464, Oct. 1, 1992; Amdt. 174-83, 61 FR 28678, June 5, 1996; Amdt.174-83, 61 FR 50255, Sept. 25, 1996; Amdt. 174-83, 61 FR 51339, Oct. 1, 1996; 64 FR 51919, Sept. 27, 1999]

§174.86 Maximum allowable operating speed.

For molten metals and molten glass shipped in packagings other than those prescribed in §173.247 of this subchapter, the maximum allowable operating speed may not exceed 15 mph for shipments by rail.

[Amdt. 174-69, 56 FR 49990, Oct. 2, 1991]

Subpart E - Class I (Explosive) Materials

§174.101 Loading Class 1 (explosive) materials.

(a) Boxes containing Division 1.1 or 1.2 (Class A explosive) materials must be loaded so that the ends of wooden boxes will not bear against sides of any fiberboard boxes and so that the ends of any box will not cause a pressure point on a small area of another box.

(b) Explosive bombs, unfuzed projectiles, rocket ammunition and rocket motors, Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) materials, which are not packed in wooden boxes, or large metal packages of incendiary bombs, each weighing 226 kg (500 pounds) or more, may be loaded in stock cars or in flat bottom gondola cars only if they are adequately braced. Boxed bombs, rocket ammunition and rocket motors, Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) materials, which due to their size cannot be loaded in closed cars, may be loaded in open-top cars or on flatcars, provided they are protected from the weather and accidental ignition.

(c) Boxes of Division 1.1 or 1.2 (Class A explosive) materials packed in long cartridges, bags, or sift-proof liners, and containing no liquid explosive ingredient, may be loaded on their sides or ends.

(d) Division 1.1 or 1.2 (Class A explosive) materials may not be loaded higher than any permanent car lining unless additional lining is provided as high as the lading.

(e) When the lading of a car includes any Class 1 (explosive) materials, the weight of the lading must be distributed insofar as possible to equalize the weight on each side of the car and over the trucks.

(f) Except when boxed, metal kegs containing Class 1 (explosive) materials must be loaded on their sides with their ends toward the ends of the car. Packages of Class 1 (explosive) materials may not be placed in the space opposite the doors unless the doorways are boarded on the inside as high as the lading. This paragraph does not apply to palletized packages if they are braced so they cannot fall or slide into the doorways during transportation.

(g) Wooden kegs, fiber kegs, barrels, and drums must be loaded on their sides or ends, to best suit the conditions.

(h) Packages containing any Division 1.1 or 1.2 (Class A explosive) materials for (see §174.104), detonators, detonator assemblies, or boosters with detonators must be securely blocked and braced to prevent the packages from changing position, falling to the floor, or sliding into each other, under conditions normally incident to transportation. Class 1 (explosive) materials must be loaded so as to avoid transfer at stations. For recommended methods of blocking and bracing, see Bureau of Explosives Pamphlets No. 6 and 6A. Heavy packages or containers must be trucked, rolled, or moved by skids, fork trucks, or other handling devices and may not be dropped from trucks, platforms, or cars. Planks for rolling trucks from platforms to cars must have beveled ends. Loading platforms and the shoes of each workman must be free from grit. All possible precautions must be taken against fire. Class 1 (explosive) materials must be kept in a safe place and inaccessible to unauthorized persons while being held by a carrier for loading or delivery.

(i) To prevent delays of local freight trains, when there are shipments of Class 1 (explosive) materials for different destinations loaded in a "peddler car" or "way car" the shipment for each destination must be stayed separately.

(j) Forwarding and transfer stations for Class 1 (explosive) materials must be provided with the necessary materials for staying.

(k) Shippers must furnish the material for staying packages of Class 1 (explosive) materials loaded by them.

(l) Division 1.1 or 1.2 (Class A explosive) materials may not be loaded, transported, or stored in a rail car equipped with any type of lighted heater or open-flame device, or electric devices having exposed heating coils, or in a rail car equipped with any apparatus or mechanism utilizing an internal combustion engine in its operation.

(m) [Reserved]

(n) A container car or freight container on a flatcar or a gondola car other than a drop-bottom car, when properly loaded, blocked, and braced to prevent change of position under conditions normally incident to transportation, may be used to transport any Division 1.1 or 1.2 (Class A explosive) material except black powder packed in metal containers. A freight container must be designed, constructed, and maintained so as to be weather tight and capable of preventing the entrance of sparks. In addition:

(1) A freight container must be of such design and so braced as to show no evidence of failure of the container or the bracing when subjected to impact from each end of at least 13 km (8.1 miles) per hour. Its efficiency shall be determined by actual test, using dummy loads equal in weight and general character to material to be shipped.

(2) A container car or car which is loaded with freight containers must be placarded with the Class 1 (explosive) materials placards as required by subpart F of part 172 of

this subchapter and with properly executed car certificates as required by §174.104.

(3) Lading must be so loaded, blocked, and braced within the freight container that it will not change position under impact from each end of at least 13 km (8.1 miles) per hour.

(o) Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) materials may be loaded and transported in a tight closed truck body or trailer on a flatcar. Wooden boxed bombs, rocket ammunition, and rocket motors, Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) materials, which due to their size cannot be loaded in tight, closed truck bodies or trailers, may be loaded in or on open-top truck bodies or trailers. However, they must be protected against accidental ignition. In addition:

(1) Each truck body or trailer must meet the requirements of part 177 of this subchapter, applicable to shipments of Class 1 (explosive) materials by motor vehicle.

(2) Each truck body or trailer must be so secured on the rail car so that it will not permanently change position or show evidence of failure or impending failure of the method of securing the truck body or trailer under impact from each end of at least 13 km (8.1 miles) per hour. Its efficiency shall be determined by actual test, using dummy loads equal in weight and general character to the material to be shipped. For recommended methods of blocking and bracing, see Bureau of Explosives Pamphlet 6C.

(3) Lading must be so loaded, blocked, and braced within or on the truck body or trailer that it will not change position under impact from each end of at least 13 km (8.1 miles) per hour. For recommended methods of blocking and bracing see Bureau of Explosives Pamphlet 6C.

(4) Each rail car containing Class 1 (explosive) materials and each rail car loaded with truck bodies, trailers or containers containing Class 1 (explosive) materials must be placarded with Class 1 (explosive) materials placards as required by subpart F of part 172 of this subchapter and with properly executed car certificates as required by §174.104.

(5) Each fuel tank of a heater or refrigerating machinery on the truck bodies or trailers must be drained and all automatic heating or refrigerating machinery must be made inoperative by disconnection of the automatic controls or the source of power for their operations.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-26B, 41 FR 57071, Dec. 30, 1976; Amdt. 174-36, 44 FR 70732, Dec. 10, 1979; Amdt. 174-59, 51 FR 5974, Feb. 18, 1986; Amdt. 174-68, 55 FR 52681, Dec. 21, 1990; Amdt. 174-83, 61 FR 51339, Oct. 1, 1996]

§174.102 Forbidden mixed loading and storage.

(a) Division 1.1 or 1.2 (Class A explosive) materials and initiating or priming explosives may not be transported together in the same rail car. Additionally, they may not be transported or loaded in the same rail car or stored on carrier property with charged electric storage batteries or with any hazardous material for which a NONFLAMMABLE GAS, FLAMMABLE GAS, FLAMMABLE LIQUID, FLAMMABLE SOLID, OXIDIZER, ORGANIC PEROXIDE, RADIOACTIVE or CORROSIVE label is required.

(b) Class 1 (explosive) materials may not be loaded together or with other hazardous materials, except as provided in §174.81. See §174.104 for loading shipments of Class 1 (explosive) materials or any other material in a placarded and certified car containing a shipment of Division 1.1 or 1.2 (Class A explosive) materials.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52681, Dec. 21, 1990]

§174.103 Disposition of damaged or astray shipments.

(a) Packages of Class 1 (explosive) materials found damaged or broken in transit may be repaired when practicable and not dangerous. A broken box of Division 1.1 or 1.2 (Class A explosive) materials that cannot be repaired must be reinforced by stout wrapping paper and twine, placed in another strong box and surrounded by dry, fine sawdust or dry and clean cotton waste or elastic wads made from dry newspapers. A ruptured can or keg must be sealed and enclosed in a strong cloth bag of good quality and boxed. Damaged packages thus protected and properly marked may be forwarded. The box and waybill must be marked to indicate that it has been repacked.

(b) Care must be exercised in repacking damaged containers so that no spark is produced by contact of metal or other hard surfaces which could ignite loose particles of explosive compositions that may be strewn on car floors or freight. In addition, the car floors must be thoroughly swept, and washed with a plentiful supply of water. Iron-wheel trucks, metal hammers, or other metal tools that may produce sparks may not be used. Metal tools must be limited to those made of brass, bronze, or copper.

(c) Each package of Class 1 (explosive) materials showing evidence of leakage of liquid ingredients must:

(1) Be refused if leakage is discovered before acceptance;

(2) Be disposed of to a person who is competent and willing to remove them from the carrier's property, if the leakage is discovered while the shipment is in transit; or

(3) Be removed immediately by consignee, if the leakage is discovered at the shipment's destination.

(d) When the disposition required by paragraph (c) of this section cannot be made, the leaking package must be packed in other boxes large enough to permit enclosure and the leaking boxes must be surrounded by at least 5 cm (2 inches) of dry, fine sawdust or dry and clean cotton waste, and be stored in a station magazine or other safe place until the arrival of an inspector of the Bureau of Explosives, or other authorized person, to superintend the destruction or disposition of the condemned material.

(e) If careful inspection shows that an astray shipment of Class 1 (explosive) materials is in proper condition for safe transportation, it must be forwarded immediately to its destination if known, or returned to the shipper by the most practicable route.

(f) When a package in an astray shipment is not in proper condition for safe transportation (see paragraphs (a), (c), and (d) of this section), or when the name and address of the consignee and the shipper are unknown, disposition must be made as prescribed by paragraphs (c) and (d) of this section.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52681, Dec. 21, 1990]

§174.104 Division 1.1 or 1.2 (Class A explosive) materials; car selection, preparation, inspection, and certification.

(a) Except as provided in §174.101 (b), (n), and (o), Division 1.1 or 1.2 (Class A explosive) materials being transported by rail may be transported only in a certified and properly placarded closed car of not less than 36,300 kg (80,028 pounds) capacity, with steel underframes and friction draft gear or cushioned underframe, except that on a narrow-gauge railroad they may be transported in a car of less capacity as long as the car of greatest capacity and strength available is used.

(b) Each rail car used for transporting Division 1.1 or 1.2 (Class A explosive) materials must meet the following requirements as applicable:

(1) The car must be equipped with air brakes, hand brakes, and roller bearings which are in condition for service.

(2) The car may not have any holes or cracks in the roof, sides, ends, or doors through which sparks may enter, or unprotected decayed spots which may hold sparks and start a fire.

(3) The roof of the car must be carefully inspected from the outside for decayed spots, especially under or near the running board, and such spots must be covered or repaired to prevent their holding fire from sparks. A car with a roof generally decayed, even if tight, may not be used.

(4) The doors must close tightly so that sparks cannot get in at the joints, and, if necessary to achieve this degree of tightness, the doors must be stripped. The stripping should be placed on the inside and fastened to the door frames where it will form a shoulder against which the closed doors are pressed by means of wedges or cleats in door shoes or keepers. The openings under the doors should be similarly closed. The hasp fastenings must be examined with the doors closed and fastened, and the doors must be cleated when necessary to prevent them from shifting. When the car is opened for any reason, the wedges or cleats must be replaced before car containing Class 1 (explosive) materials is permitted to proceed.

(5) The roller bearings and the trucks must be carefully examined and put in such condition as to reduce to a minimum the danger of hotboxes or other failure necessitating the setting out of the car before reaching its destination.

(6) The car must be carefully swept out before it is loaded. For less-than-carload

shipments the space in which the packages are to be loaded must be carefully swept. If evidence of a potential hazardous residue is apparent after the floor has been swept, the carrier must either decontaminate the car or provide a suitable substitute car.

(7) Any holes in the floor or lining must be repaired and special care taken that there are no projecting nails or bolts or exposed pieces of metal which may work loose or produce holes in packages of Class 1 (explosive) materials during transit. Protruding nails in the floor or lining which have worked loose must be drawn, and if necessary for the purpose of fastening the floor or lining, new nails must be driven through other parts thereof.

(8) Metal floor plates must be completely covered with wood, plywood, or fiber or composition sheets of adequate thickness and strength to prevent contact of the floor plates with the packages of Class 1 (explosive) materials under conditions incident to transportation, except that the covering of metal floor plates is not necessary for carload shipments loaded by the Department of Defense provided the Class 1 (explosive) materials are of such nature that they are not liable to leakage of dust, powder, or vapor which might become the cause of an explosion.

(9) If the car is equipped with automobile loading devices, it may not be used unless the loading device is securely attached to the roof of the car with fastenings supplementing those already provided and so fixed that it cannot fall.

(10) The car must be equipped with high-friction composition brake shoes (except metal deck flat cars used for COFC/TOFC service may be equipped with high phosphorus cast iron brakeshoes) and brake rigging designed for this type of brake shoe. Each brake shoe on the car must be at least 1 cm (0.4 inch) thick, and in safe and suitable condition for service.

(11) The car must have either a metal subfloor with no combustible material exposed beneath the car, or metal spark shields extending from center sill to side sills and from end sills to at least 30 cm (12 inches) beyond the extreme treads of the inside wheels of each truck, which are tightly fitted against the subfloor so that there is no vacant space or combustible material exposed. The metal subfloor or spark shields may not have an accumulation of oil, grease, or other debris which could support combustion.

(c) Before Division 1.1 or 1.2 (Class A explosive) materials may be loaded into a rail car, the car must have been inspected and certified to be in compliance with the requirements of paragraph (b) of this section by a qualified person designated under §215.11 of this title. The certification shall be made in Car Certificate No. 1 on the form prescribed in paragraph (f) of this section.

(d) If the carrier furnishes the car to a shipper for loading Division 1.1 or 1.2 (Class A explosive) materials, the shipper or his authorized employee shall, before commencing the loading of the car, inspect the interior thereof, and after loading certify to the proper condition of the car and the loading. This certification shall be made on the first signature line in Car Certificate No. 2 on the form prescribed in paragraph (f) of this section. In addition, the finished load must be inspected and certified to be in compliance with the requirements of this part by a qualified person designated under §215.11 of this title before the car goes forward. This certification shall be made on the second signature line in Car Certificate No. 2 on the form prescribed in paragraph (f) of this section. If the loading is performed by the carrier, Car Certificate No. 2 may only be signed by a qualified person designated under §215.11 of this title.

(e) If a trailer or container containing Division 1.1 or 1.2 (Class A explosive) materials is loaded on a flatcar, the loading and securing of the load on the car must be supervised by a representative of the shipper or carrier. The certification shall be made in Car Certificate No. 3 on the form prescribed in paragraph (f) of this section.

(f) Each car certificate for use in connection with the inspection of rail cars for the carriage of Division 1.1 or 1.2 (Class A explosive) materials shall be printed on strong tag board measuring 18 by 18 cm (7.1 by 7.1 inches) or 15 by 20 cm (5.9 by 7.9 inches). It must be duly executed in triplicate by the carrier, and by the shipper if he loads the shipments. The original must be filed by the carrier at the forwarding station in a separate file and the other two must be attached to the car, one to each outer side on a fixed placard board or as otherwise provided.

________________Railroad

CAR CERTIFICATE

____

19_.

I hereby certify that I have this day personally examined Car Number ___ and that the car is in condition for service and complies with the FRA Freight Car Safety Standards (49 CFR part 215) and with the requirements for freight cars used to transport explosives prescribed by the DOT Hazardous Materials Regulation (49 CFR part 174).

Qualified Person Designated Under
49 CFR 215.11

____

19_.

I have this day personally examined the above car and hereby certify that the explosives in or on this car, or in or on vehicles or in containers have been loaded and braced; that placards have been applied, according to the regulations prescribed by the Department of Transportation; and that the doors of cars so equipped fit or have been stripped so that sparks cannot enter.

Shipper or his authorized agent

Qualified Person Designated Under
49 CFR 215.11

____

19_.

I hereby certify that I have this day personally supervised the loading of the vehicles or containers on and their securement to the above car.

Shipper or railway employee inspecting
loading and securement

Note 1: A shipper must decline to use a car not in proper condition.
Note 2: All certificates, where applicable, must be signed.
Note 3: Car certificates remaining on hand as of the effective date of these regulations may be used until stocks are exhausted but not after July 1, 1977.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §174.104, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§174.105 Routing shipments, Division 1.1 or 1.2 (Class A explosive) materials.
Before a shipment of Division 1.1 or 1.2 (Class A explosive) materials destined to a point beyond the lines of the initial carrier is accepted from the shipper, the initial carrier shall ascertain that the shipment can go forward by the route designated. To avoid delays en route, the initial carrier must be in possession of full rate information before forwarding the shipment.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.106 "Order-Notify" or "C.O.D." shipments, Division 1.1 or 1.2 (Class A explosive) materials.
(a) A carrier may not accept for transportation Division 1.1 or 1.2 (Class A explosive) materials, detonators, or detonating primers in any quantity when consigned to "order-notify" or "C.O.D.", except on a through bill of lading to a place outside the United States.
(b) A carrier may not accept for transportation Division 1.1 or 1.2 (Class A explosive) materials, detonators, or detonating primers which the shipper consigns to himself unless the shipper has a resident representative to receive them at the delivery point.
(c) A carrier may not accept Division 1.1 or 1.2 (Class A explosive) materials for transportation subject to "stop-off privileges en route for partial loading or unloading."

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-36, 44 FR 70732, Dec. 10, 1979; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.110 Car magazine.

When specially authorized by the carrier, Division 1.1 or 1.2 (Class A explosive) materials in quantity not exceeding 68 kg (150 pounds) may be carried in construction or repair cars if the packages of Class 1 (explosive) materials are placed in a "magazine" box made of sound lumber not less than 2.5 cm (0.98 inch) thick, covered on the exterior with metal, and provided with strong handles. The box must be plainly stenciled on the top, sides, and ends, in letters not less than 5 cm (2 inches) high, "EXPLOSIVES-DANGEROUS-HANDLE CAREFULLY". The box must be provided with strong hinges and with a lock for keeping it securely closed. Vacant space in the box must be filled with a cushioning material such as sawdust or excelsior, and the box must be properly stayed to prevent movement within the car. The car must be placarded with EXPLOSIVES 1.1 or 1.2 (EXPLOSIVES A) placards when the magazine contains Division 1.1 or 1.2 (Class A explosive) materials.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.112 Loading Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials (Also see _3174.101).

(a) Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials may not be loaded, transported or stored in a rail car equipped with any type of lighted heater or open-flame device, or in a rail car equipped with any apparatus or mechanism utilizing an internal combustion engine in its operation.

(b) Except as provided in §174.101(b), (n), or (o) Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials must be transported in a closed car or container car which is in good condition, and into which sparks cannot enter. The car does not require the car certificates prescribed in §174.104(c) through (f). If the doors are not tight, they must be stripped to prevent the entrance of sparks. Wood floored cars must be equipped with spark shields (see §174.104). Packages of Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials must be blocked and braced to prevent their movement and possible damage due to movement of other freight during transportation. For recommended methods of blocking and bracing see Bureau of Explosives Pamphlet No. 6.

(c) Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials may not be transported in a truck body, trailer, or container on a flatcar unless:

(1) The truck body, trailer, or container is closed and tight;

(2) All automatic heating or refrigerating machinery with which the truck body, trailer, or container is equipped is inoperative; and

(3) Packages of Division 1.3 (Class B explosive) materials and Division 1.2 (devices corresponding to Class B explosive) materials are blocked and braced within the truck

body, trailer, or container to prevent their movement and possible damage due to movement of other freight during transportation (ends, sidewalls, or doors of the truck body, trailer, or container may not be relied on to prevent the shifting of heavy loads). For recommended methods of blocking and bracing see Bureau of Explosives Pamphlet No. 6C. See §174.101(o).

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26B, 41 FR 57072, Dec. 30, 1976; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990; Amdt. 174-83, 61 FR 51339, Oct. 1, 1996]

§174.114 Record to be made of change of seals on "Cars loaded with Division 1.1 or 1.2 (explosive) materials".

When a car seal is changed on a car requiring "EXPLOSIVES 1.1 or EXPLOSIVES 1.2 (EXPLOSIVES A) placards" while en route or before delivery to a consignee, a record of the change showing the following information must be made on or attached to the waybill or other form of memorandum which must accompany the car to its destination:

Railroad Place Date

Car Initials Car Number Number or description of seal broken

____

____

____

____

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.115 Loading Division 1.4 (Class C explosive) materials.

(a) Division 1.4 (Class C explosive) materials may be loaded into any closed car in good condition, or into any container car in good condition. Car certificates are not required. Packages of Division 1.4 (Class C explosive) materials must be blocked and braced to prevent their movement and possible damage due to movement of other freight during transportation. For methods of recommended loading and bracing see

Bureau of Explosives Pamphlet No. 6.

(b) Division 1.4 (Class C explosive) materials may not be transported in a truck body, trailer, or container on a flatcar unless:

(1) The truck body, trailer, or container is closed and tight;

(2) All automatic heating or refrigerating machinery with which the truck body, trailer, or container is equipped is inoperative; and

(3) Packages of Division 1.4 (Class C explosive) materials are blocked and braced within the truck body, trailer, or container to prevent their movement and possible damage due to movement of other freight during transportation. Ends, side walls, or doors of the truck body, trailer, or container may not be relied on to prevent shifting of heavy loads. For recommended methods of blocking and bracing see Bureau of Explosives Pamphlet No. 6C.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-36, 44 FR 70732, Dec. 10, 1979; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

Subpart F - Detailed Requirements for Class 2 (Gases) Materials

§174.200 Special handling requirements.

(a) Division 2.1 (flammable gas) materials may not be loaded, transported, or stored in a rail car equipped with any type of lighted heater or open-flame device, or in a rail car equipped with any apparatus or mechanism utilizing an internal combustion engine in its operation.

(b) Division 2.1 (flammable gas) materials may not be loaded in a truck body or trailer equipped with any type of lighted heater or any automatic heating or refrigerating apparatus when such truck bodies or trailers are loaded on flatcars except as provided in paragraph (c) of this section.

(c) Heating or refrigeration apparatus may be operated on a motor vehicle loaded on a flatcar when the motor vehicle is loaded with Division 2.1 (flammable gas) materials only if:

(1) The lading space is not equipped with any electrical apparatus that is not non-sparking or explosion-proof;

(2) There is no combustion apparatus in the lading space;

(3) There is no connection for the return of air from the lading space to any combustion apparatus; and

(4) The heating system conforms to §393.77 of this title and does not heat any part of the lading over 54 ^{o}C (129 ^{o}F).

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR

52682, Dec. 21, 1990; 56 FR 66281, Dec. 20, 1991]

§174.201 Class 2 (gases) material cylinders.

(a) Except as provided in paragraphs (b) and (c) of this section, cylinders containing Class 2 (gases) materials being transported in a rail car must be:

(1) Securely lashed in an upright position so as to prevent their overturning;

(2) Loaded into racks securely attached to the car;

(3) Packed in boxes or crates of such dimensions as to prevent their overturning; or

(4) Loaded in a horizontal position.

(b) Specification DOT-4L (§178.57 of this subchapter) cylinders being transported in a rail car must be loaded in an upright position and be securely braced.

(c) Cylinders containing Class 2 (gases) materials may be transported in stock cars, gondola cars and flat cars. However, they may not be transported in hopper bottom cars.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-32, 43 FR 48644, Oct. 19, 1978; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.204 Tank car delivery of gases, including cryogenic liquids.

(a) A tank car containing Class 2 (gases) material may not be unloaded unless it is consigned for delivery and unloaded on a private track (see §171.8 of this subchapter). However, if a private track is not available, it may be delivered and unloaded on carrier tracks subject to the following conditions:

(1) A tank car of DOT-106A or 110A type (§179.300 or §179.301 of this subchapter) may not be delivered and the loaded unit tanks may not be removed from the car frame on carrier tracks. However, a carrier may give permission for the unloading of these containers on carrier tracks only if a private siding is not available within a reasonable trucking distance of the final destination. In addition, before the car is accepted for transportation, the shipper must obtain from the delivering carrier and file with the originating carrier, written permission for the removal and the consignee must furnish an adequately strong mechanical hoist by which the tanks can be lifted from the car and deposited directly upon vehicles furnished by the consignee for immediate removal from carrier property.

(2) The following tank cars may not be delivered and unloaded on carrier tracks unless the lading is piped directly from the car to permanent storage tanks of sufficient capacity to receive the entire contents of the car; however, such cars may be stored on a private track (see §171.8 of this subchapter) or on carrier tracks designated by the carrier for such storage:

(i) A tank car containing Division 2.1 (flammable gas) material that is a cryogenic liquid; or

(ii) A tank car, except for a DOT-106A or 110A multi-unit tank car tank (§179.300 or §179.301 of this subchapter), containing anhydrous ammonia; hydrogen chloride, refrigerated liquid; hydrocarbon gas, liquefied; or liquefied petroleum gas; and having interior pipes for liquid and gas discharge valves equipped with check valves.

(b) [Reserved]

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-26A, 41 FR 40685, Sept. 20, 1976; Amdt. 174-32, 43 FR 48644, Oct. 19, 1978; Amdt. 174-43, 48 FR 27699, June 16, 1983; 48 FR 50440, 50441, Nov. 1, 1983; Amdt. 174-68, 55 FR 52682, Dec. 21, 1990]

§174.290 Materials extremely poisonous by inhalation shipped by, for, or to the Department of Defense.

(a) General. The provisions of this section apply only to materials extremely poisonous by inhalation which are Division 2.3 materials in Hazard Zone A and Division 6.1 materials in Hazard Zone A, as defined in §173.133(a)(2) of this subchapter. Such materials when shipped by, for, or to the Department of Defense may be transported by rail only if loaded and handled in accordance with the requirements of this section.

(b) A Division 2.3 Hazard Zone A or a Division 6.1 Hazard Zone A material extremely poisonous by inhalation may be transported in:

(1) UN 1N1 or UN 1N2 metal drums or equivalent military specification metal drums, by boxcar, gondola car (flat bottom), or stock car in carload lots. See §174.55(a) (1) through (4) and §174.600 for blocking, bracing, and stowage requirements;

(2) Tanks which are authorized under this subchapter for a Hazard Zone A material extremely poisonous by inhalation, Specification DOT 106A (§§179.300 and 179.301 of this subchapter), mounted on or secured to a multi-unit car or gondola car (flat bottom) in carload lots only;

(3) Bombs, by boxcar, or gondola car (flat bottom) in carload lots only; or

(4) Projectiles or ammunition for cannon with gas filled projectiles, by boxcar in carload or less-than-carload lots.

(c) Each shipment of one or more carloads of a material extremely poisonous by inhalation, as described in paragraph (b) of this section, must be accompanied by a Department of Defense qualified escort supplied with equipment to handle leaks and other packaging failures which could result in escape of the material. The escort shall remain with the shipment during the entire time that it is in the custody of the carrier and in the event of leakage or escape of material, shall make repairs and perform decontamination as necessary.

(d) When a material extremely poisonous by inhalation is transported in a tank, the tank must be securely mounted on a rail car especially provided for it or on a gondola car prepared with substantial wooden frames and blocks.

(e) Bombs, projectiles, and cannon ammunition being transported by rail must be loaded, blocked and braced as shown in Bureau of Explosives Pamphlet No. 6A, or Department of Defense specifications. When a shipment is loaded in a gondola car it must be securely blocked and braced and not loaded higher than the sides of the car.

(f) When a material extremely poisonous by inhalation is transported in drums with filling holes in the heads, they must be loaded on their bottoms. They may be loaded in rows, lengthwise of the car and any space between the sides of the car and the nearest row of drums must be "filled in" with wooden boards or lumber nailed to sides of the car sufficient in length and width to contact both hoops of drums, or they may be loaded across the car in staggered stacks of which the number of drums in alternate stacks is reduced by one drum. All drums in stacks following the first stack loaded in the end of the car must be placed tightly into the angle of the space formed by the sidewalls of the drum in the preceding stack. Any space between the sides of the car and the drums in stacks having the greater number of drums must be filled in with wooden boards or lumber nailed to sides of the car sufficient in length and width to contact both hoops of the drums.

(g) When a material extremely poisonous by inhalation is transported in drums with filling holes in the sides, they must be loaded on their sides with the filling holes up. They must be loaded lengthwise of the car in rows and any space between the sides of the car and the nearest row of drums must be filled in with wooden boards or lumber nailed to sides of the car sufficient in length and width to contact both hoops of the drums.

(h) When a material extremely poisonous by inhalation is transported in drums in a boxcar, they must be loaded from ends of the car toward the space between the car doors, and there braced by center gates and wedges. See Sketch 1, Bureau of Explosives Pamphlet No. 6.

(i) The doorways of a boxcar in which a material poisonous by inhalation is being transported must be protected by one of the methods prescribed in Sketch 1, Bureau of Explosives Pamphlet No. 6A.

[Amdt. 174-68, 55 FR 52683, Dec. 21, 1990; Amdt. 174-74, 58 FR 51533, Oct. 1, 1993]

Subpart G - Detailed Requirements for Class 3 (Flammable Liquid) Materials

§174.300 Special handling requirements.

(a) Class 3 (flammable liquid) materials may not be loaded, transported, or stored in a rail car equipped with any type of lighted heater or open-flame device, or in a rail car equipped with any apparatus or mechanism utilizing an internal combustion engine in its operation.

(b) A truck body or trailer which is loaded with a Class 3 (flammable liquid) materials and equipped with a lighted heater or any automatic heating or refrigerating apparatus may not be loaded on a flatcar except as provided in paragraph (c) of this section.

(c) Heating or refrigeration apparatus on a motor vehicle loaded with Class 3 (flammable liquid) materials may be operated while the motor vehicle is loaded on a flatcar only if:

(1) The lading space is not equipped with any electrical apparatus that is not non-sparking or explosion-proof;

(2) There is no combustion apparatus in the lading space;

(3) There is no connection for the return of air from the lading space to any combustion apparatus; and

(4) The heating system conforms to §393.77 of this title and does not heat any part of the lading over 54 ^{o}C (129 ^{o}F).

(d) Metal barrels or drums containing Class 3 (flammable liquid) materials may be transported in a steel gondola or flatcar or in a stock car. However, they may not be transported in a hopper bottom car.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-31, 43 FR 31143, July 20, 1978; Amdt. 174-68, 55 FR 52683, Dec. 21, 1990]

§174.304 Class 3 (flammable liquid) materials in tank cars.

A tank car containing a Class 3 (flammable liquid) material, other than liquid road asphalt or tar, may not be transported by rail unless it is originally consigned or subsequently reconsigned to a party having a private track on which it is to be delivered and unloaded (see §171.8 of this subchapter) or to a party using railroad siding facilities which are equipped for piping the liquid from the tank car to permanent storage tanks of sufficient capacity to receive the entire contents of the car.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-32, 43 FR 48644, Oct. 19, 1978; Amdt. 174-68, 55 FR 52683, Dec. 21, 1990]

Subpart H - [Reserved]

Subpart J - Detailed Requirements for Division 6.1 (Poisonous) Materials

§174.600 Special handling requirements for materials extremely poisonous by inhalation.

A tank car containing a material extremely poisonous by inhalation which is a Division 2.3 material in Hazard Zone A or a Division 6.1 material in Hazard Zone A, as defined in §173.133(a)(2) of this subchapter, may not be transported by rail unless it is originally consigned or subsequently reconsigned to a party having a private track on which it is to be delivered and unloaded (see §171.8 of this subchapter) or to a party using railroad siding facilities which are equipped for piping the liquid or gas from the tank car to permanent storage tanks or sufficient capacity to receive the entire contents of the car. See the requirements in §174.290 for materials extremely poisonous by inhalation which are shipped by, for, or to the Department of Defense.

[Amdt. 174-68, 55 FR 52684, Dec. 21, 1990]

§174.615 Cleaning cars.

(a) [Reserved]

(b) After Division 6.1 (poisonous) materials are unloaded from a rail car, that car must be thoroughly cleaned unless the car is used exclusively in the carriage of Division 6.1 (poisonous) materials.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-68, 55 FR 52684, Dec. 21, 1990; Amdt. 174-82, 61 FR 18933, Apr. 29, 1996]

§174.680 Division 6.1 (poisonous) materials with foodstuffs.

(a) Except as provided in paragraph (b) of this section, a carrier may not transport any package bearing a POISON or POISON INHALATION HAZARD label in the same car with any material marked as, or known to be, a foodstuff, feed or any other edible material intended for consumption by humans or animals.

(b) A carrier must separate any package bearing a POISON label displaying the text "PG III," or bearing a "PG III" mark adjacent to the POISON label, from materials marked as or known to be foodstuffs, feed or any other edible materials intended for consumption by humans or animals, as required in §174.81(e)(3) for classes identified with the letter "O" in the Segregation Table for Hazardous Materials.

[64 FR 10781, Mar. 5, 1999]

Subpart K - Detailed Requirements for Class 7 (Radioactive) Materials

§174.700 Special handling requirements for Class 7 (radioactive) materials.

(a) Each rail shipment of low specific activity materials or surface contaminated objects as defined in §173.403 of this subchapter must be loaded so as to avoid spillage and scattering of loose material. Loading restrictions are prescribed in §173.427 of this subchapter.

(b) The number of packages of Class 7 (radioactive) materials that may be transported by rail car or stored at any single location is limited to a total transport index number (as defined in §173.403 of this subchapter) of not more than 50. This provision does not apply to exclusive use shipments as described in §§173.403, 173.427, 173.441, and 173.457 of this subchapter.

(c) Each package of Class 7 (radioactive) material bearing RADIOACTIVE YELLOW-II or RADIOACTIVE YELLOW-III labels may not be placed closer than 0.9 meter (3 feet) to an area (or dividing partition between areas) which may be continuously occupied by any passenger, rail employee, or shipment of one or more animals, nor closer than 4.5 meters (15 feet) to any package containing undeveloped film (if so marked). If more than one package of Class 7 (radioactive) materials is present, the distance must be computed from the table below on the basis of the total transport index number (determined by adding together the transport index numbers on the labels of the individual packages) of packages in the rail car or storage area:

Total transport index	Minimum separation distance to nearest undeveloped film		Minimum distance to area of persons or minimum distance from dividing partition of a combination car	
-	Meters	Feet	Meters	Feet
None	0	0	0	0
0.1 to 10.0	4.5	15	0.9	3
10.1 to 20.0	6.7	22	1.2	4
20.1 to 30.0	7.7	29	1.5	5
30.1 to 40.0	10	33	1.8	6
40.1 to 50.0	10.9	36	2.1	7

Note: The distance in this table must be measured from the nearest point on the nearest packages of Class 7 (radioactive) materials.

(d) Each fissile material, controlled shipment must be transported in accordance with one of the methods prescribed in §173.457 of this subchapter. The transport controls must be adequate to assure that no fissile material, controlled shipment is transported in the same transport vehicle with any other fissile Class 7 (radioactive) material shipment. In loading and storage areas, each fissile material, controlled shipment must be segregated by a distance of at least 6 meters (20 feet) from other packages required to bear one of the "radioactive" labels described in part 172 of this subchapter.

(e) A person shall not remain unnecessarily in, on or near a transport vehicle containing Class 7 (radioactive) materials.

(f) In the case of packages shipped under the exclusive use provisions of §173.441(b) of this subchapter for packages with external radiation levels in excess of 2 mSv per hour (200 mrem per hour) at the package surface-

(1) The transport vehicle must meet the requirements for a closed transport vehicle (§173.403 of this subchapter);

(2) Each package must be secured so that its position within the transport vehicle remains fixed under conditions normally incident to transportation; and

(3) The radiation level may not exceed 0.02 mSv per hour (2 mrem per hour) in any normally occupied position in the transport vehicle or adjacent rail car.

[Amdt. 174-80, 60 FR 50331, Sept. 28, 1995, as amended by Amdt. 174-80, 61 FR 20753, May 8, 1996]

§174.715 Cleanliness of transport vehicles after use.

(a) Each transport vehicle used for transporting Class 7 (radioactive) materials as exclusive use, as defined in §173.403 of this subchapter, must be surveyed with appropriate radiation detection instruments after each use. A transport vehicle may not be returned to service until the radiation dose rate at any accessible surface is 0.005 mSv per hour (0.5 mrem per hour) or less, and there is no significant removable radioactive surface contamination, as defined in §173.443 of this subchapter.

(b) This section does not apply to any transport vehicle used solely for transporting Class 7 (radioactive) materials if a survey of the interior surface shows that the radiation dose rate does not exceed 0.1 mSv per hour (10 mrem per hour) at the interior surface or 0.02 mSv per hour (2 mrem per hour) at 1 meter (3.3 feet) from any interior surface. The transport vehicle must be stenciled with the words "FOR RADIOACTIVE MATERIALS USE ONLY" in lettering at least 7.6 centimeters (3 inches) high in a conspicuous place on both sides of the exterior of the transport vehicle, and it must be kept closed at all times other than during loading and unloading.

[Amdt. 174-80, 60 FR 50332, Sept. 28, 1995]

§174.750 Incidents involving leakage.

(a) In addition to the incident reporting requirements of §§171.15 and 171.16 of this subchapter, the carrier shall also notify the offeror at the earliest practicable moment following any incident in which there has been breakage, spillage, or suspected radioactive contamination involving Class 7 (radioactive) materials shipments. Transport vehicles, buildings, areas, or equipment in which Class 7 (radioactive) materials have been spilled may not be again placed in service or routinely occupied until the radiation dose rate at every accessible surface is less than 0.005 mSv per hour (0.5 mrem per hour) and there is no significant removable radioactive surface contamination (see §173.443 of this subchapter).

(b) The package or materials should be segregated as far as practicable from personnel contact. If radiological advice or assistance is needed, the U.S. Department of Energy (DOE) should also be notified. In case of obvious leakage, or if it appears likely that the inside container may have been damaged, care should be taken to avoid inhalation, ingestion, or contact with the Class 7 (radioactive) material. Any loose Class 7 (radioactive) materials should be left in a segregated area and held pending disposal instructions, from qualified persons.

[Amdt. 174-26, 41 FR 16092, Apr. 15, 1976, as amended by Amdt. 174-42, 48 FR 10245, Mar. 10, 1983; Amdt. 174-61, 51 FR 34987, Oct. 1, 1986; Amdt. 174-65, 53 FR 38274, Sept. 29, 1988; Amdt. 174-68, 55 FR 52684, Dec. 21, 1990; Amdt. 174-80, 60 FR 50332, Sept. 28, 1995]

Pt. 175

[CFR] PART 175 - CARRIAGE BY AIRCRAFT

[TITLE 49] [SUBTITLE B] [PART 175]

Subpart A-General Information and Regulations

Sec.

Subpart B-Loading, Unloading and Handling

Subpart C-Specific Regulations Applicable According to Classification of Material

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Source: Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, unless otherwise noted.

Subpart A - General Information and Regulations

§175.1 Purpose and scope.

This part prescribes requirements, in addition to those contained in parts 171, 172 and 173 of this subchapter, applicable to aircraft operators transporting hazardous materials aboard (including attached to or suspended from) aircraft.

[Amdt. 175-15, 45 FR 35332, May 27, 1980]

§175.3 Unacceptable hazardous materials shipments.

Hazardous materials that are not prepared for shipment in accordance with this subchapter may not be accepted for transportation or transported aboard an aircraft.

[Amdt. 175-25, 47 FR 54822, Dec. 6, 1982]

§175.5 Applicability.

(a) This part applies to the acceptance for transportation, loading and transportation of hazardous materials in any aircraft in the United States and in aircraft of United States registry anywhere in air commerce. This part does not apply to:

(1) Aircraft owned and operated by a government when not engaged in carrying persons or property for commercial purposes;

(2) Aircraft which are not owned by a government nor engaged in carrying persons or property for commercial purposes but which are under the exclusive direction and control of a government for a period of not less than 90 days as specified in a written contract or lease. An aircraft is under the exclusive direction and control of a government when the government exercises responsibility for:

(i) Approving crew members and determining that they are qualified to operate the aircraft;

(ii) Determining the airworthiness and directing maintenance of the aircraft; and

(iii) Dispatching the aircraft, including the times of departure, airports to be used, and type and amount of cargo to be carried;

(3) Aircraft of United States registry under lease to and operated by foreign nationals outside the United States if:

(i) Hazardous materials forbidden aboard aircraft by §172.101 of this subchapter are not carried on the aircraft; and

(ii) Other hazardous materials are carried in accordance with the regulations of the State (nation) of the aircraft operator.

[Amdt. 175-15, 45 FR 35332, May 27, 1980]

§175.10 Exceptions.

(a) This subchapter does not apply to:

(1) Aviation fuel and oil in tanks that are in compliance with the installation provisions of 14 CFR, chapter 1.

(2) Hazardous materials required aboard an aircraft in accordance with the applicable airworthiness requirements and operating regulations. Unless otherwise approved by

the Associate Administrator for Hazardous Materials Safety, items of replacement for such hazardous materials must be transported in accordance with this subchapter except that-

(i) In place of the required packagings, packagings specially designed for the transport of aircraft spares and supplies may be used, provided such packagings provide at least an equivalent level of protection to those that would be required by this subchapter;

(ii) Aircraft batteries are not subject to quantity limitations such as those provided in §172.101 or §175.75(a) of this subchapter; and,

(iii) A tire assembly with a serviceable tire is not subject to the provisions of this subchapter provided the tire is not inflated to a gauge pressure exceeding the maximum rated pressure for that tire.

(3) Hazardous materials loaded and carried in hoppers or tanks of aircraft certificated for use in aerial seeding, dusting, spraying, fertilizing, crop improvement, or pest control, to be dispensed during such an operation.

(4) The following hazardous materials when carried by a passenger or crew member for personal use in conformance with the following conditions:

(i) Non-radioactive medicinal and toilet articles (including aerosols) may be carried in checked or carry-on baggage;

(ii) One self-defense spray (see §171.8 of this subchapter), not exceeding 118 ml (4 fluid ounces) by volume, that incorporates a positive means to prevent accidental discharge may be carried in checked baggage only;

(iii) Other aerosols in Division 2.2 with no subsidiary risk may be carried in checked baggage only; and

(iv) The aggregate quantity of hazardous materials carried by the person may not exceed 2 kg (70 ounces) by mass or 2 liters (68 fluid ounces) by volume and the capacity of each container may not exceed 0.5 kg (18 ounces) by mass or 470 ml (16 fluid ounces) by volume.

(5) Small-arms ammunition for personal use carried by a crewmember or passenger in his baggage (excluding carry-on baggage) if securely packed in fiber, wood or metal boxes, or other packagings specifically designed to carry small amounts of ammunition. This paragraph does not apply to persons traveling under the provisions of 14 CFR 108.11 (a) and (b).

(6) [Reserved]

(7) Oxygen, or any hazardous material used for the generation of oxygen, for medical use by a passenger, which is furnished by the aircraft operator in accordance with 14 CFR 121.574 or 135.91. For purposes of this paragraph, an aircraft operator that is not a certificate holder under 14 CFR part 121 or part 135, may apply this exception in conformance with 14 CFR 121.574 or 135.91 in the same manner as required for a certificate holder.

(8) Human beings and animals with an implanted medical device, such as a heart pacemaker, that contains Class 7 (radioactive) materials or with radio-pharmaceuticals that have been injected or ingested.

(9) Smoke grenades, flares, or similar devices carried only for use during a sport

parachute jumping activity.

(10) Personal smoking materials intended for use by any individual when carried on his person except lighters with flammable liquid reservoirs and containers containing lighter fluid for use in refilling lighters.

(11) Smoke grenades, flares, and pyrotechnic devices affixed to aircraft carrying no person other than a required flight crewmember during any flight conducted at and as a part of a scheduled air show or exhibition of aeronautical skill. The affixed installation accommodating the smoke grenades, flares, or pyrotechnic devices on the aircraft must be approved by the FAA for its intended use.

(12) Hazardous materials which are loaded and carried on or in cargo aircraft only, and which are to be dispensed or expended during flight for weather control, enviromental restoration or protection, forest preservation and protection, flood control, avalanche control purposes, or routine quality control testing of special fireworks manufactured for the Department of Defense, when the following requirements are met:

(i) Operations may not be conducted over densely populated areas, in a congested airway, or near any airport where air carrier passenger operations are conducted.

(ii) Each operator shall prepare and keep current a manual containing operational guidelines and handling procedures, for the use and guidance of flight, maintenance, and ground personnel concerned in the dispensing or expending of hazardous materials. The manual must be approved by the FAA Civil Aviation Security Office responsible for the operator's overall aviation security program or the FAA Civil Aviation Security Office in the region where the operator is located. The manual must be approved by the FAA Civil Aviation Security Field Office responsible for reviewing the operator's hazardous materials program or the FAA Civil Aviation Security Field Office in the region where the operator is located. Each operation must be conducted in accordance with the manual.

(iii) No person other than a required flight crewmember, FAA inspector, or person necessary for handling or dispensing the hazardous material may be carried on the aircraft.

(iv) The operator of the aircraft must have advance permission from the owner of any airport to be used for the dispensing or expending operation.

(v) When dynamite and blasting caps are carried for avalanche control flights, the explosives must be handled by, and at all times be under the control of, a qualified blaster. When required by State or local authority, the blaster must be licensed and the State or local authority must be identified in writing to the FAA Civil Aviation Security Field Office responsible for reviewing the operator's hazardous materials program or the FAA Civil Aviation Security Field Office in the region where the operator is located.

(vi) When special fireworks aerial illuminating flares, manufactured specifically for the DOD, are carried for in-flight routine quality control testing, the fireworks must be handled by, and at all times be under the control of, a qualified person who has been trained in accordance with a program approved by the local FAA Civil Aviation Security Field Office. The aircraft must be specially modified to conduct the testing operation and must be specifically approved for such operations by the local FAA Civil Aviation Security Field Office before the flight.

(13) Carbon dioxide, solid (dry ice) when:
(i) In quantities not exceeding 2.3 kg (5.07 pounds) per package packed as prescribed by §173.217 of this subchapter and used as a refrigerant for the contents of the package. The package must be marked with the name of the contents being cooled, the net weight of the dry ice or an indication that the net weight is 2.3 kg (5.07 pounds) or less, and also marked "Carbon Dioxide, Solid" or "Dry Ice";
(ii) Intended for use in food and beverage service aboard aircraft; or
(iii) In quantities not exceeding 2 kg (4.4 pounds) per passenger when used to pack perishables in carry-on baggage provided the package permits the release of carbon dioxide gas.
(14) A transport incubator unit necessary to protect life or an organ preservation unit necessary to protect human organs provided:
(i) The compressed gas used to operate the unit is in an authorized DOT specification cylinder and is marked, labeled, filled and maintained as prescribed by this subchapter;
(ii) Each battery used in the operation of the unit is of the nonspillable type;
(iii) The unit is constructed so that valves, fittings, and gauges are protected from damage;
(iv) The pilot in command is advised when the unit is on board, and when it is intended for use;
(v) The unit is accompanied by a person qualified to operate it;
(vi) The unit is secured in the aircraft in a manner so as not to restrict access to or use of any required emergency or regular exit or of the aisle in the passenger compartment; and,
(vii) Smoking within 3 m (10 feet) of the unit is prohibited.
(15) Alcoholic beverages, perfumes, colognes, and liquefied gas lighters that have been examined by the Bureau of Explosives (B of E) and approved by the Associate Administrator for Hazardous Materials Safety, carried aboard a passenger-carrying aircraft by the operator for use or sale on the aircraft.
(16) Alcoholic beverages not exceeding 70% alcohol by volume, perfumes and colognes, purchased through duty free sales, carried by passengers or crew as carry-on baggage.
(17) [Reserved]
(18) Carbon dioxide gas cylinders worn by passengers for the operation of mechanical limbs and spare cylinders of a similar size for the same purpose in sufficient quantities to ensure an adequate supply for the duration of the journey.
(19) A wheelchair or other battery-powered mobility aid equipped with a nonspillable battery, when carried as checked baggage, provided that-
(i) The battery meets the provisions of §173.159(d) for nonspillable batteries;
(ii) Visual inspection including, where necessary, removal of the battery, reveals no obvious defects (however, removal of the battery from the housing should be performed by qualified airline personnel only);
(iii) The battery is disconnected and terminals are insulated to prevent short circuits; and

(iv) The battery is securely attached to the wheelchair or mobility aid, is removed and placed in a strong, rigid packaging that is marked "NONSPILLABLE BATTERY" (unless fully enclosed in a rigid housing that is properly marked), or is handled in accordance with paragraph (a)(20)(iv) of this section.

(20) A wheelchair or other battery-powered mobility aid equipped with a spillable battery, when carried as checked baggage, provided that-

(i) Visual inspection including, where necessary, removal of the battery, reveals no obvious defects (however, removal of the battery from the housing should be performed by qualified airline personnel only);

(ii) The battery is disconnected and terminals are insulated to prevent short circuits;

(iii) The pilot-in-command is advised, either orally or in writing, prior to departure, as to the location of the battery aboard the aircraft; and

(iv) The wheelchair or mobility aid is loaded, stowed, secured and unloaded in an upright position or the battery is removed, the wheelchair or mobility aid is carried as checked baggage without further restriction, and the removed battery is carried in a strong, rigid packaging under the following conditions:

(A) The packaging must be leak-tight and impervious to battery fluid. An inner liner may be used to satisfy this requirement if there is absorbent material placed inside of the liner and the liner has a leakproof closure;

(B) The battery must be protected against short circuits, secured upright in the packaging, and be packaged with enough compatible absorbent material to completely absorb liquid contents in the event of rupture of the battery; and

(C) The packaging must be labeled with a CORROSIVE label, marked to indicate proper orientation, and marked with the words "Battery, wet, with wheelchair."

(21) Hair curlers containing hydrocarbon gas, no more than one per passenger or crew member, provided that the safety cover is securely fitted over the heating element. Gas refills for such curlers are not permitted in checked or carry-on baggage.

(22) A mercurial barometer or thermometer carried as carry-on-baggage only, by a representative of a government weather bureau or similar official agency, provided that individual advises the operator of the presence of the barometer or thermometer in his baggage. The barometer or thermometer must be packaged in a strong outer packaging having sealed inner liner or bag of strong, leak proof and puncture-resistant material impervious to mercury, which will prevent the escape of mercury from the package irrespective of its position. The pilot-in-command must be informed of the presence of any such barometer or thermometer by the operator of the aircraft.

(23) With the approval of the operator of the aircraft and as carry-on baggage, electrically powered heat-producing articles (e.g., battery-operated equipment, such as underwater torches and soldering equipment), which, if accidentally activated, will generate extreme heat and can cause fire. The heat-producing component, or the energy source, must be removed so as to prevent unintentional functioning during transport.

(24) With the approval of the operator and as checked baggage, a small chemical oxygen generator for personal use, one per person, that meets the following requirements:

(i) The generator, without its packaging, must be capable of withstanding a 1.8 m (5.9 feet) drop test onto a rigid, non-resilient, flat and horizontal surface, in the position most likely to cause damage, without loss of its contents and without actuation;

(ii) The generator must be equipped with an actuating device with at least two positive means of preventing unintentional actuation;

(iii) The generator must be well insulated and, when it is actuated at a temperature of 20 ^{o}C (68 ^{o}F), the temperature of any external surface of the generator must not exceed 100 ^{o}C (212 ^{o}F);

(iv) The generator must be in the manufacturer's original packaging and this must include a sealed outer wrapping or clear evidence that the generator has not been tampered with; and

(v) The generator packaging must be marked to indicate that the package meets the requirements of this paragraph (e.g., conforms with 49 CFR 175.10(a)(24)).

(25) With approval of the aircraft operator, one small carbon dioxide cylinder fitted into a self-inflating life-jacket, plus one spare cartridge, may be carried by a passenger or crew member in checked or carry-on baggage.

(26) A small medical or clinical mercury thermometer for personal use, when carried in protective cases by passengers or crew members.

(b) A cylinder containing medical-use compressed oxygen, owned or leased by an aircraft operator or offered for transportation by a passenger needing it for personal medical use at destination, may be carried in the cabin of a passenger-carrying aircraft in accordance with the following provisions:

(1) No more than six cylinders belonging to the aircraft operator and, in addition, no more than one cylinder per passenger needing the oxygen at destination, may be transported in the cabin of the aircraft under the provisions of this paragraph (b);

(2) The rated capacity of each cylinder may not exceed 850 liters (30 cubic feet);

(3) Each cylinder and its overpack or outer packaging (see Special Provision A52 in §172.102 of this subchapter) must conform to the provisions of this subchapter;

(4) The aircraft operator shall securely stow the cylinder in its overpack or outer packaging in the cabin of the aircraft and shall notify the pilot-in-command as specified in §175.33 of this part; and

(5) Shipments under this paragraph (b) are not subject to-

(i) Subpart C and, for passengers only, subpart H of part 172 of this subchapter;

(ii) Section 173.25(a)(4) of this subchapter.

(iii) Section 175.85(i).

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §175.10, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45397, Aug. 19, 1999, §175.10 was amended by adding paragraph (b) and by removing and reserving paragraph (a)(24), effective Mar.

1, 2000.

§175.20 Compliance and training.

(a) Unless this subchapter specifically provides that another person shall perform a particular duty, each operator shall comply with all applicable requirements in parts 106, 171, 172, and 175 of this chapter and shall ensure each of its hazmat employees receive training in relation thereto. (See also 14 CFR 121.135, 121.401, 121.433a, 135.323, 135.327 and 135.333.)
(b) A carrier may not transport a hazardous material by aircraft unless each of its hazmat employees involved in that transportation is trained as required by subpart H of part 172 of this subchapter.

[Amdt. 175-48, 57 FR 20953, May 15, 1992]

§175.25 Notification at air passenger facilities of hazardous materials restrictions.

(a) Each aircraft operator who engages in for-hire transportation of passengers shall display notices of the requirements applicable to the carriage of hazardous materials aboard aircraft, and the penalties for failure to comply with those requirements. Each notice must be legible, and be prominently displayed so that it can be seen by passengers in locations where the aircraft operator issues tickets, checks baggage, and maintains aircraft boarding areas.

(1) At a minimum, each notice must communicate the following information:

Federal law forbids the carriage of hazardous materials aboard aircraft in your luggage or on your person.

A violation can result in five years' imprisonment and penalties of $250,000 or more (49 U.S.C. 5124).

Hazardous materials include explosives, compressed gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials.

Examples: Paints, lighter fluid, fireworks, tear gases, oxygen bottles, and radio-pharmaceuticals.

There are special exceptions for small quantities (up to 70 ounces total) of medicinal and toilet articles carried in your luggage and certain smoking materials carried on your person.

For further information contact your airline representative.

(2) The information contained in paragraph (a)(1) of this section must be printed:

(i) In legible English and may, in addition to English, be displayed in other languages; and

(ii) In lettering of at least 1 cm (0.4 inch) in height for the first paragraph and 6.0 mm (0.2 inch) in height for the other paragraphs; and

(iii) On a background of contrasting color.

(3) Size and color of the notice are optional. Additional information, examples, or illustrations, if not inconsistent with the required information, may be included.

(4) Notwithstanding the requirements of paragraph (a)(1) of this section, a notice with the wording "A violation can result in penalties of up to $25,000 and five years' imprisonment. (49 U.S.C. 1809)" may be used through December 31, 2001.

(b) [Reserved]

[Amdt. 175-12, 45 FR 13091, Feb. 28, 1980, as amended by 175-23, 47 FR 43066, Sept. 30, 1982; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990; Amdt. 175-50, 58 FR 50505, Sept. 27, 1993; 63 FR 37462, July 10, 1998]

§175.26 Notification at cargo facilities of hazardous materials requirements.

(a) After September 30, 1994, each person who engages in the acceptance or transport of cargo for transportation by aircraft shall display notices, at each facility where cargo is accepted, to persons offering such cargo of the requirements applicable to the carriage of hazardous materials aboard aircraft, and the penalties for failure to comply with those requirements. Each notice must be legible, and be prominently displayed so that it can be seen. At a minimum, each notice must communicate the following information:

(1) Cargo containing hazardous materials (dangerous goods) for transportation by aircraft must be offered in accordance with the Federal Hazardous Materials Regulations (49 CFR parts 171-180).

(2) A violation can result in five years' imprisonment and penalties of $250,000 or more (49 U.S.C. 5124).

(3) Hazardous materials (dangerous goods) include explosives, compressed gases, flammable liquids and solids, oxidizers, poisons, corrosives and radioactive materials.

(4) Notwithstanding the requirements of paragraph (a)(2) of this section, a notice with the wording "A violation can result in penalties of up to $25,000 and five years' imprisonment (49 U.S.C. 1809)" may be used through December 31, 2001.

(b) The information contained in paragraph (a) of this section must be printed:

(1) Legibly in English, and, where cargo is accepted outside of the United States, in the language of the host country; and

(2) On a background of contrasting color.

(c) Size and color of the notice are optional. Additional information, examples, or illustrations, if not inconsistent with required information, may be included.

(d) Exceptions: Display of a notice required by paragraph (a) of this section is not required at:

(1) An unattended location (e.g., a drop box) provided a general notice advising customers of a prohibition on shipments of hazardous materials through that location is

prominently displayed; or

(2) A customer's facility where hazardous materials packages are accepted by a carrier.

[Amdt. 175-50, 58 FR 50505, Sept. 27, 1993, as amended at 63 FR 37462, July 10, 1998]

§175.30 Accepting and inspecting shipments.

(a) No person may accept a hazardous material for transportation aboard an aircraft unless the hazardous material is:

(1) Authorized, and is within the quantity limitations specified for carriage aboard aircraft according to §172.101 of this subchapter or as otherwise specifically provided by this subchapter.

(2) Described and certified on a shipping paper prepared in duplicate in accordance with subpart C of part 172 or as authorized by §171.11 of this subchapter. The originating aircraft operator must retain one copy of each shipping paper for 90 days;

(3) Labeled and marked in accordance with subparts D and E of part 172 or as authorized in §171.11 of this subchapter, and placarded (when required) in accordance with subpart F of part 172 of this subchapter; and,

(4) Labeled with a "CARGO AIRCRAFT ONLY" label (see §172.448 of this subchapter) if the material as presented is not permitted aboard passenger-carrying aircraft.

(b) Except as provided in paragraph (d) of this section, no person may carry a hazardous material in a package, outside container, or overpack aboard an aircraft unless the package, outside container, or overpack is inspected by the operator of the aircraft immediately before placing it:

(1) Aboard the aircraft; or,

(2) In a unit load device or on a pallet prior to loading aboard the aircraft.

(c) A hazardous material may only be carried aboard an aircraft if, based on the inspection prescribed in paragraph (b) of this section, the operator determines that the package, outside container, or overpack containing the hazardous material:

(1) Has no holes, leakage or other indication that its integrity has been compromised; and

(2) For Class 7 (radioactive) materials, does not have a broken seal, except that packages contained in overpacks need not be inspected for seal integrity.

(d) The requirements of paragraphs (b) and (c) of this section do not apply to:

(1) An ORM-D material packed in a freight container and offered for transportation by one consignor;

(2) Dry ice (carbon dioxide, solid); or

(e) An overpack containing packages of hazardous materials may be accepted only if the operator has taken all reasonable steps to establish that:

(1) The overpack does not contain a package bearing the "CARGO AIRCRAFT

ONLY" label unless-

(i) The overpack affords clear visibility of and easy access to the package; or

(ii) The package contains a material which may be carried inaccessibly under the provisions of §175.85(c)(1); or

(iii) Not more than one package is overpacked.

(2) The proper shipping names, identification numbers, labels and special handling instructions appearing on the inside packages are clearly visible or reproduced on the outside of the overpack, and

(3) Has determined that a statement to the effect that the inside packages comply with the prescribed specifications appears on the outside of the overpack, when specification packagings are prescribed.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-12, 45 FR 13091, Feb. 28, 1980; Amdt. 175-17, 45 FR 68654, Oct. 11, 1980; Amdt. 175-25, 47 FR 54822, Dec. 6, 1982; Amdt. 175-34, 50 FR 48420, Nov. 25, 1985; Amdt. 175-37, 51 FR 5974, Feb. 18, 1986; Amdt. 175-39, 51 FR 44791, Dec. 12, 1986; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§175.31 Reports of discrepancies.

(a) Each person who discovers a discrepancy, as defined in paragraph (b) of this section, relative to the shipment of a hazardous material following its acceptance for transportation aboard an aircraft shall, as soon as practicable, notify the nearest FAA Civil Aviation Security Office by telephone and shall provide the following information:

(1) Name and telephone number of the person reporting the discrepancy.

(2) Name of the aircraft operator.

(3) Specific location of the shipment concerned.

(4) Name of the shipper.

(5) Nature of discrepancy.

(b) Discrepancies which must be reported under paragraph (a) of this section are those involving hazardous materials which are improperly described, certified, labeled, marked, or packaged, in a manner not ascertainable when accepted under the provisions of §175.30(a) of this subchapter, including:

(1) Package which are found to contain hazardous materials:

(i) Other than as described or certified on shipping papers;

(ii) In quantities exceeding authorized limits;

(iii) In inside containers which are not authorized or have improper closures;

(iv) In inside containers not oriented as shown by package markings;

(v) With insufficient or improper absorption materials, when required; or

(2) Packages or baggage which are found to contain hazardous materials subsequent to their being offered and accepted as other than hazardous materials.

[Amdt. 175-15, 45 FR 35332, May 27, 1980, as amended by Amdt. 175-41, 52 FR

36672, Sept. 30, 1987]

§175.33 Notification of pilot-in-command.

(a) Except as provided in §175.10, when a hazardous material subject to the provisions of this subchapter is carried in an aircraft, the operator of the aircraft shall provide the pilot-in-command at least the following information in writing as early as practicable prior to departure:

(1) The proper shipping name, hazard class and identification number of the material as specified in §172.101 of this subchapter or the ICAO Technical Instructions. In the case of Class 1 material, the compatibility group letter also must be shown. If a hazardous material is described by the proper shipping name, hazard class, and identification number appearing in:

(i) Section 172.101 of this subchapter, any additional description requirements provided in §§172.202 and 172.203 of this subchapter must also be shown in the notification.

(ii) The ICAO Technical Instructions, any additional information required to be shown on shipping papers by §171.11 of this subchapter must also be shown in the notification.

(2) The total number of packages;

(3) The net quantity or gross weight, as applicable, for each package except those containing Class 7 (radioactive) materials and those for which there is no limit imposed on the maximum net quantity per package;

(4) The location of the packages aboard the aircraft;

(5) Confirmation that no damaged or leaking packages have been loaded on the aircraft;

(6) For Class 7 (radioactive) materials, the number of packages, overpacks or freight containers their category, transport index (if applicable), and their location aboard the aircraft;

(7) Confirmation that the package must be carried on cargo aircraft only if its transportation aboard passenger-carrying aircraft is forbidden; and

(8) An indication, when applicable, that a hazardous material is being carried under terms of an exemption.

(b) A copy of the written notification to pilot-in-command shall be readily available to the pilot-in-command during flight. Emergency response information required by subpart G of part 172 of this subchapter must be maintained in the same manner as the written notification to pilot-in-command during transport of the hazardous material aboard the aircraft.

[Amdt. 175-25, 47 FR 54823, Dec. 6, 1982, as amended by Amdt. 175-30, 48 FR 53713, Nov. 29, 1983; Amdt. 175-32, 49 FR 45750, Nov. 20, 1984; Amdt. 175-35, 50 FR 49394, Dec. 2, 1985; Amdt. 175-45, 55 FR 875, Jan. 10, 1990; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990; Amdt. 175-52, 59 FR 67518, Dec. 29, 1994]

§175.35 Shipping papers aboard aircraft.

(a) A copy of the shipping papers required by §175.30(a)(2) must accompany the shipment it covers during transportation aboard an aircraft.

(b) The documents required by paragraph (a) of this section and §175.33 may be combined into one document if it is given to the pilot-in-command before departure of the aircraft.

§175.40 Keeping and replacement of labels.

(a) Aircraft operators who engage in the transportation of hazardous materials must keep an adequate supply of the labels specified in subpart E of part 172 of this subchapter, on hand at each location where shipments are loaded aboard aircraft.

(b) Lost or detached labels for packages of hazardous materials must be replaced in accordance with the information provided on the shipping papers.

Subpart B - Loading, Unloading and Handling

§175.75 Quantity limitations aboard aircraft.

(a) Except as provided in §175.85(c)(3), no person may carry on an aircraft:

(1) A hazardous material except as permitted by this subchapter:

(2) More than 25 kg (55 pounds) net weight of hazardous material (and in addition thereto, 75 kg (165 pounds) net weight of Division 2.2 (non-flammable compressed gas) materials permitted to be carried aboard passenger-carrying aircraft:

(i) In an inaccessible cargo compartment,

(ii) In any freight container within an accessible cargo compartment, or

(iii) In any accessible cargo compartment in a cargo aircraft only in a manner that makes it inaccessible unless in a freight container;

(3) Packages containing Class 7 (radioactive) materials when their combined transport index number (determined by adding together the transport index numbers shown on the labels of the individual packages and/or overpacks):

(i) In passenger carrying aircraft, exceeds 50.0 or, for any single package, exceeds 3.0, or

(ii) In cargo aircraft only, exceeds 200.00 (for fissile Class 7 (radioactive) materials, see §175.702(b)(2)(iv)) or, for any single package, exceeds 10.0.

(b) No limitation applies to the number of packages of Class 9 (miscellaneous hazardous) materials, or ORM-D materials aboard an aircraft.

[Amdt. 175-1A, 41 FR 40686, Sept. 20, 1976, as amended by Amdt. 175-13, 45 FR 20101, Mar. 27, 1980; Amdt. 175-25, 47 FR 54823, Dec. 6, 1982; Amdt. 175-29, 48 FR 50461, Nov. 1, 1983; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§175.78 Stowage compatibility of cargo.

(a) For stowage on an aircraft, in a cargo facility, or at any other area at an airport designated for the stowage of hazardous materials, packages containing hazardous materials which might react dangerously with one another may not be placed next to each other or in a position that would allow a dangerous interaction in the event of leakage. As a minimum, the segregation prescribed in the following table must be maintained.

Table 1

		A	B	C	D	E	F	G
A	Explosives and Blasting Agents or ICAO Class 1	Note 3	Note 4	Note 4	Note 4	Note 4	Note 4	X
B	Compressed gases or ICAO Class 2	Note 4	-	-	-	-	-	-
C	Flammable liquids or ICAO Class 3	Note 4	-	-	-	-	X	-
D	Flammable liquids and solids (labeled SPONTANEOUSLY COMBUSTIBLE) or ICAO Division 4.2	Note 4	-	-	-	-	X	X
E	Flammable solids (labeled DANGEROUS WHEN WET) or ICAO Division 4.3	Note 4	-	-	-	-	X	X
F	Oxidizers or ICAO Division 5.1 and Organic peroxides or ICAO Division 5.2	Note 4	-	X	X	X	-	X
G	Corrosive materials or ICAO Class 8	X	-	-	X	X	X	-

Note 1: The letters across the top of the table have the same meaning as the letters along the left side of the table.

Note 2: An "X" at the intersection of a row and a column in the table means that packages containing the indicated classes of hazardous materials may not be stowed next to or in contact with each other, or in a position which would allow interaction in the event of leakage of the contents.

Note 3: For import or export shipment, explosives other than explosives of ICAO Division 1.4, Compatibility Group S, that do not belong to the same compatibility group according to the ICAO Technical Instructions may not be stowed together, except that compatibility groups C, D and E may be stowed together. Explosives of ICAO Division 1.4, Compatibility Group S may be stowed with explosives of all compatibility groups with the exception of A and L.

Note 4: Explosives, other than safety explosives (ICAO Division 1.4, Compatibility Group S) must not be stowed together with this class.

(b) No person may stow a package labeled BLASTING AGENT on an aircraft next to, or in a position that will allow contact with a package of special fireworks or railway torpedoes.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-8, 44 FR 31184, May 31, 1979; Amdt. 175-22, 47 FR 24587, June 7, 1982; Amdt. 175-25, 47 FR 54823, Dec. 6, 1982; Amdt. 175-30, 48 FR 53713, Nov. 29, 1983; Amdt. 175-50, 58 FR 50505, Sept. 27, 1993]

§175.79 Orientation of cargo.

(a) A package containing hazardous materials marked "THIS SIDE UP" or "THIS END UP", or with arrows to indicate the proper orientation of the package, must be stored and loaded aboard an aircraft in accordance with such markings.

(b) A package containing liquid hazardous materials not marked as indicated in paragraph (a) of this section, must be stored and loaded with closures up (other than side closures in addition to top closures).

[Amdt. 175-25, 47 FR 54823, Dec. 6, 1982]

§175.81 Securing of packages containing hazardous materials.

(a) Packages containing hazardous materials must be secured in an aircraft in a manner that will prevent any movement in flight which would result in damage to or change in the orientation of the packages.

(b) Packages containing Class 7 (radioactive) materials must be secured in a manner that insures that the separation requirements of §§175.701 and 175.702 will be maintained at all times during flight.

[Amdt. 175-25, 47 FR 54823, Dec. 6, 1982, as amended by Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§175.85 Cargo location.

(a) Except as provided in §175.10, no person may carry a hazardous material subject to the requirements of this subchapter in the cabin of a passenger-carrying aircraft or on the flight deck of any aircraft. Hazardous materials may be carried in a main deck cargo compartment of a passenger-aircraft provided that the compartment is inaccessible to passengers and that it meets all certification requirements for a Class B aircraft cargo compartment as provided in 14 CFR 25.857(b).

(b) Each package containing a hazardous material acceptable only for cargo aircraft must be loaded in such a manner that a crew member or other authorized person can see, handle and when size and weight permit, separate such packages from other cargo during flight.

(c) Notwithstanding the provisions of paragraph (b) of this section:

(1) When packages of the following hazardous materials are carried on cargo aircraft only, they may be carried in a location which is inaccessible to a crewmember during flight and are not subject to the weight limitation specified in paragraph (a)(2) of §175.75 of this subchapter.

(i) Class 7 (radioactive) materials,

(ii) Division 6.1 (poisonous) materials (except those labeled FLAMMABLE),

(iii) Materials in Division 6.2 (etiologic or infectious substances),

(iv) Class 3 (flammable liquid) materials with a flashpoint above 23 ^{o}C (73 ^{o}F) that do not meet the definition of another hazardous class,

(v) Class 9 (miscellaneous hazardous) materials, and ORM-D materials.

(2) When packages of hazardous materials acceptable for cargo-only or passenger-carrying aircraft are carried on cargo aircraft only where other means of transportation are impracticable or not available, packages may be carried in accordance with procedures approved in writing by the FAA Air Transportation Security Field Office responsible for the operator's overall aviation security program or the FAA Air Transportation Security Division in the region where the operator is located.

(3) When packages of hazardous materials acceptable for cargo-only or passenger-carrying aircraft are carried on small, single pilot, cargo aircraft only being used where other means of transportation are impracticable or not available, they may be carried without quantity limitation as specified in §175.75 in a location that is not accessible to the pilot if:

(i) No person other than the pilot, an FAA inspector, the shipper or consignee of the material or a representative of the shipper or consignee so designated in writing, or a person necessary for handling the material is carried on the aircraft;

(ii) The pilot is provided with written instructions on characteristics and proper handling of the materials; and

(iii) Whenever a change of pilots occurs while the material is on board, the new pilot is briefed under a hand-to-hand signature service provided by the operator of the aircraft.

(d) [Reserved]

(e) No person may carry a material subject to the requirements of this subchapter that is acceptable for carriage in a passenger-carrying aircraft (other than magnetized materials) unless it is located in the aircraft in a place that is inaccessible to persons other than crew-members.

(f) Paragraphs (a) and (e) of this section do not apply to a person operating an aircraft under §175.310 which, because of its size and configuration, makes it impossible for that person to comply.

(g) No person may load magnetized material (which might cause an erroneous magnetic compass reading) on an aircraft, in the vicinity of a magnetic compass, or compass master unit, that is a part of the instrument equipment of the aircraft, in a manner that affects its operation. If this requirement cannot be met, a special aircraft swing and compass calibration may be made.

(h) Compressed oxygen, when properly labeled Oxidizer or Oxygen, may be loaded and transported as provided in paragraph (i) of this section. No person may load or transport any other package containing a hazardous material for which an OXIDIZER label is required under this subchapter in an inaccessible cargo compartment that does not have a fire or smoke detection system and a fire suppression system.

(i) In addition to the quantity limitations prescribed in §175.75, cylinders of compressed oxygen must be stowed in accordance with the following:

(1) No more than a combined total of six cylinders of compressed oxygen may be stowed on an aircraft in the inaccessible aircraft cargo compartment(s) that do not have fire or smoke detection systems and fire suppression systems.

(2) When loaded into a passenger-carrying aircraft or in an inaccessible cargo location on a cargo-only aircraft, cylinders of compressed oxygen must be stowed horizontally on the floor or as close as practicable to the floor of the cargo compartment or unit load device. This provision does not apply to cylinders stowed in the cabin of the aircraft in accordance with §175.10(b).

(3) When transported in a Class B aircraft cargo compartment (see 14 CFR 25.857(b)) or its equivalent (i.e., an accessible cargo compartment equipped with a fire or smoke detection system but not a fire suppression system), cylinders of compressed oxygen must be loaded in a manner that a crew member can see, handle and, when size and weight permit, separate the cylinders from other cargo during flight. No more than six cylinders of compressed oxygen and, in addition, one cylinder of medical-use compressed oxygen per passenger needing oxygen at destination-with a rated capacity of 850 liters (30 cubic feet) or less of oxygen-may be carried in a Class B aircraft cargo compartment or its equivalent.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §175.85, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

Effective Date Note: At 64 FR 45397, Aug. 19, 1999, §175.85 was amended by adding paragraphs (h) and (i), effective Mar. 1, 2000.

§175.88 Inspection of unit load devices.

A unit load device may not be loaded on an aircraft unless the device has been inspected and found to be free from any evidence of leakage from, or damage to, any package containing hazardous materials.

[Amdt. 175-25, 47 FR 54824, Dec. 6, 1982]

§175.90 Damaged shipments.

(a) Packages or overpacks containing hazardous materials must be inspected for damage or leakage after being unloaded from an aircraft. When packages or overpacks containing hazardous materials are carried in a unit load device, the area where the unit load device was stowed must be inspected for evidence of leakage or contamination immediately upon removal of the unit load device from the aircraft, and the packages or overpacks inspected for evidence of damage or leakage when the unit load device is unloaded. In the event of leakage or suspected leakage, the compartment in which the package, overpack, or unit load device was carried must be inspected for contamination and any dangerous level of contamination removed.

(b) Except as provided for in §175.700, the operator of an aircraft shall remove from the aircraft any package subject to this subchapter that appears to be damaged or leaking. In the case of a package which appears to be leaking, the operator must insure that the remainder of the packages in the same shipment are in proper condition for transport aboard the aircraft and that no other package has been contaminated.

(c) No person shall place a package that is damaged or appears to be damaged or leaking aboard an aircraft subject to this part.

(d) If a package containing a material in Division 6.2 (etiologic or infectious substance) is found to be damaged or leaking, the person finding the package shall:

(1) Avoid handling the package or keep handling to a minimum;

(2) Inspect packages adjacent to the leaking package for contamination and withhold from further transportation any contaminated packages until it is ascertained that they can be safety transported;

(3) Comply with the reporting requirement of §171.15 of this subchapter; and

(4) Notify the consignor or consignee.

[Amdt. 175-25, 47 FR 54824, Dec. 6, 1982, as amended by Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

Subpart C - Specific Regulations Applicable According to Classification of Material

§175.305 Self-propelled vehicles.

(a) Self-propelled vehicles are exempt from the drainage requirements of §173.220 of this subchapter when carried in aircraft designed or modified for vehicle ferry operations and when all of the following conditions are met:

(1) Authorization for this type operation has been given by the appropriate authority in the government of the country in which the aircraft is registered;

(2) Each vehicle is secured in an upright position;

(3) Each fuel tank is filled in a manner and only to a degree that will preclude spillage of fuel during loading, unloading, and transportation; and

(4) Each area or compartment in which a self-propelled vehicle is being transported is suitably ventilated to prevent the accumulation of fuel vapors.

(b) [Reserved]

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-12, 45 FR 13091, Feb. 28, 1980; Amdt. 175-25, 47 FR 54824, Dec. 6, 1982; Amdt. 175-47, 55 FR 52685, Dec. 21, 1990]

§175.310 Transportation of flammable liquid fuel in small, passenger-carrying aircraft.

A small aircraft or helicopter operated entirely within the State of Alaska or into a remote area elsewhere in the United States may carry, in other than scheduled passenger operations, not more than 76 liters (20 gallons) of flammable liquid fuel, if:

(a) Transportation by air is the only practical means of providing suitable fuel;

(b) The flight is necessary to meet the needs of a passenger;

(c) The fuel is carried in metal containers that are either:

(1) In strong tight metal containers of not more than 20 liters (5.3 gallons) capacity, each packed inside a UN 4G fiberboard box or each packed inside a UN 4C1 wooden box, or in the case of a small aircraft in Alaska, each packed inside a wooden box of at least 1.3 cm (0.51 inch) thickness;

(2) Airtight, leakproof, inside containers of not more than 40 liters (11 gallons) capacity and of at least 28-gauge metal, each packed inside a UN 4C1 wooden box or, in the case of a small aircraft in Alaska, each packed inside a wooden box of at least 1.3 cm (0. 51 inch) thickness;

(3) UN 1A1 steel drums of not more than 20 liters (5.3 gallons) capacity; or

(4) Fuel tanks attached to flammable liquid fuel powered equipment under the following conditions:

(i) Each piece of equipment is secured in an upright position;

(ii) Each fuel tank is filled in a manner that will preclude spillage of fuel during loading, unloading, and transportation; and

(d) In the case of a helicopter, the fuel is carried on external cargo racks;

(e) Each area or compartment in which the fuel is loaded is suitably ventilated to prevent the accumulation of fuel vapors;

(f) Before each flight, the pilot-in-command:

(1) Informs each passenger of the location of the fuel and the hazards involved; and

(2) Prohibits smoking, lighting matches, the carrying of any lighted cigar, pipe, cigarette or flame, and the use of anything that might cause an open flame or spark, while loading or unloading or in flight; and

(g) Fuel is transferred to the fuel tanks only while the aircraft is on the surface.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976, as amended by Amdt. 175-1A, 41 FR 40686, Sept. 20, 1976; Amdt. 175-12, 45 FR 13091, Feb. 28, 1980; Amdt. 175-21, 46 FR 58696, Dec. 3, 1981; Amdt. 175-47, 55 FR 52686, Dec. 21, 1990]

§175.320 Cargo aircraft only; only means of transportation.

(a) Notwithstanding §172.101 of this subchapter, when means of transportation other than air are impracticable or not available, hazardous materials listed in the following table may be carried on a cargo aircraft only, subject to the conditions stated in the table and in paragraph (b) of this section and, when appropriate, paragraph (c) of this section:

Material	Class	Conditions
Detonators, detonator assemblies and boosters with detonators	Division 1.1 or 1.2 (Class A) explosives	Permitted only when no other hazardous material is aboard the aircraft.
Detonators, detonator assemblies and boosters with detonators	Division 1.4 (Class C) explosives	With the exception of Division 1.1 or 1.2 Detonators, detonator assemblies and boosters with detonators, permitted only when there are no Division 1.1 or 1.2 (Class A) explosives aboard aircraft.
Fuel, aviation, turbine engine; methyl alcohol; or toluene	Class 3 (flammable liquid)	Permitted in metal drums authorized for Packing Group I or II liquid hazardous materials having rated capacities of 220 liters (58.1 gallons) or less. May not be transported in the same aircraft with Class 1 (explosives), Class 5 (oxidizer), or Class 8 (corrosive) materials. Permitted in installed tanks each having a capacity of more than 450 liters (118.9 gallons) subject to the conditions specified in paragraph (c) of this section.
Gasoline	Class 3 (flammable liquid)	Permitted in metal drum having rated capacities of 220 liters (58.1 gallons) or less. May not be transported in the same aircraft with materials classed as Class 1 (explosive), Class 5 (oxidizer), or Class 8 (corrosive) materials. Permitted in installed tanks each having a capacity of 450 liters (118.9 gallons). Subject to the conditions specified in paragraph (c) of this section.
High explosives	Class 1 (explosive) materials	Limited to Class 1 (explosive) materials to be used for blasting. Permitted only when no other cargo is aboard the aircraft or when being transported in the same aircraft with an authorized shipment of any one or more of any of the following materials to be used for blasting:

-	-	Ammonium nitrate-fuel oil mixtures. Blasting explosives (Division 1.1D or 1.5D), or Blasting agent (Division 1.5D), Very insensitive explosive substances, n.o.s., or Substances, EVI, n.o.s. (Division 1.5D), Extremely insensitive explosive articles or Articles, EEI (Division 1.6N).
-	-	Detonating cord.
-	-	Propellant explosive (solid) (Division 1.3) (water gels only)
-	-	Propellant explosive (liquid) (Division 1.3) (water gels only)
Oil n.o.s.; petroleum oil or petroleum oil, n.o.s	Class 3 (flammable liquid)	Permitted in metal drums having rated capacities of 220 liters (58.1 gallons) or less. May not be transported in the same aircraft with materials classed as Class 1 (explosive), Class 5 (oxidizer), or Class 8 (corrosive) materials. Permitted in installed tanks each having a capacity of 450 liters (118.9 gallons). Subject to the conditions specified in paragraph (c) of this section.
Combustible liquid n.o.s	Class 3 (combustible liquid)	Permitted in installed tanks each having a capacity of more than 450 liters (118.9 gallons) subject to the conditions specified in paragraph (c) of this section.

(b) The following conditions apply to the carriage of hazardous materials performed under the authority of this section:

(1) No person other than a required flight crewmember, an FAA inspector, the shipper or consignee of the material or a representative of the shipper or consignee so designated in writing, or a person necessary for handling the material may be carried on the aircraft.

(2) The operator of the aircraft must have advance permission from the owner or operator of each manned airport where the material is to be loaded or unloaded or where the aircraft is to land while the material is on board. When the destination is changed after departure because of weather or other unforeseen circumstances, permission from the owner or operator of the alternate airport should be obtained as soon as practicable before landing.

(3) At any airport where the airport owner or operator or authorized representative thereof has designated a location for loading or unloading the material concerned, the material may not be loaded or unloaded at any other location.

(4) If the material concerned can create destructive forces or have lethal or injurious effects over an appreciable area as a result of an accident involving the aircraft or the material, the loading and unloading of the aircraft and its operation in takeoff, en route, and in landing must be conducted at a safe distance from heavily populated areas and from any place of human abode or assembly.

(5) If the aircraft is being operated by a holder of a certificate issued under 14 CFR part 121, part 127 or part 135, operations must be conducted in accordance with conditions and limitations specified in the certificate holder's operations specifications or operations manual accepted by the FAA. If the aircraft is being operated under 14 CFR part 91, operations must be conducted in accordance with an operations plan accepted

and acknowledged in writing by the Civil Aviation Security Office serving the operator's location or the place where the material is to be loaded.

(6) Each pilot of the aircraft must be provided written instructions stating the conditions and limitations of the operation being conducted and the name of the airport official[s] granting the advance permission required by the first sentence of paragraph (b)(2) of this section.

(7) The aircraft and the loading arrangement to be used must be approved for safe carriage of the particular materials concerned by the FAA Civil Aviation Security Office responsible for the operator's overall aviation security program or the appropriate FAA Civil Aviation Security Office serving the place where the material is to be loaded.

(8) When Division 1.1 or 1.2 (explosive) materials are carried aboard cargo aircraft only under the provisions of this section, the aircraft operator shall take all possible action to insure that routes over heavily populated areas are avoided commensurate with considerations of flight safety. During the approach and landing phase, the aircraft operator shall request appropriate vectors when under radar control to avoid heavily populated areas.

(9) During loading and unloading, no person may smoke, carry a lighted cigarette, cigar, or pipe, or operate any device capable of causing an open flame or spark within 15 m (50 feet) of the aircraft.

(10) If the movement involves international transportation, permission for the shipment may also be required from the appropriate authorities of the countries of origin, destination, transit and overflight prior to departure.

(c) The following additional conditions apply to the carriage of Class 3 (flammable) and combustible liquid materials in tanks each having a capacity of more than 420 liters (111 gallons) under the authority of this section:

(1) The tanks and their associated piping and equipment and the installation thereof must have been approved for the material to be transported by the appropriate FAA Regional Office.

(2) In the case of an aircraft being operated by a certificate holder, the operator shall list the aircraft and the approval information in its operating specifications. If the aircraft is being operated by other than a certificate holder, a copy of the FAA Regional Office approval required by this section must be carried on the aircraft.

(3) The crew of the aircraft must be thoroughly briefed on the operation of the particular bulk tank system being used.

(4) During loading and unloading and thereafter until any remaining fumes within the aircraft are dissipated:

(i) Only those electrically operated bulk tank shutoff valves that have been approved under a supplemental type certificate may be electrically operated.

(ii) No engine or electrical equipment, avionic equipment, or auxiliary power units may be operated, except position lights in the steady position and equipment required by approved loading or unloading procedures, as set forth in the operator's operations manual, or for operators that are not certificate holders, as set forth in a written statement.

(iii) No person may fill a container, other than an approved bulk tank, with a Class 3 (flammable and combustible liquid) materials or discharge a Class 3 (flammable and combustible liquid) materials from a container, other than an approved bulk tank, while that container is inside or within 15 m (50 feet) of the aircraft.

(iv) When filling an approved bulk tank by hose from inside the aircraft, the doors and hatches must be fully open to insure proper ventilation.

(v) Static ground wires must be connected between the storage tank or fueler and the aircraft, and between the aircraft and a positive ground device.

[Amdt. 175-1, 41 FR 16106, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §175.320, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§175.630 Special requirements for Division 6.1 (poisonous) material and Division 6.2 (infectious substance) material.

(a) A hazardous material bearing a POISON, POISON INHALATION HAZARD, or INFECTIOUS SUBSTANCE label may not be carried in the same compartment of an aircraft with material which is marked as or known to be a foodstuff, feed, or any other edible material intended for consumption by humans or animals unless either the Division 6.1 (poisonous) material or material in Division 6.2 (infectious substance) and the foodstuff, feed, or other edible material are loaded in separate unit load devices which, when stowed on the aircraft, are not adjacent to each other, or the Division 6.1 (poisonous) material or material in Division 6.2 (infectious substance) are loaded in one closed unit load device and the foodstuff, feed or other material is loaded in another closed unit load device.

(b) No person may operate an aircraft that has been used to transport any package bearing a POISON or POISON INHALATION HAZARD label unless, upon removal of such package, the area in the aircraft in which it was carried is visually inspected for evidence of leakage, spillage, or other contamination. All contamination discovered must be either isolated or removed from the aircraft. The operation of an aircraft contaminated with such Division 6.1 (poisonous) materials is considered to be the carriage of poisonous materials under paragraph (a) of this section.

[Amdt. 175-85, 62 FR 1236, Jan. 8, 1997, as amended at 64 FR 10781, Mar. 5, 1999]

§175.700 Special limitations and requirements for Class 7 (radioactive) materials.

(a) In addition to other requirements, no person may carry in a passenger-carrying aircraft any package required to be labeled in accordance with §172.403 of this subchapter with a Radioactive Yellow-II or Radioactive Yellow-III label unless:

(1) For a package required to be labeled Radioactive Yellow-III, the transport index does not exceed 3.0;

(2) The package is carried on the floor of the cargo compartment, or freight container; and

(3) The package is carried in the aircraft in accordance with §§175.701 and 175.703(c).

(b) In addition to the reporting requirements of §171.15 of this subchapter, the carrier shall also notify the offeror at the earliest practicable moment following any incident in which there has been breakage, spillage, or suspected radioactive contamination involving Class 7 (radioactive) materials shipments. Aircraft in which Class 7 (radioactive) materials have been spilled may not again be placed in service or routinely occupied until the radiation dose rate at every accessible surface is less than 0.005 mSv per hour (0.5 mrem per hour) and there is no significant removable radioactive surface contamination as determined in accordance with §173.443 of this subchapter. When contamination is present or suspected, the package and/or materials it has touched must be segregated as far as practicable from personnel contact until appropriate radiological advice or assistance is obtained. The Regional Office of the U.S. Department of Energy or appropriate State or local radiological authorities can provide advice or assistance, and should be notified in cases of obvious leakage, or if it appears likely that the inside container may have been damaged. For personnel safety, the carrier shall take care to avoid possible inhalation, ingestion, or contact by any person with Class 7 (radioactive) materials that may have leaked or spilled from its package. Any loose Class 7 (radioactive) materials and associated packaging materials must be left in a segregated area pending disposal instructions from responsible radiological authorities.

(c) Except as provided in §§173.4, 173.422 and 173.423 of this subchapter, no person shall carry any Class 7 (radioactive) materials aboard a passenger carrying aircraft unless that material is intended for use in, or incident to research, medical diagnosis or treatment.

(d) Type B(M) packages may not be offered or accepted for transportation, nor transported, on passenger-carrying aircraft.

[Amdt. 175-13, 45 FR 20101, Mar. 27, 1980, as amended by Amdt. 175-19, 46 FR 24185, Apr. 30, 1981; Amdt. 175-26, 48 FR 10245, Mar. 10, 1983; Amdt. 175-31, 49 FR 38134, Sept. 27, 1984; 50 FR 18668, May 2, 1985; Amdt. 175-47, 55 FR 52687, Dec. 21, 1990; Amdt. 175-50, 58 FR 50505, Sept. 27, 1993; Amdt. 175-51, 59 FR 49134, Sept. 26, 1994; Amdt. 175-53, 60 FR 50333, Sept. 28, 1995; 62 FR 51561, Oct. 1, 1997; 63 FR 52850, Oct. 1, 1998; 64 FR 51919, Sept. 27, 1999]

§175.701 Separation distance requirements for packages containing Class 7 (radioactive) materials in passenger-carrying aircraft.

(a) *General. No person may carry in a passenger-carrying aircraft any package* *required by §172.403 of this subchapter to be labeled Radioactive Yellow-II, or Radioactive Yellow-III unless the package is placed in the aircraft in accordance with the minimum separation distances prescribed in paragraph (b) or (c) of this section.*

(b) Separation distances. (1) Except as provided in paragraph (c) of this section, the minimum separation distances prescribed in paragraphs (b)(2) and (b)(3) of this section are determined by measuring the shortest distance between the surfaces of the Class 7 (radioactive) materials package and the surfaces bounding the space occupied by passengers or animals. If more than one package of Class 7 (radioactive) materials is placed in a passenger-carrying aircraft, the minimum separation distance for these packages shall be determined in accordance with paragraphs (b)(2) and (b)(3) of this section on the basis of the sum of the transport index numbers of the individual packages or overpacks.

(2) The following table prescribes minimum separation distances that must be maintained in passenger-carrying aircraft between Class 7 (radioactive) materials labeled Radioactive Yellow-II or Radioactive Yellow-III and passengers and crew:

Transport index or sum of transport indexes of all packages in the aircraft or predesignated area	Minimum separation distances	
-	Centimeters	Inches
0.1 to 1.0	30	12
1.1 to 2.0	50	20
2.1 to 3.0	70	28
3.1 to 4.0	85	34
4.1 to 5.0	100	40
5.1 to 6.0	115	46
6.1 to 7.0	130	52
7.1 to 8.0	145	57
8.1 to 9.0	155	61
9.1 to 10.0	165	65
10.1 to 11.0	175	69
11.1 to 12.0	185	73
12.1 to 13.0	195	77
13.1 to 14.0	205	81
14.1 to 15.0	215	85
15.1 to 16.0	225	89
16.1 to 17.0	235	93
17.1 to 18.0	245	97
18.1 to 20.0	260	102
20.1 to 25.0	290	114
25.1 to 30.0	320	126
30.1 to 35.0	350	138
35.1 to 40.0	375	148
40.1 to 45.0	400	157
45.1 to 50.0	425	167

(3) Class 7 (radioactive) materials in packages, overpacks or freight containers

labeled Radioactive Yellow-II or Radioactive Yellow-III must be separated from live animals by a distance of at least 0.5 meters (20 inches) for journeys not exceeding 24 hours, and by a distance of at least 1.0 meters (39 inches) for journeys longer than 24 hours.

(c) *Predesignated areas. A package required by §72.403 of this subchapter to be labeled Radioactive Yellow-II or Radioactive Yellow-III may be carried in a passenger-carrying aircraft in accordance with a system of predesignated areas established by the aircraft operator. Each aircraft operator that elects to use a system of predesignated areas shall submit a detailed description of the proposed system to the Associate Administrator for Hazardous Materials Safety for approval prior to implementation of the system. A proposed system of predesignated areas is approved if the Associate Administrator for Hazardous Materials Safety determines that it is designed to assure that:*

(1) The packages can be placed in each predesignated area in accordance with the minimum separation distances prescribed in paragraph (b)(2) of this section; and

(2) The predesignated areas are separated from each other by minimum distance equal to at least four times the distances required by paragraphs (b)(1) and (b)(2) of this section for the predesignated area containing packages with the largest sum of transport indexes.

[Amdt. 175-13, 45 FR 20102, Mar. 27, 1980, as amended by Amdt. 175-23, 47 FR 43066, Sept. 30, 1982; Amdt. 175-25, 47 FR 54824, Dec. 6, 1982; Amdt. 175-47, 55 FR 52687, Dec. 21, 1990; 56 FR 66281, Dec. 20, 1991; Amdt. 175-49, 58 FR 50494, Sept. 27, 1993]

§175.702 Requirements for carriage of packages containing Class 7 (radioactive) materials in a cargo aircraft only.

(a) As used in this section, the term "group of packages" means packages that are separated from each other in an aircraft by a distance of 6 m (20 feet) or less.

(b) No person may carry in a cargo aircraft only any package required by §172.403 of this subchapter to be labeled Radioactive Yellow-II or Radioactive Yellow-III unless:

(1) The total transport index for all of the packages does not exceed 50.0 and the package is carried in accordance with §175.701(a); or

(2) The total transport index for all of the packages exceeds 50.0 and:

(i) The separation distance between the surfaces of the Class 7 (radioactive) materials packages, overpacks or freight containers and any space occupied by-

(A) Humans is at least 9 meters (30 feet); and

(B) Live animals is at least 0.5 meters (20 inches) for journeys not exceeding 24 hours and at least 1.0 meters (39 inches) for journeys longer than 24 hours;

(ii) The transport index for any group of packages does not exceed 50.0; and

(iii) Each group of packages is separated from every other group in the aircraft by not less than 6 m (20 feet), measured from the outer surface of each group; and

(iv) The total transport index for all packages containing fissile Class 7 (radioactive) materials does not exceed 50.0.

[Amdt. 175-13, 45 FR 20102, Mar. 27, 1980, as amended by Amdt. 175-29, 48 FR 50461, Nov. 1, 1983; Amdt. 175-47, 55 FR 52687, Dec. 21, 1990; Amdt. 175-49, 58 FR 50494, Sept. 27, 1993]

§175.703 Other special requirements for the acceptance and carriage of packages containing Class 7 (radioactive) materials.

(a) No person may carry in an aircraft any package of Class 7 (radioactive) materials required by §172.403 of this subchapter to be labeled Radioactive Yellow-II or Radioactive Yellow-III closer than the distances shown in the following table to any package marked as containing undeveloped film:

Transport index	Minimum separation distance to nearest undeveloped film for various times of transit									
-	Up to 2 hours		2 to 4 hours		4 to 8 hours		8 to 12 hours		Over 12 hours	
-	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet	Meters	Feet
0.1 to 1.0	0.3	1	0.6	2	0.9	3	1.2	4	1.5	5
1.1 to 5.0	0.9	3	1.2	4	1.8	6	2.4	8	3.3	11
5.1 to 10.0	1.2	4	1.8	6	2.7	9	3.3	11	4.5	15
10.1 to 20.0	1.5	5	2.4	8	3.6	12	4.8	16	6.6	22
20.1 to 30.0	2.1	7	3.0	10	4.5	15	6.0	20	8.7	29
30.1 to 40.0	2.4	8	3.3	11	5.1	17	6.6	22	9.9	33
40.1 to 50.0	2.7	9	3.6	12	5.7	19	7.2	24	10. 8	36

(b) No person may accept for carriage in an aircraft packages of Class 7 (radioactive) materials, other than limited quantities, contained in a rigid or non-rigid overpack, including a fiberboard box or plastic bag, unless they have been prepared for shipment in accordance with §173.448(g) of this subchapter.

(c) No person shall carry in an aircraft a fissile material controlled shipment (as defined in §173.403 of this subchapter), except-

(1) In a cargo aircraft only which has been assigned for the exclusive use of the shipper for the specific shipment of fissile Class 7 (radioactive) material. Instructions for the exclusive use must be developed by the shipper and carrier, and the instructions issued with the shipping papers; or

(2) In an aircraft in which there are no other packages required to bear a radioactive label as prescribed in §172.403 of this subchapter. Specific arrangements must be made between the shipper and carrier, with instructions to that effect issued with the

shipping papers.

(d) No person shall offer or accept for transportation, or transport, by air-

(1) Vented Type B(M) packages, packages which require external cooling by an ancillary cooling system or packages subject to operational controls during transport; or

(2) Liquid pyrophoric Class 7 (radioactive) materials.

(e) Packages with radiation levels at the package surface or a transport index in excess of the limits specified in §173.441(a) of this subchapter may not be transported by aircraft except under special arrangements approved by RSPA.

[Amdt. 175-13, 45 FR 20102, Mar. 27, 1980, as amended by Amdt. 175-26, 48 FR 10245, Mar. 10, 1983; Amdt. 175-26, 48 FR 31220, July 7, 1983; Amdt. 175-29, 48 FR 50461, Nov. 1, 1983; Amdt. 175-47, 55 FR 52687, Dec. 21, 1990; Amdt. 175-53, 60 FR 50333, Sept. 28, 1995]

§175.704 Plutonium shipments.

Shipments of plutonium by air which are subject to 10 CFR 71.88(a)(4) must comply with the following:

(a) A plutonium package weighing less than 40 kg (88 lbs) and having its height and diameter both less than 50 cm (19.7 in), must be stowed aboard the aircraft on the main deck or the lower cargo compartment in the aft-most location that is possible for cargo of its size and weight. No other type of cargo may be stowed aft of a plutonium package.

(b) A plutonium package must be secured and restrained to prevent shifting under normal transport. A plutonium package weighing 40 kg (88 lbs) or more must be securely cradled and tied down to the main deck of the aircraft such that the tied down system is capable of providing package restraint against the following inertial forces acting separately relative to the deck of the aircraft: Upward, 2g; Forward, 9g; Sideward, 1.5g; Downward, 4.5g.

(c) A plutonium package weighing less than 40 kg (88 lbs), and having its height and diameter both less than 50 cm (19.7 in), may not be transported aboard an aircraft carrying other cargo required to bear an "Explosive A" or an "Explosive 1.1" label. Any other plutonium package may not be transported aboard an aircraft carrying other cargo bearing any of the following hazardous material labels: Explosive A; Explosive B; Explosive C; Explosive 1.1, 1.2, 1.3, 1.4, 1.5 or 1.6; Spontaneously Combustible; Dangerous When Wet; Organic Peroxide; Non-Flammable Gas; Flammable Liquid; Flammable Solid; Flammable Gas; Oxidizer; or Corrosive.

[Amdt. 175-53, 60 FR 50333, Sept. 28, 1995]

§175.705 Inspection of aircraft for contamination by Class 7 (radioactive)

materials.

(a) Aircraft used routinely for the carriage of Class 7 (radioactive) materials shall be periodically checked for radioactive contamination. The frequency of checks shall be related to the likelihood of contamination and the extent to which Class 7 (radioactive) materials are carried.

(b) An aircraft must be taken out of service if the level of contamination exceeds that provided in §175.700(b).

[Amdt. 175-25, 47 FR 54824, Dec. 6, 1982, as amended by Amdt. 175-47, 55 FR 52687, Dec. 21, 1990]

Pt. 176

[CFR] PART 176 - CARRIAGE BY VESSEL

[TITLE 49] [SUBTITLE B] [PART 176]

Subpart A-General

Sec.

Subpart B-General Operating Requirements

Subpart C-General Handling and Stowage

Subpart D-General Segregation Requirements

Subpart E-Special Requirements for Transport Vehicles Loaded With Hazardous Materials and Transported on Board Ferry Vessels

Subpart F-Special Requirements for Barges

Subpart G-Detailed Requirements for Class 1 (Explosive) Materials

Subpart H-Detailed Requirements for Class 2 (Compressed Gas) Materials

Subpart I-Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials

Subpart J-Detailed Requirements for Class 4 (Flammable Solids), Class 5 (Oxidizers and Organic Peroxides), and Division 1.5 (Blasting Agents) Materials

Subpart K [Reserved]

Subpart L-Detailed Requirements for Division 2.3 (Poisonous Gas) and Division 6.1 (Poisonous) Materials

Subpart M-Detailed Requirements for Radioactive Materials

Subpart N-Detailed Requirements for Class 8 (Corrosive Materials) Materials

Subpart O-Detailed Requirements for Cotton and Vegetable Fibers, Motor Vehicles, and Asbestos

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Subpart A - General

§176.1 Purpose and scope.

This part prescribes requirements in addition to those contained in parts 171, 172, and 173 of this subchapter to be observed with respect to the transportation of hazardous materials by vessel.

§176.2 Definitions.
As used in this part-

Cantline means the v-shaped groove between two abutting, parallel horizontal cylinders.

Cargo net means a net made of fiber or wire used to provide convenience in handling loose or packaged cargo to and from a vessel.

Clear of living quarters means that the hazardous material must be located so that in the event of release of the material, leakage or vapors will not penetrate accommodations, machinery spaces or other work areas by means of entrances or other openings in bulkheads or ventilation ducts.

Closed freight container means a freight container which totally encloses its contents by permanent structures. A freight container formed partly by a tarpaulin, plastic sheet, or similar material is not a closed freight container.

Commandant (G-MTH) means the Chief, Marine Technical and Hazardous Materials Division, Office of Marine Safety, Security and Environmental Protection, United States Coast Guard, Washington, DC 20593-0001.

Compartment means any space on a vessel that is enclosed by the vessel's decks and its sides or permanent steel bulkheads.

CSC safety approval plate means the safety approval plate specified in Annex I of the International Convention for Safe Containers (1972) and conforming to the specifications in 49 CFR 451.23 and 451.25. The plate is evidence that a freight container was designed, constructed, and tested under international rules incorporated into U.S. regulations in 49 CFR parts 450 through 453. The plate is found in the door area of the container.

Deck structure means a structure of substantial weight and size located on the weather deck of a vessel and integral with the deck. This term includes superstructures, deck houses, mast houses, and bridge structures.

Draft means a load or combination of loads capable of being hoisted into or out of a vessel in a single lift.

Dunnage means lumber of not less than 25 mm (0.98 inch) commercial thickness or equivalent material laid over or against structures such as tank tops, decks, bulkheads, frames, plating, or ladders, or used for filling voids or fitting around cargo, to prevent damage during transportation.

Explosives anchorage means an anchorage so designated under 33 CFR part 110, subpart B.

Explosive article means an article or device which contains one or more explosive substances. Individual explosive articles are identified in the schedules for Class I (explosive) articles found in the IMDG Code.

Explosives handling facility means-

(1) A "designated waterfront facility" designated under 33 CFR part 126 when loading, handling, and unloading Class 1 (explosives) materials; or

(2) A facility for loading, unloading, and handling military Class 1 (explosives) materials which is operated or controlled by an agency of the Department of Defense.

Explosive substance means a solid or liquid material, or a mixture of materials, which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to its surroundings. Individual explosive substances are identified in the schedules for Class 1 (explosive) substances in the IMDG Code.

Handling means the operation of loading and unloading a vessel; transfer to, from, or within a vessel, and any ancillary operations.

Hold means a compartment below deck that is used exclusively for the carriage of cargo.

In containers or the like means in any clean, substantial, weatherproof box structure which can be secured to the vessel's structure, including a portable magazine or a closed transport unit. Whenever this stowage is specified, stowage in deckhouses, mast lockers and oversized weatherproof packages (overpacks) is also acceptable.
Incompatible materials means two materials whose stowage together may result in undue hazards in the case of leakage, spillage, or other accident.
Landing mat means a shock absorbing pad used in loading Class 1 (explosive) materials on vessels.
Machinery Spaces of Category A are those spaces, and trunks to such spaces, which contain:
(1) Internal combustion machinery used for main propulsion:
(2) Internal combustion machinery used for purposes other than main propulsion where

such machinery has in the aggregate a total power output of not less than 375 kw; or (3) any oil-fired boiler or fuel unit.
Magazine means an enclosure designed to protect certain goods of Class 1 (explosive) materials from damage by other cargo and adverse weather conditions during loading, unloading, and when in transit; and to prevent unauthorized access. A magazine may be a fixed structure in the vessel, a closed freight container, a closed transport vehicle, or a portable magazine.
Master of the Vessel, as used in this part, includes the person in charge of an unmanned vessel or barge.
Open freight container means a freight container that does not totally enclose its contents by permanent structures.
Overstowed means a package or container is stowed directly on top of another. However, with regard to Class 1 (explosive) stowage, such goods may themselves be stacked to a safe level but other goods should not be stowed directly on top of them.
Pallet means a portable platform for stowing, handling, and moving cargo.
Palletized unit means packages or unpackaged objects stacked on a pallet, banded and secured to the pallet by metal, fabric, or plastic straps for the purpose of handling as a single unit.
Pie plate means a round, oval, or hexagonal pallet without sideboards, used in conjunction with a cargo net to handle loose cargo on board a vessel.
Portable magazine means a strong, closed, prefabricated, steel or wooden, closed box or container, other than a freight container, designed and used to handle Class 1 (explosive) materials either by hand or mechanical means.
Readily combustible material means a material which may or may not be classed as a hazardous material but which is easily ignited and supports combustion. Examples of readily combustible materials include wood, paper, straw, vegetable fibers, products made from such materials, coal, lubricants, and oils. This definition does not apply to packaging material or dunnage.
Responsible person means a person empowered by the master of the vessel to make all decisions relating to his or her specific task, and having the necessary knowledge and experience for that purpose.
Safe working load means the maximum gross weight that cargo handling equipment is approved to lift.
Skilled person means a person having the knowledge and experience to perform a certain duty.
Skipboard means a square or rectangular pallet without sideboards, usually used in conjunction with a cargo net to handle loose cargo on board a vessel.
Splice as used in §176.172 of this part, means any repair of a freight container main structural member which replaces material, other than complete replacement of the member.
Transport unit means a transport vehicle or a freight container. A closed transport unit means a transport unit in which the contents are totally enclosed by permanent structures. An open transport unit means a transport unit which is not a closed transport unit. Transport units with fabric sides or tops are not closed transport units for the

purposes of this part.
Tray means a type of pallet constructed to specific dimensions for handling a particular load.

[Amdt. 176-30, 55 FR 52687, Dec. 21, 1990]

§176.3 Unacceptable hazardous materials shipments.

(a) A carrier may not transport by vessel any shipment of a hazardous material that is not prepared for transportation in accordance with parts 172 and 173 of this subchapter.
(b) A carrier may not transport by vessel any explosive or explosive composition described in §173.54 of this subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.4 Port security and safety regulations.

(a) Each carrier, master, agent, and charterer of a vessel and all other persons engaged in handling hazardous materials on board vessels shall comply with the applicable provisions of 33 CFR parts 6, 109, 110, 125, 126, and 160.
(b) Division 1.1 and 1.2 (Class A and B explosive) materials may only be loaded on and unloaded from a vessel at-
(1) A facility of particular hazard as defined in 33 CFR 126.05(b);
(2) An explosives anchorage listed in 33 CFR part 110; or
(3) A facility operated or controlled by the Department of Defense.
(c) With the concurrence of the COTP, Division 1.1 and 1.2 (Class A and B explosive) materials may be loaded on or unloaded from a vessel in any location acceptable to the COTP.

[Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.5 Application to vessels.

(a) Except as provided in paragraph (b) of this section, this subchapter applies to each domestic or foreign vessel when in the navigable waters of the United States, regardless of its character, tonnage, size, or service, and whether self-propelled or not, whether arriving or departing, underway, moored, anchored, aground, or while in dry dock.
(b) This subchapter does not apply to:
(1) A public vessel not engaged in commercial service;

(2) A vessel constructed or converted for the principal purpose of carrying flammable or combustible liquid cargo in bulk in its own tanks, when only carrying these liquid cargoes;

(3) A vessel of 15 gross tons or smaller when not engaged in carrying passengers for hire;

(4) A vessel used exclusively for pleasure;

(5) A vessel of 500 gross tons or smaller when engaged in fisheries;

(6) A tug or towing vessel, except when towing another vessel having Class 1 (explosive) materials, Class 3 (flammable liquids), or Division 2.1 (flammable gas) materials, in which case the owner/operator of the tug or towing vessel shall make such provisions to guard against and extinguish fire as the Coast Guard may prescribe;

(7) A cable vessel, dredge, elevator vessel, fireboat, icebreaker, pile driver, pilot boat, welding vessel, salvage vessel, or wrecking vessel; or

(8) A foreign vessel transiting the territorial sea of the United States without entering the internal waters of the United States, if all hazardous materials being carried on board are being carried in accordance with the requirements of the IMDG Code.

(c) [Reserved]

(d) Except for transportation in bulk packagings (as defined in §171.8 of this subchapter), the bulk carriage of hazardous materials by water is governed by 46 CFR chapter I, subchapters D, I, N and O.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-14, 47 FR 44471, Oct. 7, 1982; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986; Amdt. 176-30, 55 FR 52688, Dec. 21, 1990; 56 FR 66281, Dec. 20, 1991; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.9 "Order-Notify" or "C.O.D." shipments.

A carrier may not transport Division 1.1 or 1.2 (Class A explosive) materials, detonators, or boosters with detonators which are:

(a) Consigned to "order-notify" or "C.O.D.", except on a through bill of lading to a place outside the United States; or

(b) Consigned by the shipper to himself unless he has a resident representative to receive the shipment at the port of discharge.

[Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.11 Exceptions.

(a) A hazardous material may be offered and accepted for transport by vessel when in conformance with the IMDG Code, subject to the conditions and limitations set forth in §171.12 of this subchapter. The requirements of §§176.83, 176.84, and 176.112

through 176.174 are not applicable to shipments of Class 1 (explosive) materials made in accordance with the IMDG Code. A hazardous material which conforms to the provisions of this paragraph (a) is not subject to the requirement specified in §172.201(d) of this subchapter for an emergency response telephone number, when transportation of the hazardous material originates and terminates outside the United States and the hazardous material-

(1) Is not offloaded from the vessel; or

(2) Is offloaded between ocean vessels at a U.S. port facility without being transported by public highway.

(b) Canadian shipments and packages may be transported by vessel if they are transported in accordance with this subchapter. (See §171.12a of this subchapter.)

(c) The requirements of this subchapter governing the transportation of combustible liquids do not apply to the transportation of combustible liquids in non-bulk (see definitions in §171.8 of this subchapter) packages on board vessels.

(d) Transport vehicles, containing hazardous materials loaded in accordance with specific requirements of this subchapter applicable to such vehicles, may be transported on board a ferry vessel or carfloat, subject to the applicable requirements specified in §§176.76, 176.100, and subpart E of this part.

(e) Hazardous materials classed and shipped as ORM-D are not subject to the requirements of this part unless they are offered for transporation as hazardous wastes.

(f) Paragraph (a) of this section does not apply to hazardous materials, including certain hazardous wastes and hazardous substances as defined in §171.8 of this subchapter, which are not subject to the requirements of the IMDG Code.

(g) The requirements of this subchapter do not apply to atmospheric gases used in a refrigeration system.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.11, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.13 Responsibility for compliance and training.

(a) Unless this subchapter specifically provides that another person shall perform a particular duty, each carrier shall perform the duties specified and comply with all applicable requirements in this part and shall ensure its hazmat employees receive training in relation thereto.

(b) A carrier may not transport a hazardous material by vessel unless each of its hazmat employees involved in that transportation is trained as required by subpart H of part 172 of this subchapter.

(c) The record of training required by §172.704(d) of this subchapter for a crewmember who is a hazmat employee subject to the training requirements of this subchapter must be kept on board the vessel while the crewmember is in service on board the vessel.

[Amdt. 176-31, 57 FR 20954, May 15, 1992, as amended by Amdt. 176-35, 59 FR 49134, Sept. 26, 1994]

§176.15 Enforcement.

(a) An enforcement officer of the U.S. Coast Guard may at any time and at any place, within the jurisdiction of the United States, board any vessel for the purpose of enforcement of this subchapter and inspect any shipment of hazardous materials as defined in this subchapter.

(b) [Reserved]

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986]

§176.18 Assignment and certification.

(a) The National Cargo Bureau, Inc., is authorized to assist the Coast Guard in administering this subchapter with respect to the following:

(1) Inspection of vessels for suitability for loading hazardous materials;

(2) Examination of stowage of hazardous materials;

(3) Making recommendations for stowage requirements of hazardous materials cargo; and

(4) Issuance of certificates of loading setting forth that the stowage of hazardous materials is in accordance with the requirements of this subchapter.

(b) A certificate of loading issued by the National Cargo Bureau, Inc., may be accepted by the Coast Guard as prima facie evidence that the cargo is stowed in conformity with the requirements of this subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-24, 51 FR 5974, Feb. 18, 1986]

Subpart B - General Operating Requirements

§176.24 Shipping papers.

A carrier may not transport a hazardous material by vessel unless the material is properly described on the shipping paper in the manner prescribed in part 172 of this subchapter.

§176.27 Certificate.

(a) A carrier may not transport a hazardous material by vessel unless he has received a certificate prepared in accordance with §172.204 of this subchapter.

(b) In the case of an import or export shipment of hazardous materials which will not be transported by rail, highway, or air, the shipper may certify on the bill of lading or other shipping paper that the hazardous material is properly classed, described, marked, packaged, and labeled according to part 172 of this subchapter or in accordance with the requirements of the IMDG Code. See §171.12 of this subchapter.

(c)(1) A person responsible for packing or loading a freight container or transport vehicle containing hazardous materials for transportation by a manned vessel in ocean or coastwise service, must provide the vessel operator, at the time the shipment is offered for transportation by vessel, with a signed container packing certificate stating, at a minimum, that-

(i) The freight container or transport unit is serviceable for the materials loaded therein, contains no incompatible goods, and is properly marked, labeled or placarded, as applicable; and

(ii) When the freight container or transport unit contains packages, those packages have been inspected prior to loading, are properly marked, labeled or placarded, as applicable; are not damaged; and are properly secured.

(2) The certification may appear on a shipping paper or on a separate document as a statement such as "It is declared that the packing of the container has been carried out in accordance with the provisions of 49 CFR 176.27(c)".

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-12, 45 FR 81572, Dec. 11, 1980; Amdt. 176-14, 47 FR 44471, Oct. 7, 1982; Amdt. 176-36, 59 FR 67518, Dec. 29, 1994]

§176.30 Dangerous cargo manifest.

(a) The carrier, its agents, and any person designated for this purpose by the carrier or agents shall prepare a dangerous cargo manifest, list, or stowage plan. This document may not include a material which is not subject to the requirements of 49 CFR or the IMDG Code. This document must be kept in a designated holder on or near the vessel's bridge. It must contain the following information:

(1) Name of vessel and official number. (If the vessel has no official number, the international radio call sign must be substituted.);

(2) Nationality of vessel;

(3) Shipping name and identification number of each hazardous material on board as

listed in §172.101 of this subchapter or as listed in the IMDG Code and an emergency response telephone number as prescribed in subpart G of part 172 of this subchapter.

(4) The number and description of packages (barrels, drums, cylinders, boxes, etc.) and gross weight for each type of packaging;

(5) Classification of the hazardous material in accordance with either;

(i) The Hazardous Materials Table, the §172.101 table; or

(ii) The International Maritime Organization's IMDG Code.

(6) Any additional description required by §172.203 of this subchapter.

(7) Stowage location of the hazardous material on board the vessel.

(8) In the case of a vessel used for the storage of explosives or other hazardous materials, the following additional information is required:

(i) Name and address of vessel's owner;

(ii) Location of vessel's mooring;

(iii) Name of person in charge of vessel;

(iv) Name and address of the owner of the cargo; and

(v) A complete record, by time intervals of one week, of all receipts and disbursements of hazardous materials. The name and address of the consignor must be shown against all receipts and the name and address of the consignee against all deliveries.

(b) The hazardous material information on the dangerous cargo manifest must be the same as the information furnished by the shipper on the shipping order or other shipping paper, except that the IMO "correct technical name" and the IMO class may be indicated on the manifest as provided in paragraphs (a)(3) and (a)(5) of this section. The person who supervises the preparation of the manifest, list, or stowage plan shall ensure that the information is correctly transcribed, and shall certify to the truth and accuracy of this information to the best of his knowledge and belief by his signature and notation of the date prepared.

(c) The carrier and its agents shall insure that the master, or a licensed deck officer designated by the master and attached to the vessel, or in the case of a barge, the person in charge of the barge, acknowledges the correctness of the dangerous cargo manifest, list or stowage plan by his signature.

(d) For barges, manned or unmanned, the requirements of this section apply except for the following:

(1) In the case of a manned barge, the person in charge of the barge shall prepare the dangerous cargo manifest.

(2) In the case of an unmanned barge, the person responsible for loading the barge is responsible for the preparation of a dangerous cargo manifest, list, or stowage plan and must designate an individual for that purpose.

(3) For all barges, manned or unmanned, the dangerous cargo manifest must be on board the barge in a readily accessible location and a copy must be furnished to the person in charge of the towing vessel.

(e) Each carrier who transports or stores hazardous materials on a vessel shall retain a copy of the dangerous cargo manifest, list, or stowage plan for at least one year, and shall make that document available for inspection in accordance with §176.36(b) of this

subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.30, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.31 Exemptions.
If a hazardous material is being transported by vessel under the authority of an exemption and a copy of the exemption is required to be on board the vessel, it must be kept with the dangerous cargo manifest.

§176.36 Preservation of records.
(a) When this part requires shipping orders, manifest, cargo lists, stowage plans, reports, or any other papers, documents or similar records to be prepared, the carrier shall preserve them or copies of them in his place of business or office in the United States for a period of one year after their preparation.
(b) Any record required to be preserved must be made available upon request to an authorized representative of the Department of Transportation.

§176.39 Inspection of cargo.
(a) *Manned vessels. The carrier, its agents, and any person designated for this purpose by the carrier or agents shall cause an inspection of each hold or compartment containing hazardous materials to be made after stowage is complete, and at least once every 24 hours thereafter, weather permitting, in order to ensure that the cargo is in a safe condition and that no damage caused by shifting, spontaneous heating, leaking, sifting, wetting, or other cause has been sustained by the vessel or its cargo since loading and stowage. However, freight containers or individual barges need not be opened. A vessel's holds equipped with smoke or fire detecting systems having an automatic monitoring capability need not be inspected except after stowage is complete and after periods of heavy weather. The carrier, its agents, and any person designated for this purpose by the carrier or agents shall cause an entry to be made in the vessel's deck log book for each inspection of the stowage of hazardous materials performed.*
(b) Unmanned and magazine vessels. An inspection of the cargo must be made after stowage has been completed to ensure that stowage has been accomplished properly and that there are no visible signs of damage to any packages or evidence of heating, leaking, or sifting. This inspection must be made by the individual who is responsible to

the carrier and who is in charge of loading and stowing the cargo on the unmanned vessels or the individual in charge in the case of a magazine vessel.
(c) The carrier, its agents, and any person designated for this purpose by the carrier or agents of each ocean-going vessel carrying hazardous material shall, immediately prior to entering a port in the United States, cause an inspection of that cargo to be made.
(d) When inspecting a cargo of hazardous materials capable of evolving flammable vapors, any artificial means of illumination must be of an explosion-proof type.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-8, 44 FR 23228, Apr. 19, 1979; Amdt. 176-9, 44 FR 49458, Aug. 23, 1979]

§176.45 Emergency situations.

(a) When an accident occurs on board a vessel involving hazardous materials, and the safety of the vessel, its passengers or crew are endangered, the master shall adopt such procedures as will, in his judgment, provide maximum safety for the vessel, its passengers, and its crew. When the accident results in damaged packages or the emergency use of unauthorized packagings, these packages may not be offered to any forwarding carrier for transportation. The master shall notify the nearest Captain of the Port, U.S. Coast Guard, and request instructions for disposition of the packages.

(b) Hazardous materials may be jettisoned only if the master believes this action necessary to prevent or substantially reduce a hazard to human life or reduce a substantial hazard to property.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976]

§176.48 Situation requiring report.

(a) When a fire or other hazardous condition exists on a vessel transporting hazardous materials, the master shall notify the nearest Captain of the Port as soon as possible and shall comply with any instructions given by the Captain of the Port.

(b) When an incident occurs during transportation in which a hazardous material is involved, a report may be required (see §§171.15 and 171.16 of this subchapter).

(c) If a package, portable tank, freight container, highway or railroad vehicle containing hazardous materials is jettisoned or lost, the master shall notify the nearest Captain of the Port as soon as possible of the location, quantity, and type of the material.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986; Amdt. 176-25, 52 FR 8592, Mar. 19, 1987]

§176.50 Acceptance of damaged or leaking packages.

A carrier may not transport by vessel any package that is so damaged as to permit the escape of its contents, that appears to have leaked, or that gives evidence of failure to properly contain the contents unless it is restored or repaired to the satisfaction of the master of the vessel. A package containing radioactive materials (other than low specific activity materials) may not be repaired or restored.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976]

§176.52 Rejections of shipments in violation.

(a) A carrier may not knowingly transport by vessel any hazardous material offered under a false or deceptive name, marking, invoice, shipping paper or other declaration, or without the shipper furnishing written information about the true nature of the material at the time of delivery.

(b) If a shipment in violation is found in transit, the master of the vessel shall adopt procedures which in his judgment provide maximum safety to the vessel, its passengers and its crew and which are in compliance with §176.45. If the vessel is in port, the material may not be delivered to any party, and the master shall immediately notify the nearest Captain of the Port and request instructions for disposition of the material.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976]

§176.54 Repairs involving welding, burning, and power-actuated tools and appliances.

(a) Except as provided in paragraph (b) of this section, repairs or work involving welding or burning, or the use of power-actuated tools or appliances which may produce intense heat may not be undertaken on any vessel having on board explosives or other hazardous materials as cargo.

(b) Paragraph (a) of this section does not apply if:

(1) The repairs or work are approved by the COTP under 33 CFR 126.15(c); or

(2) Emergency repairs to the vessel's main propelling or boiler plant or auxiliaries are necessary for the safety of the vessel. If such repairs are performed, the master of the vessel must immediately notify the nearest COTP.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

Subpart C - General Handling and Stowage

§176.57 Supervision of handling and stowage.

(a) Hazardous materials may be handled or stowed on board a vessel only under the direction and observation of a responsible person assigned this duty.

(b) For a vessel engaged in coastwise voyages, or on rivers, bays, sounds or lakes, including the Great Lakes when the voyage is not foreign-going, the responsible person may be an employee of the carrier and assigned this duty by the carrier, or a licensed officer attached to the vessel and assigned by the master of the vessel.

(c) For a domestic vessel engaged in a foreign-going or intercoastal voyage, the responsible person must be an officer possessing an unexpired license issued by the USCG and assigned this duty by the master of the vessel.

(d) For a foreign vessel, the responsible person must be an officer of the vessel assigned this duty by the master of the vessel.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.58 Preparation of the vessel.

(a) Each hold or compartment in which hazardous materials are to be stowed must be free of all debris before the hazardous materials are stowed. Bilges must be examined and all residue of previous cargo removed.

(b) All decks, gangways, hatches, and cargo ports over or through which hazardous materials must be passed or handled in loading or unloading must be free of all loose materials before cargo handling operations begin.

(c) No debris that creates a fire hazard or a hazardous condition for persons engaged in handling hazardous materials may be on the weather deck of a vessel during loading or unloading operations.

(d) Hatch beams and hatch covers may not be stowed in a location that would interfere with cargo handling.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.60 "No Smoking" signs.

When smoking is prohibited during the loading, stowing, storing, transportation, or unloading of hazardous materials by this part, the carrier and the master of the vessel are jointly responsible for posting "NO SMOKING" signs in conspicuous locations.

§176.63 Stowage locations.

(a) The table in §172.101 of this subchapter specifies generally the locations authorized for stowage of the various hazardous materials on board vessels. This part prescribes additional requirements with respect to the stowage of specific hazardous materials in addition to those authorized in §172.101 of this subchapter. This section sets forth the basic physical requirements for the authorized locations.

(b) To qualify as "on deck" stowage, the location must be on the weather deck. If it is in a house on the weather deck, it must have a permanent structural opening to the atmosphere, such as a door, hatch companionway or manhole, and must be vented to the atmosphere. It may not have any structural opening to any living quarters, cargo, or other compartment unless the opening has means for being closed off and secured. Any deck house containing living quarters, a steering engine, a refrigerating unit, a refrigerated stowage box, or a heating unit may not be used unless that area is isolated from the cargo stowage area by a permanent, and tight metallic bulkhead. Stowage in a shelter or 'tween deck is not considered to be "on deck". A barge which is vented to the atmosphere and is stowed on deck on a barge-carrying ship is considered to be "on deck". When an entry in §172.101 of this subchapter requires "on-deck" stowage and is qualified by the requirement "shade from radiant heat", the stowage must be protected from the direct rays of the sun by means of structural erections or awnings except that such protection is not required for shipment in portable tanks.

(c) To qualify as "under deck" stowage, the location must be in a hold or compartment below the weather deck capable of being ventilated and allotted entirely to the carriage of cargo. It must be bounded by permanent steel decks and bulkheads or the shell of the vessel. The deck openings must have means for effectively closing the hold or compartment against the weather, and in the case of superimposed holds, for effectively closing off each hold. A hold or compartment containing a crew passage formed by battens or by mesh or wire screen bulkhead may not be used for the stowage of any hazardous material unless a watchman is provided for this area.

(d) To qualify as "under deck away from heat", the location must be under deck and have built-in means for ventilation. If it is subject to heat from any artificial source, it only qualifies for the stowage of those hazardous materials for which "under deck" stowage is authorized.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-12, 45 FR 81572, Dec. 11, 1980]

§176.65 Alternative stowage procedures.

When a hazardous material is to be loaded on board a vessel and it is shown to the satisfaction of the Coast Guard Captain of the Port for the place where the vessel is being loaded that it is impracticable to comply with a stowage location requirement specified in the §172.101 table of this subchapter or a segregation, handling or stowage requirement specified in this part, the Captain of the Port may authorize in writing the use of an alternative stowage location or method of segregation, handling or stowage subject to such conditions as he finds will insure a level of safety at least equal to that afforded by the regulatory requirement concerned.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.69 General stowage requirements for hazardous materials.

(a) Hazardous materials (except as provided in paragraph (c) of this section and Class 9 (miscellaneous hazardous) materials) must be stowed in a manner that will facilitate inspection during the voyage, their removal from a potentially dangerous situation, and the removal of packages in case of fire.

(b) Each package marked in accordance with §172.312(a)(2) of this subchapter must be stowed as to remain in the position indicated during transportation.

(c) If a vessel designed for and carrying hazardous materials in freight containers or a vessel designed for and carrying hazardous materials in barges is equipped with a fixed fire extinguishing and fire detection system, the freight containers or barges need not be stowed in the manner required by paragraph (a) of this section. When freight containers or barges containing hazardous materials are stowed on deck, they need not be stowed in the manner required by paragraph (a) of this section if fire fighting equipment capable of reaching and piercing the freight container or barge is on board the vessel.

(d) Packages of hazardous materials must be secured and dunnaged to prevent movement in any direction. Vertical restraints are not required if the shape of the package and the stuffing pattern preclude shifting of the load.

(e) Packages of hazardous materials must be braced and dunnaged so that they are not likely to be pierced by the dunnage or crushed by a superimposed load.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-12, 45 FR 81573, Dec. 11, 1980; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; 56 FR 66282, Dec. 20, 1991]

§176.70 Stowage requirements for marine pollutants.

(a) Marine pollutants must be properly stowed and secured to minimize the hazards to the marine environment without impairing the safety of the ship and the persons on board.

(b) Where stowage is permitted "on deck or under deck", under deck stowage is preferred except when a weather deck provides equivalent protection.

(c) Where stowage "on deck only" is required, preference should be given to stowage on well-protected decks or to stowage inboard in sheltered areas of exposed decks.

[Amdt. 176-31, 57 FR 52940, Nov. 5, 1992]

§176.72 Handling of break-bulk hazardous materials.

(a) A metal bale hook may not be used for handling any package of hazardous materials.

(b) The use of equipment designed to lift or move cargo by means of pressure exerted on the packages may not be used for handling any package of hazardous materials if the device can damage the package or the package is not designed to be moved in that manner.

(c) Pallets, slings, cargo nets and other related equipment used in loading packages of hazardous materials must give adequate support to the packages. The packages must be contained so that they are not able to fall during loading.

§176.74 On deck stowage of break-bulk hazardous materials.

(a) Packages containing hazardous materials must be secured by enclosing in boxes, cribs or cradles and proper lashing by use of wire rope, strapping or other means, including shoring and bracing, or both. Lashing of deck cargo is permitted if eye pads are used to attach the lashings. Lashings may not be secured to guard rails. Bulky articles must be shored.

(b) A packaging susceptible to weather or water damage must be protected so that it will not be exposed to the weather or to sea water.

(c) Not more than fifty percent of the total open deck area should be used for stowage of hazardous materials (except Class 9 (miscellaneous hazardous) materials material).

(d) Fireplugs, hoses, sounding pipes, and access to these must be free and clear of all cargo.

(e) Crew and passenger spaces and areas set aside for the crew's use may not be used to stow any hazardous material.

(f) A hazardous material may not be stowed within a horizontal distance of 25 feet of an operating or embarkation point of a lifeboat.

(g) Hazardous materials must be stowed to permit safe access to the crew's quarters and to all parts of the deck required in navigation and necessary working of the vessel.

(h) When runways for use of the crew are built over stowed hazardous materials, they must be constructed and fitted with rails and lifelines so as to afford complete protection to the crew when in use.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; 56 FR 66282, Dec. 20, 1991]

§176.76 Transport vehicles, freight containers, and portable tanks containing hazardous materials.

(a) Except as provided in paragraphs (b) through (f) of this section, hazardous materials authorized to be transported by vessel may be carried on board a vessel in a transport vehicle or freight container, subject to the following conditions (see additional requirements concerning the transport of Class 1 (explosive) materials in §§176.168 through 176.172 of this subchapter):

(1) The material must be in proper condition for transportation according to the requirements of this subchapter;

(2) All packages in the transport vehicle or freight container must be secured to prevent movement in any direction. Vertical restraint is not required if the shape of the packages, loading pattern, and horizontal restraint preclude vertical movement of the load within the freight container or transport vehicle;

(3) Bulkheads made of dunnage which extend to the level of the cargo must be provided unless the packages are stowed flush with the sides or ends;

(4) Dunnage must be secured to the floor when the cargo consists of dense materials or heavy packages;

(5) Each package marked in accordance with §172.312(a)(2) of this subchapter must be stowed as marked;

(6) Any slack spaces between packages must be filled with dunnage;

(7) The weight in a container must be distributed throughout as evenly as possible and the maximum permissible weight must not be exceeded;

(8) Adjacent levels of baggaged and baled cargo must be stowed in alternate directions so that each tier binds the tier above and below it;

(9) [Reserved]

(10) The lading must be contained entirely within the freight container or vehicle body without overhang or projection except that oversized machinery such as tractors or vehicles with batteries attached may overhang or project outside the intermodal container provided all of that portion of the lading that consists of hazardous materials is contained entirely within the freight container. No open-bed container or vehicle is permitted to carry hazardous materials unless it is equipped with a means of properly securing the lading.

(b) A transport vehicle containing hazardous materials may be carried only on board a trailership, trainship, ferry vessel or car float.

(c) [Reserved]

(d) A transport vehicle or freight container equipped with heating or refrigeration equipment may be operated on board a vessel. However, the equipment may not be operated in any hold or compartment in which any flammable liquid or gas is stowed. Any heating or air conditioning equipment having a fuel tank containing a flammable liquid or gas may be stowed only "on deck". Equipment electrically powered and designed to operate within an environment containing flammable vapors may be operated below deck in a hold or compartment containing a flammable liquid or gas. (See §176.79.)

(e) A transport vehicle, loaded with any hazardous material which is required to be stowed "on deck" by §172.101 of this subchapter, may be stowed one deck below the weather deck when transported on a trainship or trailership which is unable to provide "on deck" stowage because of the vessel's design. Otherwise, the transport vehicle or container must be transported "on deck."

(f) A hazardous material may be carried on board a vessel in a portable tank subject to the following conditions:

(1) Small passenger vessels of 100 gross tons, or less, may carry a hazardous material in a portable tank only when 16 or less passengers are on board and only when specifically authorized by the Officer-in-Charge, Marine Inspection, by endorsement of the vessel's Certificate of Inspection.

(2) Portable tanks containing Flammable liquids or gases, Combustible liquids with flashpoints below 141 ^{o}F. that are insoluble in water, or organic peroxides, spontaneously combustible materials, or water reactive materials must be stowed on deck irrespective of the stowage authorized in §172.101 of this subchapter. Portable tanks containing hazardous materials not restricted to on deck stowage by the previous sentence must be stowed in accordance with the requirements specified in §172.101 of this subchapter.

(3) Aluminum, magnesium, and their alloys are specifically prohibited as materials of construction of portable tanks.

(g) *Cryogenic liquids. For shipment of cryogenic liquids on board a vessel the packaging must be designed and filled so that:*

(1) Any cryogenic liquid being transported in a cargo tank, regardless of the pressure in the package, must be contained in a steel jacketed Specification MC-338 (§178.338 of this subchapter) insulated cargo tank.

(2) Any valve or fitting with moving or abrading parts that may come in contact with any cryogenic liquid may not be made of aluminum.

(3) For a flammable cryogenic liquid being transported in a cargo tank, the elapsed time between the loading of the cargo tank and the subsequent unloading of the cargo tank at its final destination may not exceed the marked rated holding time (MRHT) of the cargo tank for the cryogenic liquid being transported, which must be displayed on or adjacent to the specification plate.

(4) Portable tanks, cargo tanks, and tank cars containing cryogenic liquids must be stowed "on deck" regardless of the stowage authorized in §172.101 of this subchapter. Cargo tanks or tank cars containing cryogenic liquids may be stowed one deck below the weather deck when transported on a trailership or trainship that is unable to provide "on deck" stowage because of the vessel's design. Tank cars must be Class DOT-113

or AAR-204W tank cars.

(h) A fumigated transport unit may only be transported on board a vessel subject to the following conditions and limitations:

(1) The fumigated transport unit may be placed on board a vessel only if at least 24 hours have elapsed since the unit was last fumigated;

(2) The fumigated transport unit is accompanied by a document showing the date of fumigation and the type and amount of fumigant used;

(3) Prior to loading, the master is informed of the intended placement of the fumigated transport unit on board the vessel and the information provided on the accompanying document;

(4) Equipment that is capable of detecting the fumigant and instructions for the equipment's use is provided on the vessel;

(5) The fumigated transport unit must be stowed at least five meters from any opening to accommodation spaces;

(6) Fumigated transport units may only be transported on deck on vessels carrying more than 25 passengers; and

(7) Fumigants may not be added to transport units while on board a vessel.

(i) Containers packed or loaded with flammable gases or liquids having a flashpoint of 23^{o} C or less and carried on deck must be stowed "away from" possible sources of ignition.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.76, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.77 Stowage of barges containing hazardous materials on board barge-carrying vessels.

(a) A barge which contains hazardous materials may be transported on board a barge-carrying vessel if it is stowed in accordance with the requirements of this section.

(b) A barge which contains hazardous materials for which only "on deck" stowage is authorized must be stowed above the weather deck and be vented to the atmosphere.

(c) A barge which contains hazardous materials for which both "on deck" and "below deck" storage is authorized may be stowed above or below the weather deck.

§176.78 Use of power-operated industrial trucks on board vessels.

(a) *Power Operated trucks. A power-operated truck (including a power-operated tractor, forklift, or other specialized truck used for cargo handling) may not be used on board a vessel in a space containing a hazardous material unless the truck conforms to the*

requirements of this section. The COTP may suspend or prohibit the use of cargo handling vehicles or equipment when that use constitutes a safety hazard.
(b) Each truck must have a specific designation of Underwriter's Laboratories or Factory Mutual Laboratories. Any repair or alteration to a truck must be equivalent to that required on the original designation.
(c) *Description of designations. The recognized testing laboratory type designations are as follows:*
(1) An "E" designated unit is an electrically-powered unit that has minimum acceptable safeguards against inherent fire hazards.
(2) An "EE" designated unit is an electrically-powered unit that has, in addition to all the requirements for the "E" unit, the electric motor and all other electrical equipment completely enclosed.
(3) An "EX" designated unit is an electrically-powered unit that differs from the "E" and "EE" unit in that the electrical fittings and equipment are so designed, constructed, and assembled that the unit may be used in certain atmospheres containing flammable vapors or dusts.
(4) A "G" designated unit is a gasoline-powered unit having minimum acceptable safeguards against inherent fire hazards.
(5) A "GS" designated unit is a gasoline-powered unit that is provided with additional safeguards to the exhaust, fuel, and electrical systems.
(6) An "LP" designated unit is similar to a "G" unit except that it is powered by liquefied petroleum gas instead of gasoline.
(7) An "LPS" designated unit is a unit similar to a "GS" unit except that liquefied petroleum gas is used for fuel instead of gasoline.
(8) A "D" designated unit is a unit similar to a "G" unit except that it is powered by a diesel engine instead of a gasoline engine.
(9) A "DS" designated unit is a unit powered by a diesel engine provided with additional safeguards to the exhaust, fuel, and electrical systems.
(d) *Class 1 (explosive) materials. No power-operated truck may be used to handle Class 1 (explosive) materials or other cargo in an area near Class 1 (explosive) materials on board a vessel except:*
(1) A power-operated truck designated EE or EX.
(2) A power-operated truck designated LPS, GS, D, or DS may be used under conditions acceptable to the COTP.
(e) *Other hazardous materials. (1) Only an "EX", "EE", "GS", "LPA", or "DS" truck may be used in a hold or compartment containing Division 2.1 (flammable gas) materials, Class 3 (flammable liquids), Class 4 (flammable solids) materials, or Class 5 (oxidizers or organic peroxides) materials, cottons or other vegetable fibers, or bulk sulfur.*
(2) Only a designated truck may be used to handle any other hazardous material not covered in paragraph (d) or (e)(1) of this section.
(f) *Minimum safety features. In addition to the construction and design safety features required, each truck must have at least the following minimum safety features:*
(1) The truck must be equipped with a warning horn, whistle, gong, or other device that may be heard clearly above normal shipboard noises.

(2) When the truck operation may expose the operator to danger from a falling object, the truck must be equipped with a driver's overhead guard. When the overall height of the truck with forks in the lowered position is limited by head room the overhead guard may be omitted. This overhead guard is only intended to offer protection from impact of small packages, boxes, bagged material, or similar hazards.
(3) A forklift truck used to handle small objects or unstable loads must be equipped with a load backrest extension having height, width, and strength sufficient to prevent any load, or part of it, from falling toward the mast when the mast is in a position of maximum backward tilt. The load backrest extension must be constructed in a manner that does not interfere with good visibility.
(4) The forks on a fork lift truck must be secured to the carriage so as to prevent any unintentional lifting of the toe which could create a hazard. The forks may not display permanent deformation when subjected to a test load of three times the rated capacity.
(5) Each fork extension or other attachment must be secured to prevent unintentional lifting or displacement on primary forks.
(6) Tires extending beyond the confines of the truck shall be provided with a guard to prevent the tires from throwing particles at the operator.
(7) Unless the steering mechanism is a type that prevents road reactions from causing the steering handwheel to spin, a mushroom type steering knob must be used to engage the palm of the operator's hand, or the steering mechanism must be arranged in some other manner to prevent injury. The knob must be mounted within the perimeter of the wheel.
(8) All steering controls must be confined within the clearnace of the truck or guarded so that movement of the controls will not result in injury to the operator when passing stanchions, obstructions or other.
(g) *Special operating conditions. (1) A truck may not be used on board a vessel unless prior notification of its use is given to the master or senior deck officer on board.*
(2) Before a truck is operated on board a vessel, it must be in a safe operating condition as determined by the master or senior deck officer on board.
(3) Any truck that emits sparks or flames from the exhaust system must immediately be removed from service and may not be returned to service until the cause of these sparks or flames has been eliminated.
(4)-(5) [Reserved]
(6) All truck motors must be shut off immediately when a breakage or leakage of packages containing flammable liquids or gases, flammable solids, oxidizers, or organic peroxides occurs or is discovered.
(7) The rated capacity of the truck must be posted on the truck at all times in a conspicuous place. This capacity may not be exceeded.
(8) At least one Coast Guard approved marine type size 1 Type B, or UL approved 5BC portable fire extinguisher, or its approved equivalent, must be affixed to the truck in a readily accessible position or must be kept in close proximity, available for immediate use.
(9) The vessel's fire fighting equipment, both fixed (where installed) and portable, must be kept ready for immediate use in the vicinity of the space being worked.

(h) *Refueling. (1) A truck using gasoline as fuel may not be refueled in the hold or on the weather deck of a vessel unless a portable non-spilling fuel handling system of not over five gallons capacity is used. Gasoline may not be transferred to a portable non-spilling fuel handling device on board the vessel.*
(2) A truck using liquefied petroleum gas as fuel may not be refueled in the hold or on the weather deck of a vessel unless it is fitted with a removable tank and the hand-operated shutoff valve of the depleted tank is closed. In addition, the motor must be run until it stalls from lack of fuel and then the hand-operated shut off valve closed before the quick disconnect fitting to the fuel tank is disconnected.
(3) A truck using diesel oil as fuel may not be refueled on the weather deck or in the hold of a vessel unless a portable container of not over a five gallon capacity is used. A truck may be refueled or a portable container may be refilled from a larger container of diesel fuel on the weather deck of a vessel if a suitable pump is used for the transfer operation and a drip pan of adequate size is used to prevent any dripping of fuel on the deck.
(4) Refueling must be performed under the direct supervision of an experienced and responsible person specifically designated for this duty by the person in charge of the loading or unloading of the vessel.
(5) Refueling may not be undertaken with less than two persons specifically assigned and present for the complete operation, at least one of whom must be experienced in using the portable fire extinguishers required in the fuel area.
(6) At least one Coast Guard approved marine type size 1 Type B or UL approved 5BC portable fire extinguisher or its approved equivalent, must be provided in the fueling area. This is in addition to the extinguisher required by paragraph (g)(8) of this section.
(7) The location for refueling trucks must be designated by the master or senior deck officer on board the vessel. "NO SMOKING" signs must be conspicuously posted in the area.
(8) The location designated for refueling must be adequately ventilated to insure against accumulation of any hazardous concentration of vapors. When a truck is being refueled, the ventilation requirements of §176.79 apply.
(9) Before any truck in a hold is refueled or before any fuel handling device or unmounted liquefied petroleum gas cylinder is placed in a hold, the motors of all trucks in the same hold must be stopped.
(10) All fuel handling devices and unmounted liquefied petroleum gas containers must be removed from a hold before any truck motor is started and the trucks are placed in operation in that hold.
(i) *Replacing batteries. Batteries for electrically powered trucks and for the ignition systems of internal combustion powered trucks may be changed in the hold of a vessel subject to the following conditions:*
(1) Only suitable handling equipment may be employed.
(2) Adequate precautions must be taken to avoid damage to the battery, short circuiting of the battery, and spillage of the electrolyte.
(j) *Charging of batteries. Batteries of industrial trucks may be recharged in a hold of a vessel subject to the following conditions:*

(1) The batteries must be housed in a suitable, ventilated, portable metal container with a suitable outlet at the top for connection of a portable air hose, or must be placed directly beneath a suitable outlet at the top for connection of a portable air hose. The air hose must be permanently connected to an exhaust duct leading to the open deck and terminate in a gooseneck or other suitable weather head. If natural ventilation is not practicable or adequate, mechanical means of exhaust must be employed in conjunction with the duct. The air outlet on the battery container must be equipped with an interlock switch so arranged that the charging of the battery cannot take place unless the air hose is properly connected to the box.
(2) If mechanical ventilation is used, an additional interlock must be provided between the fan and the charging circuit so that the fan must be in operation in order to complete the charging circuit for operation. It is preferable that this interlock switch be of a centrifugal type driven by the fan shaft.
(3) The hold may not contain any hazardous materials.
(4) The charging facilities may be part of the truck equipment or may be separate from the truck and located inside or outside the cargo hold. The power supply or charging circuit (whichever method is used) must be connected to the truck by a portable plug connection of the break-away type. This portable plug must be so engaged with the truck battery charging outlet that any movement of the truck away from the charging station will break the connection between the plug and receptacle without exposing any live parts to contact with a conducting surface or object and without the plug falling to the deck where it may become subject to damage.
(5) All unmounted batteries must be suitably protected or removed from an area in the hold of the vessel before any truck is operated in that area.
(k) *Stowage of power-operated industrial trucks on board a vessel. Trucks stowed on board a vessel must meet vessel stowage requirements in §176.905.*
(l) Packaging and stowage of fuel on board a vessel. Division 2.1 (flammable gas) materials and flammable liquids used as fuel for industrial trucks must be packaged and stowed as authorized in 46 CFR 147.60 or 46 CFR 147.45, respectively.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; Amdt. 176-39, 61 FR 18933, Apr. 29, 1996; Amdt. 176-43, 62 FR 24741, May 6, 1997]

Subpart D - General Segregation Requirements

§176.80 Application.

(a) This subpart sets forth segregation requirements in addition to any segregation requirements set forth elsewhere in this subchapter.

(b) Hazardous materials in limited quantities when loaded in transport vehicles and freight containers, are excepted from the segregation requirements of this subpart and any additional segregation specified in this subchapter for transportation by vessel.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-3, 42 FR 57967, Nov. 7, 1977]

§176.83 Segregation.

(a) *General. (1) The requirements of this section apply to all cargo spaces on deck or under deck of all types of vessels, and to all cargo transport units.*

(2) Segregation is obtained by maintaining certain distances between incompatible hazardous materials or by requiring the presence of one or more steel bulkheads or decks between them or a combination thereof. Intervening spaces between such hazardous materials may be filled with other cargo which is not incompatible with the hazardous materials.

(3) The general requirements for segregation between the various classes of dangerous goods are shown in the segregation table. In addition to these general requirements, there may be a need to segregate a particular material from other materials which would contribute to its hazard. Such segregation requirements are indicated by code numbers in Column 10B of the §172.101 Table.

(4) Segregation is not required between hazardous materials of different classes which comprise the same substance but vary only in their water content (e.g., sodium sulphide in Division 4.2 or Class 8).

(5) Whenever hazardous materials are stowed together, whether or not in a transport unit, the segregation of such hazardous materials from others must always be in accordance with the most restrictive requirements for any of the hazardous materials concerned.

(6) When the §172.101 table or §172.402 requires packages to bear a subsidiary hazard label or labels, the segregation appropriate to the subsidiary hazards must be applied when that segregation is more restrictive than that required by the primary hazard. For the purposes of this paragraph, the segregation requirements corresponding to an explosive subsidiary hazard are-except for organic peroxides which are those corresponding to Division 1.3-those for Division 1.4 (Class C explosive) materials.

(7) Where, for the purposes of segregation, terms such as "away from" a particular hazard class are used in the §172.101 table, the segregation requirement applies to:

(i) All hazardous materials within the hazard class; and

(ii) All hazardous materials for which a secondary hazard label of that class is required.

(8) Notwithstanding the requirements of paragraphs (a)(6) and (a)(7) of this section, hazardous materials of the same class may be stowed together without regard to segregation required by secondary hazards (subsidiary risk label(s)), provided the

substances do not react dangerously with each other and cause:

(i) Combustion and/or evolution of considerable heat;

(ii) Evolution of flammable, toxic or asphyxiant gases;

(iii) The formation of corrosive substances; or

(iv) The formation of unstable substances.

(9) Stowage in a shelter-'tween deck cargo space is not considered to be "on deck" stowage.

(10) Where the code in column (10B) of the §172.101 Table specifies that "Segregation as for. . ." applies, the segregation requirements applicable to that class in the §176.83(b) General Segregation Table must be applied. However, for the purposes of paragraph (a)(8) of this section, which permits substances of the same class to be stowed together provided they do not react dangerously with each other, the segregation requirements of the class as represented by the primary hazard class in the §172.101 Table entry must be applied.

(b) *General Segregation Table. The following table sets forth the general requirements for segregation between the various classes of hazardous materials. The properties of materials within each class may vary greatly and may require greater segregation than is reflected in this table. If the §172.101 table sets forth particular requirements for segregation, they take precedence over these general requirements.*

Table §176.83(b)-General Segregation Requirements for Hazardous Materials
[Segregation must also take account of a single secondary hazard label, as required by paragraph (a)(6) of this section.]

Class	1.1 1.2 1.5	1.3	1.4 1.6	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8	9
Explosives, 1.1, 1.2, 1.5	(*)	(*)	(*)	4	2	2	4	4	4	4	4	4	2	4	2	4	X
Explosives, 1.3	(*)	(*)	(*)	4	2	2	4	3	3	4	4	4	2	4	2	2	X
Explosives, 1.4, 1.6	(*)	(*)	(*)	2	1	1	2	2	2	2	2	2	X	4	2	2	X
Flammable gases 2.1	4	4	2	X	X	X	2	1	2	X	2	2	X	4	2	1	X
Non-toxic, non-flammable gases 2.2	2	2	1	X	X	X	1	X	1	X	X	1	X	2	1	X	X
Poisonous gases 2.3	2	2	1	X	X	X	2	X	2	X	X	2	X	2	1	X	X
Flammable liquids 3	4	4	2	2	1	2	X	X	2	1	2	2	X	3	2	X	X
Flammable solids 4.1	4	3	2	1	X	X	X	X	1	X	1	2	X	3	2	1	X
Spontaneously combustible substances 4.2	4	3	2	2	1	2	2	1	X	1	2	2	1	3	2	1	X
Substances which are dangerous when wet 4.3	4	4	2	X	X	X	1	X	1	X	2	2	X	2	2	1	X
Oxidizing substances 5.1	4	4	2	2	X	X	2	1	2	2	X	2	1	3	1	2	X
Organic peroxides 5.2	4	4	2	2	1	2	2	2	2	2	2	X	1	3	2	2	X
Poisons 6.1	2	2	X	X	X	X	X	X	1	X	1	1	X	1	X	X	X
Infectious substances 6.2	4	4	4	4	2	2	3	3	3	2	3	3	1	X	3	3	X
Radioactive materials 7	2	2	2	2	1	1	2	2	2	2	1	2	X	3	X	2	X
Corrosives 8	4	2	2	1	X	X	X	1	1	1	2	2	X	3	2	X	X
Miscellaneous dangerous substances 9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Numbers and symbols relate to the following terms as defined in this section:

1-"Away from."

2-"Separated from."

3-"Separated by a complete compartment or hold from."

4-"Separated longitudinally by an intervening complete compartment or hold from."

X-The segregation, if any, is shown in the §172.101 table.

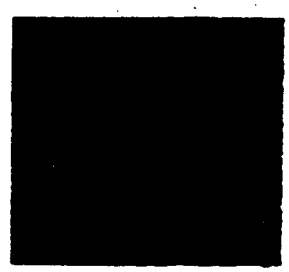
*-See §176.144 of this part for segregation within Class 1.

(c) *Segregation requirements for breakbulk cargo. (1) The requirements of this paragraph apply to the segregation of packages containing hazardous materials and stowed as breakbulk cargo;*

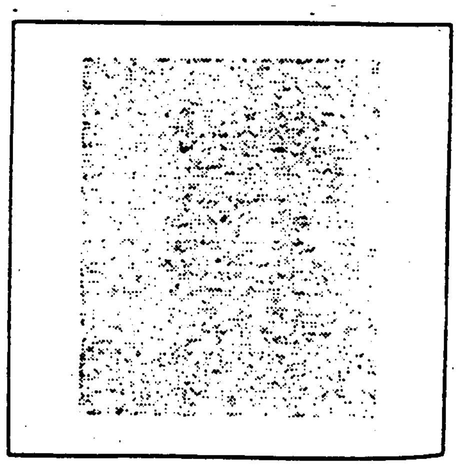
(2) Definition of the segregation terms:

(i) Legend:

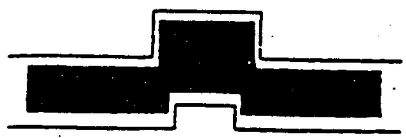
(A) Package containing incompatible goods.



(B) Reference package.

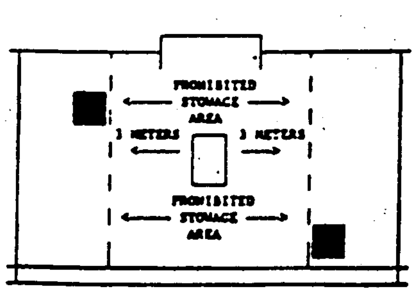


(C) Deck resistant to fire and liquid.

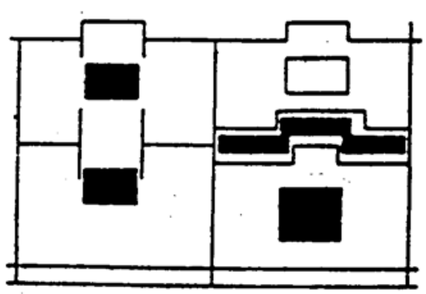


Note: Full vertical lines represent transverse bulkheads between compartments or holds resistant to fire and liquid.

(ii) *"Away from": Effectively segregated so that the incompatible materials cannot interact dangerously in the event of an accident but may be carried in the same compartment or hold or on deck provided a minimum horizontal separation of 3 meters (10 feet) projected vertically is obtained.*

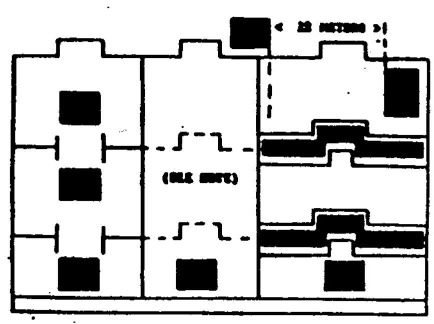


(iii) "Separated From": In different compartments or holds when stowed under deck.



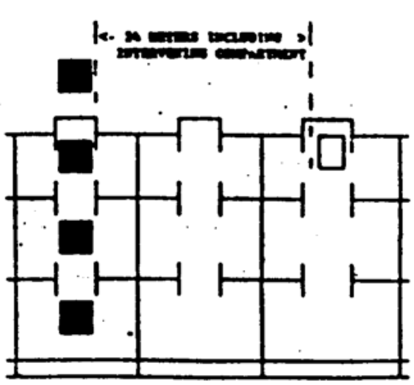
If the intervening deck is resistant to fire and liquid, a vertical separation (i.e., in different compartments accepted as equivalent to this segregation. For "on deck" stowage, this segregation means a separation by a distance of at least 6 meters (20 feet) horizontally.

(iv) "Separated by a complete compartment or hold from": Either a vertical or horizontal separation. If the intervening decks are not resistant to fire and liquid, then only a longitudinal separation (i.e., by a intervening complete compartment or hold) is acceptable. For "on deck" stowage, this segregation means a separation by a distance of at least 12 meters (39 feet) horizontally. The same distance must be applied if one package is stowed "on deck, and the other one in an upper compartment.



Note: One of the two decks must be resistant to fire and liquid.

(v) "Separated longitudinally by an intervening complete compartment or hold from": Vertical separation alone does not meet this requirement. Between a package "under



deck" and one "on deck" a minimum distance of 24 meters (79 feet) including a complete compartment must be maintained longitudinally. For "on deck" stowage, this segregation means a separation by a distance of at least 24 meters (79 feet) longitudinally.

(d) Segregation in transport units: Two hazardous materials for which any segregation is required may not be stowed in the same transport unit.

(e) Segregation of hazardous materials stowed as breakbulk cargo from those packed in transport units: (1) Hazardous materials stowed as breakbulk cargo must be segregated from materials packed in open transport units in accordance with paragraph (c) of this section.

(2) Hazardous materials stowed as breakbulk cargo must be segregated from materials packed in closed transport units in accordance with paragraph (c) of this section, except that:

(i) Where "away from" is required, no segregation between packages and the closed transport units is required; and

(ii) Where "separated from" is required, the segregation between the packages and the closed transport units may be the same as for "away from".

(f) *Segregation of containers on board container vessels: (1) This paragraph applies to the segregation of freight containers which are carried on board container vessels, or on other types of vessels provided these cargo spaces are properly fitted for permanent stowage of freight containers during transport.*

(2) For container vessels which have cargo spaces used for breakbulk cargo or any other method of stowage, the appropriate paragraph of this section applies to the relevant cargo space.

(3) *Segregation Table: Table §176.83(f) sets forth the general requirements for segregation between freight containers on board container vessels.*

(4) In table §176.83(f), a container space means a distance of not less than 6 m (20 feet) fore and aft or not less than 2.5 m (8 feet) athwartship.

Table 176.83(f)-Segregation of Containers on Board Container Ships

Segregation requirement	Vertical			Horizontal						
-	Closed versus closed	Closed versus open	Open versus open		Closed versus closed		Closed versus open		Open versus open	
-	-	-	-	-	On deck	Under deck	On deck	Under deck	On deck	Under deck
1. "Away from"	One on top of the other	Open on top of closed	Not in the same vertical	Fore and aft Athwart	No restriction No	No restriction No	No restriction No	No restriction No	One container space	One container space

	permitted	permitted Otherwise as for open versus open	line unless segregated by a deck	ships	restriction	restriction	restriction	restriction	One container space	or one bulkhead. One container space.
2. "Separated from"	Not in the same vertical line unless segregated by a deck	As for open versus open	Not in the same vertical line unless segregated by a deck	Fore and aft Athwartships	One container space One container space	One container space or one bulkhead One container space	One container space One container space	One container space or one bulkhead Two container spaces	One container space. Two container spaces.	One bulkhead. One bulkhead.
3. "Separated by a complete compartment or hold from"	Not in the same vertical line unless segregated by a deck	As for open versus open	Not in the same vertical line unless segregated by a deck	Fore and aft Athwartships	One container space Two container spaces	One bulkhead One bulkhead	One container space Two container spaces	One bulkhead One bulkhead	Two container spaces Three container spaces	Two bulkheads. Two bulkheads.
4. "Separated longitudinally by an intervening complete compartment or hold from"	Prohibited	-	-	Fore and aft Athwartships	Four container spaces Prohibited	One bulkhead and four container spaces * Prohibited	Four container spaces Prohibited	Two bulkheads Prohibited	Four container spaces Prohibited	Two bulkheads. Prohibited.

*Containers not less than 6 meters (20 feet) from intervening bulkhead.

Note: All bulkheads and decks must be resistant to fire and liquid.

(g) *Segregation of transport units on board trailerships: (1) The requirements of this paragraph apply to the segregation of transport units which are carried on board trailerships or in "roll-on/roll-off" cargo spaces.*

(2) For trailerships which have spaces suitable for breakbulk cargo, containers, or any other method of stowage, the appropriate paragraph of this section applies to the relevant cargo space.

(3) *Segregation Table. Table §176.83(g) sets forth the general requirements for*

segregation between transport units on board trailerships.

Table 176.83(g)-Segregation of Transport Units on Board Trailerships and Trainships.

Segregation requirement							
-		Closed versus closed		Closed versus open		Open versus open	
-	-	On deck	Under deck	On deck	Under deck	On deck	Under deck
1. "Away From"	Fore and aft	No restriction	No restriction	No restriction	No restriction	At least 3 meters	At least 3 meters.
-	Athwartships	No restriction	No restriction	No restriction	No restriction	At least 3 meters	At least 3 meters.
2. "Separated from"	Fore and aft Athwartships	At least 6 meters At least 3 meters	At least 6 meters or one bulkhead At least 3 meters or one bulkhead	At least 6 meters At least 3 meters	At least 6 meters or one bulkhead At least 6 meters or one bulkhead	At least 6 meters At least 6 meters	At least 12 meters or one bulkhead At least 12 meters or one bulkhead
3. "Separated by a complete compartment or hold from"	Fore and aft Athwartships	At least 12 meters At least 12 meters	At least 24 meters + deck At least 24 meters + deck	At least 24 meters At least 24 meters	At least 24 meters + deck At least 24 meters + deck	At least 36 meters At least 36 meters	Two decks or two bulkheads. Prohibited.
4. "Separated longitudinally by an intervening complete compartment or hold from"	Fore and aft Athwartships	At least 36 meters Prohibited	Two bulkheads or at least 36 meters + two decks Prohibited	At least 36 meters Prohibited	At least 48 meters including two bulkheads Prohibited	At least 48 meters Prohibited	Prohibited. Prohibited.

NOTE: All bulkheads and decks must be resistant to fire and liquid.

(h) *Segregation on board barge carrying vessels: (1) The requirements of this section apply to the segregation in shipborne barges as well as to the segregation between shipborne barges carried on board vessels specially designed and equipped to carry such barges.*

(2) On barge-carrying vessels which incorporate other stowage spaces or any other method of stowage, barges containing hazardous materials must be segregated from

hazardous materials not stowed in barges as prescribed in paragraphs (b) and (j) of this section.

(i) *Segregation in shipborne barges: Hazardous materials transported in shipborne barges must be segregated as prescribed in paragraphs (a), (b), and (c) of this section.*

(j) Segregation between shipborne barges on barge-carrying vessels: (1) When a shipborne barge is loaded with two or more hazardous materials with different requirements for segregation, the most stringent applicable segregation requirement must be applied.

(2) "Away from" and "separated from" require no segregation between shipborne barges.

(3) For barge-carrying vessels with vertical holds, "Separated by a complete compartment or hold from" means that separate holds are required. On barge-carrying vessels having horizontal barge levels, separate barge levels are required and the barges may not be in the same vertical line.

(4) "Separated longitudinally by an intervening complete compartment or hold from" means, for barge-carrying vessels with vertical holds, that separation by an intervening hold or engine room is required. On barge-carrying vessels having horizontal barge levels, separate barge levels and a longitudinal separation by at least two intervening barge spaces are required.

(k) *Segregation requirements for ferry vessels: A ferry vessel (when operating either as a passenger or cargo vessel) that cannot provide the separation required in this section may carry incompatible hazardous materials in separate transport vehicles if they are stowed to give the maximum possible separation.*

[Amdt. 176-30, 55 FR 52690, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995; 64 FR 10781, 10782, Mar. 5, 1999]

§176.84 Other requirements for stowage and segregation for cargo vessels and passenger vessels.

(a) *General. When column 10B of the §172.101 table refers to a numbered or alpha-numeric stowage provision for water shipments, the meaning and requirements of that provision are as set forth in this section. Terms in quotation marks are defined in §176.83.*

(b) Table of provisions:

Code	Provisions
1	[Reserved]
2	Temperature controlled material.
3	Do not stow with high explosives.
4	[Reserved]

5	[Reserved]
6	Emergency temperature material.
7	[Reserved]
8	Glass carboys not permitted on passenger vessels.
9	Glass carboys not permitted under deck.
10	Glass bottles not permitted under deck.
11	Keep away from heat and open flame.
12	Keep as cool as reasonably practicable.
13	Keep as dry as reasonably practicable.
14	For metal drums, stowage permitted under deck on cargo vessels.
15	May be stowed in portable magazine or metal locker.
16	No other cargo may be stowed in the same hold with this material.
17	Segregation same as for flammable gases but "away from" dangerous when wet.
18	Prohibited on any vessel carrying explosives (except explosives in Division 1.4, Compatibility group S).
19	Protect from sparks and open flames.
20	Segregation same as for corrosives.
21	Segregation same as for flammable liquids.
22	Segregation same as for flammable liquids if flash point below 61°C (142°F).
23	Segregation same as for flammable liquids if flash point between 23°C (73°F) and 61°C (142°F).
24	Segregation same as for flammable solids.
25	Shade from radiant heat.
26	Stow "away from" acids.
27	Stow "away from" alkaline compounds.
28	Stow "away from" flammable liquids.
29	Stow "away from" ammonium compounds.
30	Stow "away from" animal or vegetable oils.
31	Stow "away from" combustible materials.
32	Stow "away from" copper, its alloys and its salts.
33	Stow "away from" fluorides.
34	Stow "away from" foodstuffs.
35	Stow "away from" all odor-absorbing cargo.
36	Stow "away from" heavy metals and their compounds.
37	Stow "away from" hydrazine.
38	Stow "away from" all other corrosives.
39	Stow "away from" liquid halogenated hydrocarbons.
40	Stow "clear of living quarters".
41	Stow "away from" mercury and its compounds.
42	Stow "away from" nitric acids and perchloric acids not exceeding 50 percent acid by weight.
43	Stow "away from" organic materials.
44	Stow "away from" oxidizers.
45	Stow "away from" permanganates.
46	Stow "away from" powdered metals.
47	Stow "away from" sodium compounds.
48	Stow "away from" sources of heat.
49	Stow "away from" corrosives.
50	Stow "away from" sources of heat where temperatures in excess of 55°C (131°F) for a period of 24 hours or more will be encountered.
51	Stow "separated from" acetylene.
52	Stow "separated from" acids.
53	Stow "separated from" alkaline compounds.
54	Stow "separated from" animal or vegetable oils.
55	Stow "separated from" ammonia.

56	Stow "separated from" ammonium compounds.
57	Stow "separated from" chlorine.
58	Stow "separated from" cyanides.
59	Stow "separated from" combustible materials.
60	Stow "separated from" chlorates, chlorites, hypochlorites, nitrites, perchlorates, permanganates, and metallic powders.
61	Stow "separated from" corrosive materials.
62	Stow "separated from" diborane.
63	Stow "separated from" diethylene triamine.
64	Stow "separated from" explosives.
65	Stow "separated from" flammable substances.
66	Stow "separated from" flammable solids.
67	Stow "separated from" halides.
68	Stow "separated from" hydrogen.
69	Stow "separated from" hydrogen peroxide.
70	Stow "separated from" mercury salts.
71	Stow "separated from" nitric acid.
72	Stow "separated from" nitrogen compounds.
73	Stow "separated from" chlorates.
74	Stow "separated from" oxidizers.
75	Stow "separated from" permanganates.
76	Stow "separated by a complete compartment or hold from" organic peroxides.
77	Stow "separated longitudinally by a complete compartment or hold from" explosives.
78	Stow "separated longitudinally by an intervening complete compartment or hold from" explosives.
79	The maximum net quantity in one package for this material shipped aboard a passenger vessel is limited to 22.7 kg (50 pounds).
80	Toy torpedoes must not be packed with other special fireworks.
81	Under deck stowage permitted only if an indicating substance such as chloropicrin has been added.
82	Under deck stowage is permitted only if containing not more than 36 percent by weight of hydrazine.
83	[Reserved]
84	Under deck stowage must be in well-ventilated space.
85	Under deck stowage must be in mechanically ventilated space.
86	Stow "separated by a complete compartment or hold from" explosives Division 1.3.
87	Stow "separated from" Class 1 (explosives) except Division 1.4.
88	Stow "separated by a complete compartment or hold from" Class 1 (explosives) except Division 1.4.
89	Segregation same as for oxidizers.
90	Stow "separated from" radioactive materials.
91	Stow "separated from" flammable liquids.
92	Stow "separated from" powdered materials.
93	Stow not accessible to unauthorized persons on passenger vessels.
94	Plastic jerricans and plastic drums not permitted under deck.
95	Stow "separated from" foodstuffs.
96	Glass carboys not permitted under deck on passenger vessels.
97	Stow "away from" azides.
98	Stow "away from" all flammable materials.
99	Only new metal drums permitted on passenger vessels.
100	Stow "away from" flammable solids.
101	Stow "separated from" iron oxide.
102	Stow "separated from" all odor absorbing cargoes.
103	Only to be loaded under dry weather conditions.

104	Stow "separated from" bromine.
105	As approved by the Competent Authority of the country concerned.
106	Stow "separated from" powdered metal.
107	Stow "separated from" peroxides and superoxides.
108	The transport temperature should be indicated on the tank.
109	Label as a flammable liquid if flash point is 61°C (142°F) or below.
110	Packaging Group II if concentration does not exceed 70 percent acid.
111	If concentration exceeds 50 percent acid, notes 66, 74, 89, and 90 apply.
112	Packaging Group II for concentrations not less that 50 percent and Packaging Group III for concentrations less than 50 percent.
113	Packaging Group II if concentrations does not exceed 60 percent acid.
114	Corrosive subsidiary risk label required unless concentration is less than 80 percent.
115	If packaged in glass or earthenware inner packagings in wooden or fiberboard outer packagings, the maximum quantity on any vessel is 500 kg (equivalent to 450 liters).
116	In a cargo space capable of being opened up in an emergency. The possible need to open hatches in case of fire to provide maximum ventilation and to apply water in an emergency and the consequent risk to the stability of the ship through flooding of the cargo space should be considered before loading.
117	In a clean cargo space capable of being opened up in an emergency. In the case of bagged fertilizer in freight containers, it is sufficient if in the case of an emergency, the cargo is accessible through free approaches (hatch entries) and mechanical ventilation enables the master to exhaust any gases or fumes resulting from decomposition. The possible need to open hatches in case of fire to provide maximum ventilation and to apply water in an emergency and the consequent risk to the stability of the ship through flooding of the cargo space should be considered before loading.
118	Stowage-Category D, Category E freight containers and pallet boxes only. Ventilation may be required. The possible need to open hatches in a case of fire to provide maximum ventilation and to supply water in an emergency, and the consequent risk to the stability of the ship through flooding of the cargo space, should be considered before loading.
119	Double strip stowage recommended.
120	Provide good surface and through ventilation.
121	Packaging group III when the flash point of the flammable liquid is 23°C (73°F) or above.
122	Stow "separated from" infectious substances.
123	Stow "away from" infectious substances.
M1-M6	[Reserved]

(c) *Provisions for the stowage of Class 1 (explosive) materials: (1) Unless otherwise specified in column 10B of the §172.101 table, explosive substances and explosive articles must be stowed as follows:*

(i) On deck: In containers or the like.

(ii) Under deck: Ordinary stowage.

(2) The following notes in column 10B of the §172.101 table apply to the transport of Class 1 (explosive) materials by vessel:

Note	Provision
1E	Cargo vessel, on deck, in containers or the like.
2E	Cargo vessel, on deck, in portable magazines.
3E	Cargo vessel, on deck, secured to the vessel's structure.
4E	Cargo vessel, under deck, Magazine, Type A.

5E	Cargo vessel, under deck, Magazine, Type B.
6E	Cargo vessel, under deck, Magazine, Type C.
7E	Cargo vessel, under deck, Ordinary Stowage.
8E	Cargo vessel, under deck, Special Stowage.
9E	Passenger vessel, stowage as for cargo vessel.
10E	Magazine, Type B, if in effectively sealed dust-tight packages; otherwise, Magazine, Type A.
11E	On-deck portable magazine must be steel.
12E	Stowage as specified by Competent Authority.
13E	On deck, in containers not exceeding 2.5 metric ton gross per container or group. There may not be more than 2 such containers or groups; they must be separated from each other, and from any other explosive substance or article by at least 9 m (30 feet). Containers or groups must be at least 9 m (30 feet) from the bridge or accommodation.
14E	On deck, in steel portable magazines or steel freight containers.
15E	On-deck, containers must be leakproof.
16E	On deck, in containers or sheeted stacks. The gross weight of each stack or group of containers may not exceed 2.5 metric ton. There may not be more than 2 stacks or groups of containers; they must be separated from each other, and from any other explosive substances or articles by at least 9 m (30 feet). Stacks or containers must be at least 9 m (30 feet) from the bridge or accommodation.
17E	On deck stowage is recommended.
18E	For international shipments, stow in the same manner as is required for "cartridges for weapons' inert projectile" UN 0012, Division 1.4S.
19E	Substances which contain ammonium nitrate or other ammonium salts must be stowed "away from" Explosives, Blasting, Type C, UN 0083.
20E	Stow in accordance with §176.84(c)(3) of this subchapter.
21E	Cargo space ventilation must be carefully controlled to avoid excessive condensation.
22E	May not be stowed together with explosive substances containing ammonium nitrate or other ammonium salts.
23E	Segregate from other Class 1 (explosive) materials in the same manner as is required for flammable liquids.
24E	Passenger vessels, on deck or under deck, in portable magazines only.
25E	Passenger vessels, in containers or the like, on deck only.
26E	Cargo vessel, on deck, in containers or the like (non-metallic lining is necessary if not in sealed dust tight packages).
27E	Cargo vessel, on deck, in containers or the like (non-metallic lining is necessary).
28E	Cargo vessel, when items are transported as projectiles or cartridges for guns, cannons, or mortars, notes 1E and 7E are applicable. All other times, notes 14E, 15E, and 8E are applicable.

(3) Explosive articles designated by special provision "20E" in column 10B of the 172.101 table must be stowed as follows:

(i) Projectiles for guns, cannon, or mortars:

(A) *On deck: in containers or the like.*

(B) Under deck: ordinary stowage.

(ii) All other types:

(A) *On deck: in steel portable magazines or steel freight containers which are capable of preventing leakage of their contents.*

(B) Under deck: Special stowage.

[Amdt. 176-30, 55 FR 52693, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20,

1991; Amdt. 176-43, 62 FR 24742, May 6, 1997]

Subpart E - Special Requirements for Transport Vehicles Loaded With Hazardous Materials and Transported on Board Ferry Vessels

§176.88 Application.

The requirements in this subpart are applicable to transport vehicles containing hazardous materials being transported on board ferry vessels and are in addition to any prescribed elsewhere in this subchapter. Vessels in a service similar to a ferry service, but not over a designated ferry route, may be treated as a ferry vessel for the purpose of this subpart if approved in writing by the District Commander.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40690, Sept. 20, 1976]

§176.89 Control of transport vehicles.

(a) A transport vehicle containing hazardous materials may be transported on board a ferry vessel, subject to the following conditions:

(1) The operator or person in charge of the vehicle shall deliver to the vessel's representative a copy of the shipping papers and certificate required by §§176.24 and 176.27;

(2) The vehicle shall be placed at the location indicated by the vessel's representative;

(3) The parking brakes of the vehicle shall be set securely to prevent movement;

(4) The motor of a highway vehicle shall be shut off and not restarted until the vessel has completed its voyage and docked;

(5) All vehicle lights shall be cut off and not relighted until the vessel has completed its voyage and docked;

(6) The operator of a highway vehicle shall remain with the vehicle;

(7) No repairs or adjustments must be made to the vehicle while it is on the vessel;

(8) No hazardous materials are to be released from the vehicle; and

(9) Any instructions given by the vessel's representative during the voyage, and during "roll on" and "roll off" operations must be observed.

(b) Smoking by any person in or around a vehicle is prohibited.

§176.90 Private automobiles.
A private automobile which is carrying any Class 1 (explosive) material (except permitted fireworks or small arms ammunition) may not be transported on a passenger-carrying ferry vessel unless the Class 1 (explosive) material is in compliance with packaging, labeling, marking, and certification requirements of this subchapter. Permitted fireworks and small arms ammunition may be carried without the required packaging, labeling, marking, or certification if they are in tight containers.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.91 Motorboats.
A motorboat may be transported on board a ferry vessel with gasoline in the tank and two other containers not exceeding 23 L (six gallons) capacity each if they are in the motorboat, closed, and in good condition.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.92 Cylinders laden in vehicles.
Any cylinder of Class 2 (compressed gas) material which is required to have a valve protection cap fitted in place may be transported on board a ferry vessel without having the valve protection cap in place when it is laden in a transport vehicle and is not removed from the vehicle while on the vessel.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.93 Vehicles having refrigerating or heating equipment.
(a) A transport vehicle fitted with refrigerating or heating equipment using a flammable liquid or Division 2.1 (flammable gas) material, or diesel oil as fuel, may be transported on a ferry vessel. However, the refrigerating or heating equipment may not be operated while the vehicle is on the vessel, unless the equipment complies with the following requirements:
(1) The installation is rigidly mounted and free of any movement other than normal vibration in operation;
(2) An easily accessible shutoff control is fitted to the fuel and electrical supply of the refrigerating or heating equipment; and

(3) The fuel storage tank, the fuel lines, the carburetor and any other fuel devices are tight and show no signs of leakage.

(b) If the vehicle operator desires to operate the refrigerating or heating equipment while on the vessel and the equipment is not fitted with automatic starting and stopping devices, it must be started before the vehicle is taken on board. It may continue in operation while the vehicle is on the vessel, but if the motor stops it may not be restarted.

(c) In the case of a ferry vessel on a voyage exceeding 30 minutes' duration, stowage must be provided for transport vehicles having refrigerating or heating equipment operated by internal combustion engines which will permit ready diffusion of exhaust gases to the open air. Passenger vehicles may not be stowed in a position adjacent to vehicles operating internal combustion motors which expose the occupants of the passenger vehicles to excessive concentrations of exhaust fumes from such motors.

(d) A transport vehicle containing solid carbon dioxide as a refrigerant may be transported on a ferry vessel only if it is stowed in a well ventilated location.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

Subpart F - Special Requirements for Barges

Source: Amdt. 176-8, 44 FR 23228, Apr. 19, 1979, unless otherwise noted.

§176.95 Application.

The requirements prescribed in this subpart are applicable to the transportation of packaged hazardous materials on board barges. The requirements prescribed elsewhere in this subchapter for vessels similarly apply, except as provided in this subpart, to the transportation of packaged hazardous materials on board barges.

§176.96 Materials of construction.

Barges used to transport hazardous materials must be constructed of steel.

[Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.97 Prohibition of dump scows.

Dump scows are barges having cargo carrying compartments of the hopper type and fitted with a bottom dump or a side dump. This type of barge is prohibited from the carriage of any class of hazardous material.

§176.98 Stowage of hazardous materials on board barges.

A material for which "on deck" stowage only is required by column (10) of the Hazardous Materials Table (§172.101 of this subchapter) may be stowed "under deck" on unmanned barges.

[Amdt. 176-8, 44 FR 23228, Apr. 19, 1979, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.99 Permit requirements for certain hazardous materials.

The permits required by §§176.100 and 176.415 for loading, unloading, and handling Divisions 1.1 and 1.2 (Class A and B explosives) materials, Division 1.5 (blasting agents) materials, ammonium nitrate and certain ammonium nitrate mixtures and fertilizers must be obtained before these materials may be loaded on, unloaded from, or handled on board a barge or barge-carrying vessel. However, a barge loaded with these materials being placed on, removed from, or handled on board a barge-carrying vessel is not subject to these permit requirements.

[Amdt. 176-30, 55 FR 52695, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

Subpart G - Detailed Requirements for Class 1 (Explosive) Materials

Source: Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, unless otherwise noted.

§176.100 Permit for Divisions 1.1 and 1.2 (Classes A and B explosive) materials.

Before Divisions 1.1 and 1.2 (Classes A and B explosive) materials may be discharged from, loaded on, handled or restowed on board a vessel at any place in the United States, the carrier must obtain a permit from the COTP in accordance with the procedures in 33 CFR 126.19. Exceptions to this permit requirement may be authorized by the COTP.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.102 Supervisory detail.

(a) Except as provided in paragraph (c) of this section, the COTP may assign a USCG supervisory detail to any vessel to supervise the loading, handling or unloading of Class 1 (explosive) materials.

(b) The owner, agent, charterer, master or person in charge of the vessel, and all persons engaged in the handling, loading, unloading, and stowage of Class 1 (explosive) materials shall obey all orders that are given by the officer in charge of the supervisory detail.

(c) If Class 1 (explosive) materials are loaded onto or unloaded from a vessel at a facility operated or controlled by the Department of Defense, the Commanding Officer of that facility may decline the USCG supervisory detail. Whenever the supervisory detail is declined, the Commanding Officer of the facility shall ensure compliance with the regulations in this part.

§176.104 Loading and unloading Class 1 (explosive) materials.

(a) Packages of Class 1 (explosive) materials may not be thrown, dropped, rolled, dragged, or slid over each other or over a deck.

(b) When Class 1 (explosive) materials are stowed in a hold below one in which any cargo is being handled, the hatch in the deck dividing the two holds must have all covers securely in place.

(c) Drafts of Class 1 (explosive) materials must be handled in accordance with the following:

(1) A draft may not be raised, lowered, or stopped by sudden application of power or brake.

(2) A draft may not be released by tripping or freeing one side of the cargo-handling equipment and tumbling the Class 1 (explosive) materials off.

(3) All drafts, beams, shackles, bridles, slings, and hoods must be manually freed before the winch takes control.

(4) Slings may not be dragged from under a draft by winching except for the topmost layer in the hold when power removal is the only practical method and when the cargo cannot be toppled.

(5) Handles or brackets on packages in a draft may not be used for slinging purposes.

(d) A combination woven rope and wire sling or a sling that is formed by use of an open hook may not be used in handling Class 1 (explosive) materials.

(e) Only a safety hook or a hook that has been closed by wire may be used in handling

drafts of Class 1 (explosive) materials.
(f) Wire rope or wire rope assemblies, including splices and fittings, used in handling Class 1 (explosive) materials must be unpainted and kept bare to permit inspection of their safe working condition. A mechanical end fitting (pressed fitting) may be used in place of a eye splice, if the efficiency of the mechanical end fitting is at least equal to the efficiency of an eye splice prepared as prescribed in 29 CFR 1918.51(c)(1).
(g) Packages of Division 1.1 and 1.2 (Class A and B explosive) materials which are not part of a palletized unit must be loaded and unloaded from a vessel using a chute or conveyor as described in §176.163, or a mechanical hoist and a pallet, skipboard, tray, or pie plate fitted with a cargo net or sideboards.
(h) Packages of Division 1.1 and 1.2 (Class A and B explosive) materials must be loaded or unloaded in accordance with the following:
(1) A cargo net with a pallet, skipboard, tray, or pie plate, must be loaded so that no more than a minimum displacement of packages occurs when it is lifted.
(2) A cargo net must completely encompass the bottom and sides of the draft. The mesh of the cargo net must be of a size and strength that will prevent a package in the draft from passing through the net.
(3) When a tray is used in handling packages, no package may extend more than one-third its vertical dimension above the sideboard of the tray.
(i) A landing mat must be used when a draft of nonpalletized Division 1.1 or 1.2 (Class A and B explosive materials) is deposited on deck. The landing mat must have dimensions of at least I m (3 feet) wide, 2 m (7 feet) long, and 10 cm (3.9 inches) thick, and be made of woven hemp, sisal, or similar fiber, or foam rubber, polyurethane or similar resilient material.
(j) In addition to the other requirements of this section, packages of Division 1.1 and 1.2 (Class A and B explosive) materials must be handled in accordance with the following:
(1) Packages may not be loaded or unloaded through a hatch at the same time that other cargo is being handled in any hold served by that hatch.
(2) Packages may not be loaded or unloaded from the same hatch by using two pieces of cargo equipment unless the equipment is positioned at the forward and aft ends of the hatch.
(3) Packages may not be lifted over any hazardous materials.
(4) The height of any structure, equipment, or load on a deck over which packages must be lifted may not be higher than the hatch coaming or bulwark, or 1 m (3 feet), whichever is greater.
(k) Unpackaged explosive devices may not be handled by their lifting lugs or suspension lugs.
(l) A chute may not be used when loading or unloading Class 1 (explosive) materials in compatibility group A or B.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-40, 61 FR 27175, May 30, 1996]

§176.108 Supervision of Class 1 (explosive) materials during loading, unloading, handling and stowage.

(a) During the loading, unloading, handling and stowage of Class 1 (explosive) materials, a responsible person shall be in constant attendance during the entire operation to direct the loading, unloading, handling and stowage of Class 1 (explosive) materials, including the preparation of the holds. The responsible person must be aware of the hazards involved and the steps to be taken in an emergency, and must maintain sufficient contact with the master to ensure proper steps are taken in an emergency.

(b) Each person involved in the handling of Class 1 (explosive) materials on a vessel shall obey the orders of the responsible person.

(c) The responsible person must inspect all cargo-handling equipment to determine that it is in safe operating condition before it is used to handle Class 1 (explosive) materials.

Stowage

§176.112 Application of stowage provisions.

The provisions of §§176.116(e), 176,118, and 176.120 of this subpart do not apply to Division 1.4 (Class C explosive) materials, compatibility group S. Such materials may be stowed together with all other Class 1 (explosive) materials except those of compatibility group A or L. They must be segregated from other hazardous materials in accordance with table 176.83(b) of this part.

§176.116 General stowage conditions for Class 1 (explosive) materials.

(a) *Heat and sources of ignition: (1) Class 1 (explosive) materials must be stowed in a cool part of the ship and must be kept as cool as practicable while on board. Stowage must be well away from all sources of heat, including steam pipes, heating coils, sparks, and flame.*

(2) Except where the consignment of Class 1 (explosive) materials consists only of explosive articles, the wearing of shoes or boots with unprotected metal nails, heels, or tips of any kind is prohibited.

(b) Wetness: (1) Spaces where Class 1 (explosive) materials are stowed below deck must be dry. In the event of the contents of packages being affected by water when on board immediate advice must be sought from the shippers; pending this advice handling of the packages must be avoided.

(2) Bilges and bilge sections must be examined and any residue of previous cargo removed before Class 1 materials (explosive) are loaded onto the vessel.

(c) *Security: All compartments, magazines, and transport units containing Class 1 (explosive) materials must be locked or suitably secured in order to prevent unauthorized access.*

(d) Secure stowage: Class 1 (explosive) materials must be securely stowed to prevent movement in transit; where necessary, precautions must be taken to prevent cargo sliding down between the frames at the ship's sides.
(e) Separation from accommodation spaces and machinery spaces: (1) Class 1 (explosive) materials must be stowed as far away as practicable from any accommodation spaces or any machinery space and may not be stowed directly above or below such a space. The requirements in paragraphs (e)(2) through (e)(4) of this section are minimum requirements in addition to the applicable requirements of 46 CFR chapter I. Where the requirements of this subpart are less stringent than those of 46 CFR chapter I, the 46 CFR chapter I requirements must be satisfied for ships to which they are applicable.
(2) There must be a permanent A Class steel bulkhead between any accommodation space and any compartment containing Class 1 (explosive) materials. Division 1.1 and 1.2 (Class A and B explosive) materials, 1.3 (Class B explosive) materials, or 1.5 (blasting agents) materials may not be stowed within 3 m (10 feet) of this bulkhead; in the decks immediately above or below an accommodation space they must be stowed at least 3 m (10 feet) from the line of this bulkhead projected vertically.
(3) There must be a permanent A Class steel bulkhead between a compartment containing Class 1 (explosive) materials and any machinery space. Class 1 (explosive) materials, except those in Division 1.4 (Class C explosive), may not be stowed within 3 m (10 feet) of this bulkhead; and in the decks above or below the machinery space they must be stowed at least 3 m (10 feet) from the line of this bulkhead projected vertically. In addition to this separation, there must be insulation to Class A60 standard as defined in 46 CFR 72.05-10(a)(1) if the machinery space is one of Category `A' unless the only Class 1 (explosive) materials carried are in Division 1.4S (Class C explosive).
(4) Where Class 1 (explosive) materials are stowed away from bulkheads bounding any accommodation space or machinery space, the intervening space may be filled with cargo that is not readily combustible.

§176.118 Electrical requirement.
(a) Electrical equipment and cables installed in compartments in which Class 1 (explosive) materials are stowed which do not need to be energized during the voyage must be isolated from the supply so that no part of the circuit within the compartment is energized. The method of isolation may be by withdrawal of fuses, opening of switches or circuit breakers, or disconnection from bus bars. The means, or access to the means, of disconnection/reconnection must be secured by a locked padlock under the control of a responsible person.
(b) Electrical equipment and cables in a cargo space in which Class 1 (explosive) materials are stowed which are energized during the voyage for the safe operation of the ship must meet the requirements of subchapter J of 46 CFR chapter I. Before Class 1 (explosive) materials are loaded aboard a vessel, all cables must be tested by a skilled person to ensure that they are safe and to determine satisfactory grounding,

insulation resistance, and continuity of the cable cores, metal sheathing or armoring.
(c) All Class 1 (explosive) materials must be stowed in a safe position relative to electrical equipment and cables. Additional physical protection must be provided where necessary to minimize possible damage to the electrical equipment or cables, especially during loading and unloading.
(d) Cable joints in the compartments must be enclosed in metal-clad junction boxes.
(e) All lighting equipment and cables must be of the fixed type, and must meet the relevant inspection, test, and installation standards of 46 CFR chapter I, subchapter J.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.120 Lightning protection.

A lightning conductor grounded to the sea must be provided on any mast or similar structure on a vessel on which Class 1 (explosive) materials are stowed unless effective electrical bonding is provided between the sea and the mast or structure from its extremity and throughout to the main body of the hull structure. (Steel masts in ships of all welded construction comply with this requirement).

§176.122 Stowage arrangements under deck.

When stowed under deck, Class 1 (explosive) materials must be in conformance with one of the stowage arrangements described in §§176.124 through 176.136 of this subpart.

§176.124 Ordinary stowage.

(a) Ordinary stowage is authorized for most explosive articles carried by vessel. The exceptions are those for which this subpart prescribes "magazine" or "special" stowage.
(b) Class 1 (explosive) materials requiring ordinary stowage must be stowed in accordance with §176.116 of this subpart.

§176.128 Magazine stowage, general.

(a) Magazine stowage is sub-divided into three different types of magazines designated by the letters A, B, and C. A magazine may be a fixed structure in the vessel, a closed freight container, or a portable magazine unit. Freight containers, portable magazines, and vehicles must be properly secured in position. Magazines may be positioned in any part of the vessel conforming to the general stowage conditions for Class 1 (explosive)

materials, except magazines which are fixed structures must be constructed in a location in which their doors, where fitted, are easily accessible.
(b) Magazine stowage is required for all explosive substances, except "Explosive Substances, n.o.s." in compatibility groups G, L, or S. Magazine stowage type A is required for those substances which must be kept clear of steelwork. All other explosive substances must be given magazine stowage type B, except those in compatibility group A for which magazine stowage type C is prescribed.
(c) Magazine stowage type B is required for Charges, propelling, for cannon. UN 0279, UN 0414, and UN 0242, and Charges, supplemental, explosive, UN 0600, in compatibility group C or D; and magazine stowage type C is required for detonators and similar articles in divisions and compatibility group 1.1B and 1.2B (Class A and B explosive).

§176.130 Magazine stowage Type A.
(a) In addition to protecting the Class 1 (explosive) materials and preventing unauthorized access, magazine stowage type A guards against friction between any spilled contents of packages and the vessel's sides and bulkheads.
(b) Class 1 (explosive) materials requiring magazine stowage type A must be stowed in a magazine which is tightly sheathed with wood on its inner sides and floor.
(c) When utilized as part of the magazine structure, the vessel's sides and bulkheads must be clean, free from rust or scale, and protected by battening or sweatboards spaced not more than 150 mm (6 inches) apart. All stanchions and other unprotected structural members must be similarly clean and battened. The underside of the deck above the magazine must be clean and free of rust and scale, but need not be battened.
(d) The top of the stow within the magazine must be at least 30 cm (12 inches) from the underside of the deck above.
(e) A type A magazine constructed in the square of a cargo space may not be loaded from the top.
(f) When other Class 1 (explosive) materials are stowed with Class 1 (explosive) materials for which magazine stowage type A is required, they or their packagings may have no exposed external parts made of ferrous metal or aluminum alloy.

§176.132 Magazine stowage Type B.
(a) Magazine stowage type B is the same as magazine stowage type A as prescribed in §176.130 of this part, except:
(1) The floor need not be tightly sheathed with wood but must be sparred or protected by wooden pallets or dunnage; and
(2) Battening of the vessel's sides, bulkheads, and stanchions is not required.
(b) A compartment may be used for magazine stowage type B without a magazine

structure provided that:
(1) The Class 1 (explosive) materials are stowed on wooden gratings, pallets, or dunnage, directly on the deck and not on other cargo;
(2) Other cargo stowed in the same compartment is not readily combustible material; and
(3) The position of the stowage is such that there is direct access to the hatchway.
(c) Class 1 (explosive) materials and other cargo in the same compartment must be secured to eliminate the possibility of significant movement. Where an entire deck is used as a magazine, the stowage must be so arranged that the Class 1 (explosive) materials stowed therein will be removed from the ship before working any cargo in any decks above or below the space in the same hatch.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.133 Magazine stowage Type C.

The construction requirements for magazine stowage type C are the same as for magazine stowage Type B as prescribed in §176.132 of this part, except that the magazine must be located as near as practicable to the centerline of the vessel and must not be closer to the vessel's side than a distance equal to one-eighth of the vessel's beam or 2.5 m (8.2 feet). whichever is less.

§176.134 Vehicles.

Closed vehicles may be used to transport Class 1 (explosive) materials requiring magazine stowage when carried by vessel if they meet the requirements of the appropriate magazine stowage type. See §176.168 of this subpart for additional requirements relating to the transport of Class 1 (explosive) materials in vehicles.

§176.136 Special stowage.

(a) Special stowage is required for certain articles presenting both explosive and chemical hazards, such as smoke or lachrymatory (compatibility group G or H), toxic (compatibility group K), or substances and articles which present a special risk (compatibility group L). Except as permitted in paragraph (c) of this section, Class 1 (explosive) materials requiring special stowage must be stowed on deck unless such stowage is impracticable and the COTP authorizes special stowage below deck.
(b) Class 1 (explosive) materials for which special stowage is required must be stowed as far away as practicable from living, accommodation, and working areas, and may not be overstowed. Steel portable magazines and freight containers in which such Class 1

(explosive) materials are stowed may not be located closer to the vessel's side than a distance equal to one-eighth of the vessel's beam or 2.5 m (8.2 feet), whichever is less.
(c) Explosive articles having UN number, UN 0015, UN 0016, UN 0018, UN 0019, UN 0301, or UN 0303 may be given ordinary stowage in a lower hold or 'tween deck. Other Class 1 (explosive) materials in compatibility groups G and H may be in open stowage out to the ship's side on a floodable lower hold or deep tank in such a position that other cargo cannot be contaminated by leakage; in all other cases such Class 1 (explosive) materials must be stowed in steel portable magazines or in freight containers. If a freight container is used for this purpose, the floor of the freight container must be leakproof; for example, an all-metal container may be used and a fillet of cement or other material worked across the bottom of the door pening.
(d) Class 1 (explosive) materials stowed in one compartment may not be of more than one compatibility group, except the COTP may allow Class 1 (explosive) materials of compatibility groups G and H in separate steel portable magazines to be stowed in the same compartment, not less than 3 m (10 feet) apart.
(e) Class 1 (explosive) materials in compatibility groups K and L must be stowed in a steel portable magazine regardless of the stowage position in the vessel.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995]

§176.137 Portable magazine.

(a) Each portable magazine used for the stowage of Class 1 (explosive) materials on board vessels must meet the following requirements:

(1) It must be weather-tight, constructed of wood or metal lined with wood at least 2 cm (0.787 inch) thick, and with a capacity of no more than 3.1 cubic m (110 cubic feet).

(2) All inner surfaces must be smooth and free of any protruding nails, screws or other projections.

(3) If constructed of wood, a portable magazine must be framed of nominal 5 cm x 10 cm (2x4 inch) lumber, and sheathed with nominal 20 mm (0.787 inch) thick boards or plywood.

(4) When constructed of metal, the metal must be not less than 3.2 mm (0.126 inch) thick.

(5) Runners, bearers, or skids must be provided to elevate the magazine at least 10 cm (3.9 inches) from the deck. Padeyes, ring bolts, or other suitable means must be provided for securing.

(6) If the portable magazine has a door or hinged cover, the door or cover must have a strong hasp and padlock or equally effective means of securing.

(7) The portable magazine must be marked on its top and four sides, in letters at least 8 cm (3 inches) high, as follows:

EXPLOSIVES-HANDLE CAREFULLY-KEEP LIGHTS AND FIRE AWAY.

(b) A portable magazine which meets the requirements for a type 2 or type 3 magazine under 27 CFR part 55 subpart K may be used for the stowage of Class 1 (explosive) materials on board vessels.

(c) A portable magazine with a capacity exceeding 3.1 m^3, (110 cubic feet) may be used for the stowage of Class 1 (explosive) materials under such construction, handling, and stowage requirements as the COTP approves.

§176.138 Deck stowage.

(a) Class 1 (explosive) materials stowed on deck must be carried as close to the vessel's centerline as practicable.

(b) Class 1 (explosive) materials may not be stowed within a horizontal distance of 6 m (20 feet) from any fire, machinery exhaust, galley uptake, locker used for combustible stores, or other potential sources of ignition. They must be clear of walkways and cargo working areas, fire hydrants, steam pipes, and means of access; away from all other facilities necessary for the safe working of the vessel, and not less than a horizontal distance of 8 m (26 feet) from the bridge, accommodation areas, and lifesaving appliances.

(c) Where vessels are fitted with container fastening arrangements, freight containers containing Class 1 (explosive) materials may be overstowed by containers of compatible Class 1 (explosive) materials or non-hazardous cargo. Where vessels are not fitted with container fastening arrangements, freight containers loaded with Class 1 (explosive) materials may be stowed only on the bottom tier of the stowage.

Segregation

§176.140 Segregation from other classes of hazardous materials.

(a) Class 1 (explosive) materials must be segregated from other packaged hazardous materials in accordance with §176.83.

(b) Class 1 (explosive) materials must be segregated from bulk solid dangerous cargoes in accordance with the General Introduction to the IMDG Code. Notwithstanding §176.83(b), ammonium nitrate and sodium nitrate may be stowed together with blasting explosives, except those containing chlorates, provided the mixed stowage is treated as blasting explosives (see §176.410(e)).

§176.142 Hazardous materials of extreme flammability.

(a) Except as allowed by paragraph (b) of this section, certain hazardous materials of extreme flammability may not be transported in a vessel carrying Class 1 (explosive) materials. This prohibition applies to the following hazardous materials:

-	-	-
Carbon disulfide	UN 1131	Class 3
Diethyl zinc	UN 1366	Division 4.2
Dimethyl zinc	UN 1370	Division 4.2
Magnesium alkyls	UN 3053	Division 4.2
Nickel carbonyl	UN 1259	Division 6.1
Pyrophoric liquids, n.o.s	UN 2845	Division 4.2

(b) The hazardous materials listed in paragraph (a) of this section may be transported in a vessel carrying the following Class 1 (explosive) materials as cargo:

(1) Division 1.4 (Class C explosive) materials, compatibility group S.

(2) Explosive articles having the following proper shipping names and identification numbers (see column (4) of the §172.101 table) if designed for lifesaving purposes and their total net explosive mass (weight) does not exceed 50 kg (110 lbs) per vessel:

(i) ARTICLES, PYROTECHNIC: UN Nos. 0428, 0429, 0430, 0431.

(ii) CARTRIDGES, FLASH: UN Nos. 0049, 0050.

(iii) CARTRIDGES, SIGNAL: UN Nos. 0054, 0312.

(iv) SIGNAL DEVICES, HAND: UN No. 0191.

(v) SIGNALS, DISTRESS: UN Nos. 0194, 0195.

(vi) SIGNALS, SMOKE: UN Nos. 0196, 0197, 0313.

(3) Class 1 (explosive) materials in compatibility groups C, D, and E if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(4) Explosive articles in compatibility group G, except fireworks and Class 1 (explosive) materials requiring special stowage if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(c) When a vessel carrying Class 1 (explosive) materials allowed under paragraph (b) of this section also carries a hazardous material of extreme flammability, that hazardous material must be stowed in a part of the vessel as remote as practicable from the Class 1 (explosive) materials.

§176.144 Segregation of Class 1 (explosive) materials.

(a) Except as provided in §176.145 of this subpart, Class 1 (explosive) materials may be stowed within the same compartment, magazine, portable magazine, or transport unit as indicated in table 176.144(a).

Table 176.144(a)-Authorized Mixed Stowage for Explosives

[An "X" indicates that explosives in the two different compatibility groups reflected by the location of the "X" may not be stowed in the same compartment, portable magazine, or transport unit]

Compatibility groups	A	B	C	D	E	F	G	H	J	K	L	N	S
A	-	X	X	X	X	X	X	X	X	X	X	X	X
B	X	-	X	X	X	X	X	X	X	X	X	X	-
C	X	X	-	-	-	X	1	X	X	X	X	-	-
D	X	X	-	-	-	X	1	X	X	X	X	-	-
E	X	X	-	-	-	X	1	X	X	X	X	-	-
F	X	X	X	X	X	-	X	X	X	X	X	X	-
G	X	X	1	1	1	X	-	X	X	X	X	X	-
H	X	X	X	X	X	X	X	-	X	X	X	X	-
J	X	X	X	X	X	X	X	X	-	X	X	X	-
K	X	X	X	X	X	X	X	X	X	-	X	X	-
L	X	X	X	X	X	X	X	X	X	X	2	X	X
N	X	X	-	-	-	X	X	X	X	X	X	-	-
S	X	-	-	-	-	-	-	-	-	-	X	-	-

NOTES: 1. Explosive articles in compatibility group G, other than fireworks and those requiring special stowage, may be stowed with articles of compatibility groups C, D, and E, provided no explosive substances are carried in the same compartment, portable magazine or transport unit.

2. Explosives in compatibility group L may only be stowed in the same compartment, magazine or transport unit with identical explosives within compatibility group L.

(b) Where Class 1 (explosive) materials of different compatibility groups are allowed to be stowed in the same compartment, magazine, portable magazine, or transport unit, the stowage arrangements must conform to the most stringent requirements for the entire load.

(c) Where a mixed load of Class 1 (explosive) materials of different hazard divisions and/or stowage arrangements is carried within a compartment, magazine, or transport unit, the entire load must be treated as belonging to the hazard division having the greatest hazard. (For example, if a load of Division 1.1 (Class A explosive) materials is mixed with Division 1.3 (Class B explosive) materials, the load is treated as a Division 1.1 (Class A explosive) material as defined in §173.50(b) of this subchapter and the stowage must conform to the most stringent requirements for the entire load).

(d) If some of the Class 1 (explosive) materials in a stowage mixture require magazine stowage, Class 1 (explosive) materials requiring ordinary stowage may be stowed in the same magazine. When the magazine is used for substances requiring Type A stowage, the other Class 1 (explosive) materials stowed therein must have no exposed parts of any ferrous metal or aluminum alloy, unless separated by a partition.

(e) Segregation on deck: When Class 1 (explosive) materials in different compatibility groups are carried on deck, they must be stored not less than 6 m (20 feet) apart unless they are allowed under table 176.144(a) to be stowed in the same compartment, magazine, or transport unit.

(f) On a barge used to transfer class 1 (explosive) materials from a waterfront facility to a vessel at an explosives anchorage (or from the vessel to the water front facility), if compliance with paragraph (e) of this section is not practicable, a sandbag barrier at least 0.6 m (2 feet) in thickness may be substituted for the 6 m (20 feet) separation.

§176.145 Segregation in single hold vessels.

(a) On board a vessel having a single cargo hold, Class 1 (explosive) materials in hazard division/compatibility group 1.1B and 1.2B may be stowed in the same compartment with substances of compatibility group D, provided:

(1) The net explosive weight of the compatibility group B explosive does not exceed 50 kg (110 pounds); and

(2) The compatibility group B explosive materials are stowed in a steel portable magazine that is stowed at least 6 m (20 feet) from the compatibility group D substances.

(b) Division/compatibility group 1.4B (Class C explosive) materials may be stowed in the same compartment with substances of compatibility group D provided the Class 1 (explosive) materials of different compatibility groups are separated by either a distance of at least 6 m (20 feet) or by a steel partition.

§176.146 Segregation from non-hazardous materials.

(a) Except as required by paragraphs (b) and (c) of this section, Class 1 (explosive) materials need not be segregated from other cargo of a non-dangerous nature.

(b) Mail, baggage, and personal and household effects may not be stowed in the same compartment as, or in compartments immediately above or below, Class 1 (explosive) materials other than those in compatibility group S.

(c) Where Class 1 (explosive) materials are stowed against an intervening bulkhead, any mail on the other side of the bulkhead must be stowed away from it.

(d) In order to avoid contamination:

(1) An explosive substance or article which has a secondary POISON hazard label must be stowed "separated from" all foodstuffs, except when such materials are stowed in separate closed transport units, the requirements for "away from" segregation apply.

(2) An explosive substance or article which has a secondary CORROSIVE hazard label must be stowed "away from" foodstuffs.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

Precautions During Loading and Unloading

§176.148 Artificial lighting.

Electric lights, except arc lights, are the only form of artificial lighting permitted when loading and unloading Class 1 (explosive) materials.

§176.150 Radio and radar.
(a) Except as provided in paragraph (b) of this section, when Class 1 (explosive) materials (other than explosive articles in Division 1.4 [Class C explosive] or any explosive substance) are loaded, unloaded, or handled, the responsible person must ensure that all sources of electromagnetic radiation such as radio and radar transmitters are deenergized by opening the main switches controlling the sources and tagging them to warn that the devices are not to be energized until loading or unloading has ceased.
(b) During the loading or unloading of all explosive articles (except those in Division 1.4 [Class C explosive]), no radio or radar transmitter may be used within 50 m (164 feet) of such articles except for VHF transmitters the power output of which does not exceed 25 watts and of which no part of the antenna system is within 2 m (7 feet) of the Class 1 (explosive) materials.
(c) Explosive articles which are sensitive to electromagnetic radiation from external sources must be stowed at a safe distance from the vessel's radio cabin, receiving and transmitting apparatus radio antenna or lead-in, and radar installation, with due regard to the character of the vessel and the degree of screening-off of the explosive articles.

§176.154 Fueling (bunkering).
(a) Class 1 (explosive) materials, except those in compatibility group S, may not be loaded or unloaded when fueling (bunkering) is in progress except with the prior authorization of the COTP, and under conditions prescribed by that officer.
(b) Vessels containing Class 1 (explosive) materials may not be fueled (bunkered) with the hatches open unless authorized by the COTP.

§176.156 Defective packages.
(a) No leaking, broken, or otherwise defective package containing Class 1 (explosive) materials, including packages which have been adversely affected by moisture, may be accepted for shipment. The master or person in charge of a vessel on which there is a defective package containing Class 1 (explosive) materials must seek advice from the shipper concerning withdrawal, repair, or replacement. No repair of damaged or defective package containing Class 1 (explosive) materials may be performed on board a vessel.
(b) No Class 1 (explosive) material, which for any reason has deteriorated or undergone a change of condition that increases the hazard attendant upon its conveyance or handling, may be moved in the port area, except as directed by the COTP.
(c) If any package of Class 1 (explosive) materials, or seal of a package of Class 1 (explosive) materials, appears to be damaged, that package must be set aside for

examination and repair or otherwise legally disposed of as directed by the shipper.
(d) If any Class 1 (explosive) materials are spilled or released from a package, the responsible person must ensure that an appropriate emergency response is undertaken in accordance with the emergency response information required under §172.602 of this subchapter. The master of the vessel must report each incident involving spillage or release of Class 1 (explosive) materials to the COTP as soon as practicable.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.160 Protection against weather.
Any person loading or unloading packages containing Class 1 (explosive) materials shall take adequate measures to prevent these packages from becoming wet.

§176.162 Security.
A responsible person must be present at all times when the hatches of spaces containing Class 1 (explosive) materials are open. No unauthorized person may be permitted to access spaces in which Class 1 (explosive) materials are stowed. Magazines must be secured against unauthorized entry when loading has been completed, or when loading or unloading is stopped. Packages containing Class 1 (explosive) materials may not be opened on board ship.

§176.164 Fire precautions and firefighting.
(a) Matches, lighters, fire, and other ignition sources are prohibited on and near any vessel on which Class 1 (explosive) materials are being loaded, unloaded, or handled except in places designated by the master or the COTP.
(b) A fire hose of sufficient length to reach every part of the loading area with an effective stream of water must be laid and connected to the water main, ready for immediate use.
(c) No repair work may be carried out in a cargo space containing Class 1 (explosive) materials other than those of Division 1.4 (Class C explosive). No welding, burning, cutting, or riveting operations involving the use of fire, flame, spark, or arc-producing equipment may be conducted on board except in an emergency; and, if in port, with the consent of the COTP.
(d) Each compartment, including a closed vehicle deck space, which contains Class 1 (explosive) materials must be provided with a fixed fire extinguishing system. Each adjacent cargo compartment either must be protected by a fixed fire extinguishing installation or must be accessible for firefighting operations.

(e) A vessel must have two sets of breathing apparatus and a power-operated fire pump, which, together with its source of power and sea connections, must be located outside the machinery space.

Passenger Vessels

§176.166 Transport of Class 1 (explosive) materials on passenger vessels.

(a) Only the following Class 1 (explosive) materials may be transported as cargo on passenger vessels:

(1) Division 1.4 (Class C explosive) materials, compatibility group S.

(2) Explosive articles designed for lifesaving purposes as identified in §176.143(b)(2), if the total net explosive mass (weight) does not exceed 50 kg (110 pounds).

(3) Class 1 (explosive) materials in compatibility groups C, D, and E, if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(4) Articles in compatibility group G other than those requiring special stowage, if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(5) Articles in compatibility group B, if the total net explosive mass (weight) does not exceed 5 kg (11 pounds).

(b) Class 1 (explosive) materials which may be carried on passenger vessels are identified in column (10) of the §172.101 table. They must be stowed in accordance with table 176.166(b).

Table 176.166(b)-Stowage Arrangements in Passenger Vessels

Class/Division	Samples, explosive	Goods, N.O.S. Class 1	Goods shipped under a specific proper shipping name												
			Compatibility group												
-	-	-													
-	-	-	A	B	C	D	E	F	G	H	J	K	L	N	S
1.1	d	d	c	e	e	e	e	c	e	-	c	-	c	-	-
1.2	d	d	-	e	e	e	e	c	e	c	c	c	c	-	-
1.3	d	d	-	-	e	e	-	c	e	c	c	c	c	-	-
1.4	d	d	-	b	b	b	b	c	b	-	-	-	-	-	a
1.5	d	d	-	-	-	e	-	-	-	-	-	-	-	-	-
1.6	d	d	-	-	-	-	-	-	-	-	-	-	-	e	-

a-As for cargo ships, on deck or under deck.

b-As for cargo ships, on deck or under deck, in portable magazines only.

c-Prohibited.

d-As specified by the Associate Administrator for Hazardous Materials Safety, or the competent authority of the country in which the Class 1 (explosive) materials are loaded on the vessel.

e-In containers or the like, on deck only.

(c) Notwithstanding the provisions of paragraph (a) of this section, a combination of the substances and articles listed in paragraphs (a)(1) through (a)(5) of this section may be transported on the same passenger vessel provided the total net explosive mass (weight) of the combination of Class 1 (explosive) materials carried does not exceed the smallest quantity specified for any one of the substances or articles in the combination.

Transport Units and Shipborne Barges

§176.168 Transport of Class 1 (explosive) materials in vehicle spaces.

(a) All transport vehicles and cargo must be properly secured.

(b) All transport vehicles used for the carriage of Class 1 (explosive) materials must be structurally serviceable as defined in §176.172(a)(2).

(c) Vehicles used to transport Class 1 (explosive) materials must conform to the requirements in §§177.834 and 177.835 of this subchapter.

(d) Class 1 (explosive) materials which require special stowage must be transported in transport vehicles approved for the purpose by the Associate Administrator for Hazardous Materials Safety except that Class 1 (explosive) materials in compatibility group G or H may be carried in steel portable magazines or freight containers. Closed transport vehicles may be used as magazines; transport vehicles of other types may be used to transport Class 1 (explosive) materials which require ordinary stowage.

(e) Class 1 (explosive) materials of different compatibility groups may not be stowed in the same vehicle except as allowed in §176.144 of this subpart.

(f) Vehicles containing different Class 1 (explosive) materials require no segregation from each other, except that these materials may be carried together under the provisions of §176.144 of this subchapter. In all other instances, the vehicles must be "separated from" one another.

(g) All transport vehicles used for the transport of Class 1 (explosive) materials must have lashing arrangements for securing the vehicle on the ship and preventing the movement of the vehicle on its springs during the sea passage.

(h) Where a portable magazine or closed freight container is carried on a chassis, twist locks or other suitable securing arrangements must be provided and made secure.

§176.170 Transport of Class 1 (explosive) materials in freight containers.

(a) When Class 1 (explosive) materials are stowed in a freight container, the freight container, for the purposes of this subpart, may be regarded as a magazine but not as a separate compartment.

(b) Freight containers exceeding 6 m (20 feet) in length may not carry more than 5000 kg (11,023 pounds) net explosive weight of explosive substances, except explosive substances in Division 1.4.

(c) Freight containers used to transport Class 1 (explosive) materials for which magazine stowage type A is required must have a floor consisting of tightly fitted

wooden boards, plywood or equivalent non-metallic material, and a non-metallic lining.
(d) Class 1 (explosive) materials of different compatibility groups may not be stowed within the same freight container except as allowed in §176.144 of this subpart.
(e) On vessels, other than specially fitted container ships, freight containers containing Class 1 (explosive) materials must be stowed only in the lowest tier.
(f) Freight containers carrying different Class 1 (explosive) materials require no segregation from each other, if the provisions of §176.144 of this subpart allow the Class 1 (explosive) materials to be carried together in the same compartment. In all other instances, the containers must be "separated from" one another in accordance with §176.83(f) of this part.
(g) Freight containers carrying Class 1 (explosive) materials may not be handled on board a vessel with fork lift trucks unless approved by the COTP. This does not preclude the use of front-loading trucks using side-frame lifting equipment.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.172 Structural serviceability of freight containers and vehicles carrying Class 1 (explosive) materials on ships.

(a) A freight container may not be offered for the carriage of Class 1 (explosive) materials unless the container is structurally serviceable as evidenced by a current CSC (International Convention for Safe Containers) approval plate and verified by a detailed visual examination as follows:

(1) Before a freight container or transport vehicle is packed with Class 1 (explosive) materials, it must be visually examined by the shipper to ensure it is structurally serviceable, free of any residue of previous cargo, and its interior walls and floors are free from protrusions.

(2) *Structurally serviceable means the freight container or the vehicle cannot have major defects in its structural components, such as top and bottom side rails, top and bottom end rails, door sill and header, floor cross members, corner posts, and corner fittings in a freight container. Major defects include-*

(i) Dents or bends in the structural members greater than 19 mm (0.75 inch) in depth, regardless of length;

(ii) Cracks or breaks in structural members;

(iii) More than one splice or an improper splice (such as a lapped splice) in top or bottom end rails or door headers;

(iv) More than two splices in any one top or bottom side rail;

(v) Any splice in a door sill or corner post;

(vi) Door hinges and hardware that are seized, twisted, broken, missing, or otherwise inoperative;

(vii) Gaskets and seals that do not seal; or

(viii) For freight containers, any distortion of the overall configuration great enough to prevent proper alignment of handling equipment, mounting and securing chassis or vehicle, or insertion into ships' cells.

(3) In addition, deterioration of any component of the freight container or vehicle, regardless of the material of construction, such as rusted-out metal in sidewalls or disintegrated fiberglass, is prohibited. Normal wear, however, including oxidation (rust), slight dents and scratches, and other damage that does not affect serviceability or the weather-tight integrity of the units, is not prohibited.

(b) As used in paragraph (a) of this section, *splice means any repair of a freight container main structural member which replaces material, except complete replacement of the member.*

(c) All shipments of Class 1 (explosive) materials except those in Division 1.4 (Class C explosive) must be accompanied by a statement, which may appear on the shipping paper, certifying that the freight container or the vehicle is structurally serviceable as defined in paragraph (a)(2) of this section.

§176.174 Transport of Class 1 (explosive) materials in shipborne barges.

(a) Fixed magazines may be built within a shipboard barge. Portable magazines and freight containers may be used as magazines with a barge.

(b) Shipborne barges may be used for the carriage of all types of Class 1 (explosive) materials. When carrying Class 1 (explosive) materials requiring special stowage, the following requirements apply:

(1) Class 1 (explosive) materials in compatibility group G or H must be stowed in steel portable magazines or freight containers.

(2) Class 1 (explosive) materials in compatibility group K or L must be stowed in steel portable magazines.

(c) Class 1 (explosive) materials of different compatibility groups may not be stowed within the same shipborne barge unless under §176.144(b) of this subpart they are authorized to be stowed in the same compartment.

Handling Class 1 (Explosive) Materials in Port

§176.176 Signals.

When Class 1 (explosive) materials are being loaded, handled, or unloaded on a vessel, the vessel must exhibit the following signals:

(a) By day, flag "B" (Bravo) of the international code of signals; and

(b) By night, an all-round fixed red light.

§176.178 Mooring lines.

(a) All lines used in mooring the vessel must be of sufficient strength, type, and number

for the size of the vessel and local conditions.
(b) While the vessel is moored or anchored in a port area, towing wires of adequate size and length must be properly secured to mooring bits at the bow and stern ready for immediate use with the towing eyes passed outboard and kept at about water level.
(c) The mooring arrangements must be such that the vessel can be released quickly in an emergency.

§176.180 Watchkeeping.
Whenever Class 1 (explosive) materials are on board a vessel in port, there must be sufficient crew on board to maintain a proper watch and to operate the propulsion and firefighting equipment in case of an emergency.

§176.182 Conditions for handling on board ship.
(a) *Weather conditions. Class 1 (explosive) materials may not be handled in weather conditions which may seriously increase the hazards presented by the Class 1 (explosive) materials. During electrical storms, cargo operations must be halted and all hatches containing Class 1 (explosive) materials must be closed.*
(b) Darkness. Class 1 (explosive) materials may not be handled on board a vessel during the hours of darkness unless prior consent has been obtained from the COTP.
(c) Lighting. The area where Class 1 (explosive) materials are handled, or where preparations are being made to handle Class 1 (explosive) materials, must be illuminated with lighting that is sufficient to safely perform the handling operation.
(d) Protective equipment. (1) A sufficient quantity of appropriate protective equipment must be provided for the personnel involved in handling Class 1 (explosive) materials.
(2) The protective equipment must provide adequate protection against the hazards specific to the Class 1 (explosive) materials handled.
(e) *Intoxicated persons. No person under the influence of alcohol or drugs to such an extent that the person's judgment or behavior is impaired may participate in any operation involving the handling of Class 1 (explosive) materials. The master of the vessel must keep any such person clear of any areas where Class 1 (explosive) materials are being handled.*
(f) Smoking. (1) Smoking is prohibited on the vessel while Class 1 (explosive) materials are being handled or stowed except in places designated by the master of the vessel.
(2) Conspicuous notices prohibiting smoking must be posted and clearly visible at all locations where Class 1 (explosive) materials are handled or stored.
(g) All hatches and cargo ports opening into a compartment in which Class 1 (explosive) materials are stowed must be kept closed except during loading and unloading of the compartment. After loading, hatches must be securely closed.

§176.184 Class 1 (explosive) materials of Compatibility Group L.
Class 1 (explosive) materials in compatibility group L may not be handled in a port area without the special permission of, and subject to any special precautions required by, the COTP.

§176.190 Departure of vessel.
When loading of Class 1 (explosive) materials is completed, the vessel must depart from the port area as soon as is reasonably practicable.

§176.192 Cargo handling equipment for freight containers carrying Class 1 (explosive) materials.
(a) Except in an emergency, only cargo handling equipment that has been specifically designed or modified for the handling of freight containers may be used to load, unload, or handle freight containers containing Division 1.1 or 1.2 (Class A and B explosive) materials.
(b) The gross weight of a freight container containing Class 1 (explosive) materials may not exceed the safe working load of the cargo handling equipment by which it is handled.

Magazine Vessels

§176.194 Stowage of Class 1 (explosive) materials on magazine vessels.
(a) *General. The requirements of this section are applicable to magazine vessels and are in addition to any other requirements in this subchapter.*
(b) Type vessel authorized. A single deck vessel with or without a house on deck is the only type vessel that may be used as a magazine vessel. A magazine vessel may not be moved while Class 1 (explosive) materials are on board.
(c) Location of explosives. Division 1.1, 1.2, or 1.3 (Class A and B explosive) materials, in excess of 2268 kg (5000 pounds), stored in any magazine vessel must be stowed below deck. No Class 1 (explosive) materials may be stowed on deck unless the vessel is fitted with a deck house having a stowage area which meets the requirements in this subpart for the stowage of Class 1 (explosive) materials. Detonators, detonator assemblies and boosters with detonators, Division 1.1 (Class A explosive) may not be stored on the same magazine vessel with other Division 1.1, 1.2. and 1.3 (Class A or B explosive) materials.
(d) Class 1 (explosive) materials storage spaces. Any compartment on a magazine vessel used for the stowage of Class 1 (explosive) materials must be completely sealed

with wood so as to provide a smooth interior surface. Each metal stanchion in the compartment must be boxed in the same manner. An overhead ceiling is not required when the overdeck is weather tight. All nail and bolt heads must be countersunk and any exposed metal must be covered with wood.

(e) Initiating explosives, detonators and boosters with detonators. No explosive substance in Division 1.1, compatibility group A may be stowed in the same compartment with any other Class 1 (explosive) materials when there are explosive substances in Division 1.1 or 1.2 (Class A explosive) on the same magazine vessel. Detonators, detonator assemblies and boosters with detonators must be stowed at least 8 m (26 feet) from any bulkhead forming a boundary of a compartment containing any other Class 1 (explosive) materials.

(f) Dry storage spaces. A magazine vessel having a dry storage space capable of being used for any purpose whatsoever must have a cofferdam at least 61 cm (24 inches) wide fitted between the dry storage space and each adjacent compartment containing Class 1 (explosive) materials. The cofferdam must be constructed of wood or steel, formed by two tight athwartship bulkheads extending from the skin of the vessel to the overdeck. If the cofferdam extends to the weather deck. a watertight hatch must be fitted in the deck to provide access to the cofferdam.

(g) Lighting. Non-sparking, battery-powered, self-contained electric lanterns or non-sparking hand flashlights are the only means of artificial light authorized.

(h) Living quarters. Living quarters must be fitted on the inside with a non-combustible material approved by the Commandant, USCG. Bracketed ship's lamps are the only lighting fixtures authorized to be used in the living quarters. Any stove used for heating or cooking must be securely fastened and may not be mounted closer than 15 cm (5.9 inches) to the deck or sides of the house. Any smoke pipe for the stove which passes through the roof of the house must be kept at least 8 cm (3 inches) away from any woodwork. Each smoke pipe must be protected by a layer of non-combustible material approved by the Commandant, USCG, an air space of at least 2.54 cm (1 inch), and a metal collar of at least 1.5 mm (0.059 inch) sheet secured only on the weather side of the roof. There may be no opening from any living quarters into any stowage compartment.

(i) Storage of other hazardous materials. Magazine vessels having Class 1 (explosive) materials on board may not be used for the storage of any other hazardous material.

(j) Magazine vessel's stores. Hazardous materials used as stores on board any magazine vessel must comply with the requirements of 46 CFR part 147.

(k) Matches. Safety matches requiring a prepared surface for ignition are the only type of matches authorized to be possessed or used on board a magazine vessel. They must be kept in a metal box or can with a metal cover and stored in the custodian's living quarters.

(l) Firearms. Firearms and ammunition (other than cargo) are not permitted on board a magazine vessel.

(m) Fire extinguishing equipment. No Class 1 (explosive) materials may be loaded or stowed in, unloaded from, or handled on any magazine vessel unless four fire extinguishers that meet the requirements for Type A Size II or Type B Size III in 46 CFR part 95, subpart 95.50 are near and accessible to the magazines.

(n) Supervision. A magazine vessel containing Class 1 (explosive) materials must be continuously attended by a custodian employed for that purpose by the vessel's owner.

(o) Unauthorized persons on magazine vessels. The custodian of a magazine vessel shall prevent unauthorized persons from coming on board unless it is necessary to abate a hazard to human life or a substantial hazard to property.

(p) Repacking of Class 1 (explosive) materials on board. No Class 1 (explosive) materials may be repacked on board a magazine vessel. Broken or damaged packages must be handled in accordance with the requirements of §176.156. Packages requiring an emergency response must be handled in accordance with the emergency response information required under §172.602 of this subchapter.

(q) Work boat. Each magazine vessel must be equipped with a work boat.

(r) Life preservers. One approved personal flotation device must be available for each person employed on a magazine vessel.

(s) Fenders. Each magazine vessel must be fitted with fenders in sufficient number and size to prevent any vessel tieing up alongside from coming in contact with the hull.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-41, 61 FR 51339, Oct. 1, 1996]

Subpart H - Detailed Requirements for Class 2 (Compressed Gas) Materials

Source: Amdt. 176-30, 55 FR 52704, Dec. 21, 1990, unless otherwise noted.

§176.200 General stowage requirements.

(a) Each package of Class 2 (compressed gas) material being transported by vessel must be prevented from making direct contact with the vessel's deck, side, or bulwark by dunnage, shoring, or other effective means.

(b) When cylinders of Class 2 (compressed gas) materials being transported by vessel are stowed in a horizontal position, each tier must be stowed in the cantlines of the tier below it, and the valves on cylinders in adjacent tiers must be at alternate ends of the stow. Each tier may be stepped back and the ends alternated in order to clear the flange. Lashing must be provided to prevent any movement.

(c) When cylinders of Class 2 (compressed gas) materials being transported by vessel are stowed in a vertical position they must be stowed upright in a block and cribbed or boxed in with suitable dunnage. The box or crib must be dunnaged at least 10 cm (3.9 inches) off any metal deck. The cylinders in the box or crib must be braced to prevent

any movement. The box or crib must be securely chocked and lashed to prevent any movement.
(d) Any package containing Division 2.3 (poison gas) materials must be stowed separate from all foodstuffs.
(e) Class 2 (compressed gas) materials may not be stowed "on deck" over a hold or compartment containing coal.
(f) Class 2 (compressed gas) material must be kept as cool as practicable and be stowed away from all sources of heat and ignition.

§176.205 Under deck stowage requirements.
(a) When a Class 2 (compressed gas) material is stowed below deck, it must be stowed in a mechanically ventilated cargo space with no source of artificial heat and clear of living quarters. No bulkhead or deck of that hold or compartment may be a common boundary with any boiler room, engine room, coal bunker, galley or boiler room uptake.
(b) When Division 2.1 (flammable gas) materials are stowed below deck, they must be stowed in a hold or compartment which complies with paragraph (a) of this section and the following requirements:
(1) Each hold or compartment must be ventilated.
(2) Each hold or compartment must be equipped with an overhead water sprinkler system or fixed fire extinguishing system.
(3) Each electrical power line in the hold or compartment must be protected by a strong metal covering to prevent crushing by cargo being stowed against it.
(4) Except when fitted with electrical fixtures of the explosion-proof type, each electrical circuit serving the hold or compartment must be disconnected from all sources of power. No circuit may be energized until the Division 2.1 (flammable gas) cargo and any vapors have been removed from the hold or compartment. Explosion-proof portable lighting may be used if the source of power is from electrical outlets outside the hold or compartment and above the weather deck.
(5) Any opening in a common bulkhead of an adjacent hold or compartment must be securely closed off and made gas-tight, unless the adjacent hold or compartment is also used for the stowage of Division 2.1 (flammable gas) materials.
(6) Full and efficient hatch covers must be used. Tarpaulins, if fitted, must be protected by dunnaging before overstowing with any cargo. Each tarpaulin must be in one piece and free of rents, tears, and holes.
(7) A fire screen must be fitted at the weather end of each vent duct leading from the hold or compartment. The fire screen must completely cover the open area. It must consist of two layers of corrosion-resistant metal wire of 20x20 mesh or finer, spaced not less than 1 cm (0.4 inch) or more than 4 cm (1.6 inches) apart. The screen may be removable if means for securing it in place when in service are provided.
(8) The hold or compartment may not be fitted with any gooseneck type vent trunk head.
(9) Any electrical apparatus located in the hold or compartment must be capable of

being disconnected from its power source by a positive means located outside the hold or compartment.

[Amdt. 176-30, 55 FR 52704, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.210 On deck stowage requirements.

Cylinders of Class 2 (compressed gas) materials being transported by vessel must be protected from radiant heat which, including the direct rays of the sun by structural erections or awnings. A tarpaulin covering the cylinders is not acceptable if it comes in contact with them.

§176.220 Smoking or open flame and posting of warning signs.

(a) Smoking or the use of open flame is prohibited in any hold or compartment containing a Division 2.1 (flammable gas) material, near any Division 2.1 (flammable gas) material stowed on deck, or near any ventilator leading to a hold containing this material.
(b) A sign carrying the legend:

176.220
FLAMMABLE VAPORS
KEEP LIGHTS AND FIRE AWAY
NO SMOKING

must be conspicuously posted at each approach to an "on deck" Division 2.1 (flammable gas) material stowage area and near each cargo hold ventilator leading to a hold containing this material. The sign must be painted on a white background using red letters. The letters may not be less than 8 cm (3 inches) high.

§176.225 Stowage of chlorine.

Chlorine (UN 1017) must be stowed separate from copper or brass leaf sheets and from finely divided organic material.

§176.230 Stowage of Division 2.1 (flammable gas) materials.
Division 2.1 (flammable gas) materials transported in Specification 106A or 110A multi-unit car tanks must be stowed on deck only, and must be shaded from radiant heat.

Subpart I - Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials

Source: Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, unless otherwise noted.

§176.305 General stowage requirements.
(a) A Class 3 (flammable) or combustible liquid must be kept as cool as reasonably practicable and be stowed away from all sources of heat and ignition.
(b) Except as otherwise provided in §176.76(g), a package containing a Class 3 (flammable) liquid and equipped with a vent or safety relief device must be stowed "on deck" only.
(c) The following requirements apply to each hold or compartment in which any Class 3 (flammable) or combustible liquids are being transported:
(1) The hold or compartment must be ventilated except that the stowage of non-bulk packages of Class 3 (flammable) liquids with a flash point above 23^{o}C (73^{o}F) (see 49 CFR 171.8 definitions) may be in non-ventilated holds.
(2) Stowage of a Class 3 (flammable) or combustible liquid within 6 m (20 feet) of a bulkhead which forms a boundary or deck of a boiler room, engine room, coal bunker, galley, or boiler room uptake is not permitted. If the amount of the liquid to be stowed in a hold will not permit compliance with the requirement for a 6 m (20 foot) separation, less separation distance is authorized if at least one of the following conditions exists:
(i) The bulkhead or deck is covered with at least 8 cm (3 inches) of insulation on the entire area subject to heat;
(ii) A temporary wooden bulkhead at least 5 cm (2 inches) thick is constructed in the hold at least 8 cm (3 inches) off an engine room or 15 cm (5.9 inches) off a boiler room bulkhead, covering the entire area of the bulkhead that is subject to heat, and the space between the permanent bulkhead and the temporary wooden bulkhead is filled with mineral wool or equivalent bulk noncombustible insulating material; or
(iii) A temporary wooden bulkhead is constructed of at least 2.5 cm (1 inch) thick tongue and groove sheathing, located 1 m (3 feet) from the boiler room or engine room bulkhead, and filled with sand to a height of 2 m (7 feet) above the tank top, or, if the cargo compartment is located between decks, 1 m (3 feet) of sand.
(3) Combustible liquids may not be stowed in a hold within 6 m (20 feet) of a common

bulkhead with the engine room unless the means of vessel propulsion is internal combustion engines.
(4) Each cargo opening in a bulkhead of an adjacent hold must be securely closed off and made gas-tight, unless the adjacent hold is also used for the stowage of a Class 3 (flammable) or combustible liquid.
(d) In addition to the requirements specified in paragraph (b) of this section, the following requirements apply to each hold or compartment in which a Class 3 (flammable) liquid is transported:
(1) Full and effective hatch covers must be used. Tarpaulins, if fitted, must be protected by dunnaging before overstowing with any cargo. Each tarpaulin must be in one piece and free of rents, tears, and holes;
(2) If Class 3 (flammable) liquids in excess of 1016 kg (2240 pounds) are stowed under deck in any one hold or compartment, a fire screen must be fitted at the weather end of each vent duct leading from that hold or compartment. The fire screen must completely cover the open area. It must consist of two layers of corrosion-resistant metal wire of 20x20 mesh or finer, spaced not less than 1 cm (0.4 inch) or more than 4 cm (1.6 inches) apart. The screen may be removable only if means for securing it in place when in service are provided;
(3) Each electrical power line in the hold or compartment must be protected by a strong metal covering to prevent crushing by cargo being stowed against it;
(4) Except when fitted with explosion-proof type electrical fixtures, each electrical circuit serving the hold or compartment must be disconnected from all sources of power from a point outside the hold or compartment containing flammable liquids. No circuit may be energized until the flammable liquids and any vapors have been removed from the hold or compartment. Explosion-proof type portable lighting may be used if the source of power is from electrical outlets outside the hold or compartment and above the weather deck; and
(5) A Class 3 (flammable) liquid in excess of 1016 kg (2240 pounds) may not be transported in any hold or compartment that is fitted with a gooseneck type of vent head.
(e) On a passenger vessel, each hold or compartment used to transport a Class 3 (flammable) liquid must be equipped with an overhead water sprinkler system or fixed fire-extinguishing system.
(f) On a passenger vessel, each hold or compartment used to transport Class 3 (flammable) liquids under a passenger space must have an overdeck of an A-60 type construction (see 46 CFR 72.05-10(c)(1)) or equivalent or have its underside covered with at least 8 cm (3 inches) of noncombustible insulation.
(g) No Class 3 (flammable) liquid in a drum or wooden case, having inside packagings of more than 1 L (0.3 gallon) capacity each, may be stowed as a beam filler. A wooden barrel, a wooden box or a fiberboard box, with any Class 3 (flammable) liquid material in inside packagings of not more than 1 L (0.3 gallon) capacity each, may only be stowed as a beam filler if it is possible to stow and observe any "THIS SIDE UP" marking.

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20,

1991]

§176.315 Fire protection requirements.

(a) For each 79,500 liters (21,000 U.S. gallons) or part thereof of any Class 3 (flammable) or combustible liquid being transported on board a vessel in a portable tank, rail tank car, or a motor vehicle cargo tank, there must be provided at least one B-V semiportable foam (152 liter/40 gallon capacity) (see 46 CFR 95.50), dry chemical (45.4 kg (100 pounds) minimum capacity) or equivalent fire extinguisher, or a fire hose fitted with an approved portable mechanical foam nozzle with pick-up tube and two 19 liter (5 gallon) cans of foam liquid concentrate. Each foam system must be suitable for use with each Class 3 (flammable) or combustible liquid for which it is required. Each fire extinguisher must be accessible to the tank it is intended to cover.

(b) The fire hose at each fire hydrant in the vicinity of Class 3 (flammable) and combustible liquids stowage areas must be fitted with an approved combination solid stream and water spray nozzle.

(c) The pressure must be maintained in the vessel's fire mains during the loading and unloading of any Class 3 (flammable) or combustible liquids.

(d) Two 7 kg (15-pound) capacity hand portable dry chemical or two portable 10 L (2.6 gallons) foam-type extinguishers must be accessible to any packaged Class 3 (flammable) or combustible liquid and suitable for use with the lading.

(e) The requirements of this section do not apply to portable tanks and their contents authorized under 46 CFR part 98 or 46 CFR part 64.

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.320 Use of hand flashlights.

Each hand flashlight used on deck near or in any hold or compartment containing a Class 3 (flammable) liquid, must be suitable for use in hazardous locations where fire or explosion hazards may exist.

§176.325 Smoking or open flame and posting of warning signs.

(a) Smoking or the use of open flame is prohibited in any hold or compartment containing a Class 3 (flammable) or combustible liquid, near any Class 3 (flammable) or combustible liquid stowed on deck, or near any ventilator leading to a hold containing such material.

(b) A sign carrying the legend:

176.325
FLAMMABLE VAPORS
KEEP LIGHTS AND FIRE AWAY
NO SMOKING

must be conspicuously posted at each approach to a Class 3 (flammable) or combustible liquid stowed "on deck" and near each cargo hold ventilator leading to a hold or compartment containing this material. This sign must be painted on a white background using red letters. The letters may not be less than 8 cm (3 inches) high.

§176.340 Combustible liquids in portable tanks.

Combustible liquids, having a flash point of 38°C (100°F) or higher, may be transported by vessel only in one of the portable tanks as specified below:

(a) Portable tanks authorized in §173.241 of this subchapter.

(b) In nonspecification portable tanks, subject to the following conditions:

(1) Each portable tank must conform to a DOT specification 57 portable tank, except as otherwise provided in this paragraph;

(2) The rated capacity of the tank may not exceed 4,542 liters (1,200 gallons), and the rated gross weight may not exceed 13,608 kg (30,000 pounds);

(3) The vibration test need not be performed;

(4) When the total surface area of the tank exceeds 14.9 square meters (160 square feet), the total emergency venting capacity must be determined in accordance with table I in §178.345-10 of this subchapter;

(5) In place of a specification identification marking, the tank must be marked, on two sides in letters at least 5 cm (2 inches) high on contrasting background: "FOR COMBUSTIBLE LIQUIDS ONLY" and "49 CFR 176.340". This latter marking constitutes certification by the person offering the combustible liquid materials for transportation that the portable tank conforms to this paragraph;

(6) Each tank must be made of steel;

(7) The design pressure of the tank must be not less than 62 kPa (9 psi);

(8) No pressure relief device may open at less than 34.4 kPa (5 psi);

(9) Each tank must be retested and marked at least once every 2 years in accordance with the requirements applicable to a DOT specification 57 portable tank in §173.32(e) (2), (3), and (4) of this subchapter; and

(10) Each tank must conform to the provisions of §173.24 of this subchapter and paragraphs (g), (h), (i), and (k) of §173.32 of this subchapter.

(c) Portable tanks approved by the Commandant, USCG (G-MSO).

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended by Amdt. 176-41, 61 FR 51339, Oct. 1, 1996; 62 FR 51561, Oct. 1, 1997]

Subpart J - Detailed Requirements for Class 4 (Flammable Solids), Class 5 (Oxidizers and Organic Peroxides), and Division 1.5 (Blasting Agents) Materials

Source: Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, unless otherwise noted.

§176.400 Stowage of Division 1.5 (blasting agents), Class 4 (flammable solids) and Class 5 (oxidizers and organic peroxides) materials.

(a) Class 4 (flammable solid) material and Division 5.2 (organic peroxide) material must be kept as cool as reasonably practicable and be stowed away from all sources of heat and ignition.
(b) Division 5.2 (organic peroxide) material must be stowed away from living quarters or access to them. Division 5.2 (organic peroxide) material not requiring temperature control should be protected from radiant heat, which includes direct rays of the sun, and stowed in a cool, well-ventilated area.
(c) No Division 1.5 (blasting agents) or Class 5 (oxidizers and organic peroxides) material being transported by vessel may be stowed in the same hold or compartment with any readily combustible material such as a combustible liquid, a textile product, or with a finely divided substance, such as an organic powder.
(d) No Division 1.5 (blasting agents) or Class 5 (oxidizers and organic peroxides) material being transported by vessel may be stowed in a hold or compartment containing sulfur in bulk, or in any hold or compartment above, below, or adjacent to one containing sulfur in bulk.

§176.405 Stowage of charcoal.

(a) Before stowing charcoal Division 4.2 (flammable solid), UN 1361, NA 1361, or UN 1362 on a vessel for transportation, the hold or compartment in which it is to be stowed must be swept as clean as practicable. All residue of any former cargo, including especially a petroleum product, a vegetable or animal oil, nitrate, or sulfur, must be removed.
(b) Charcoal packed in bags and offered for transportation on board a vessel in a quantity over 1016 kg (2240 pounds) must be loaded so that the bags are laid horizontally and stacked with space for efficient air circulation. If the bags are not compactly filled and closed to avoid free space within, vertical and horizontal dunnage

strips must be laid between the bags. Space for ventilating must be maintained near bulkheads, the shell of the vessel, the deck, and the overhead. No more than 40,600 kg (89,508 pounds) of charcoal may be stowed in a hold or compartment when other stowage space is available. If the unavailability of hold or compartment space requires the stowage of a larger amount, the arrangement of the stow for ventilation must be adjusted to ensure a sufficient venting effect.
(c) Any loose material from bags broken during loading must be removed. Broken bags may be repacked or have the closures repaired and the repaired bags restowed.
(d) Charcoal "screenings" packed in bags must be stowed to provide spaces for air circulation between tiers regardless of the quantity stowed.

§176.410 Division 1.5 (blasting agents) materials, ammonium nitrate and ammonium nitrate mixtures.
(a) This section prescribes requirements to be observed with respect to transportation of each of the following hazardous materials by vessel:
(1) Explosives, blasting, type E, and Explosives, blasting, type B, Division 1.5 (blasting agent) compatibility group D, UN 0331 and UN 0332.
(2) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 1942.
(3) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2068.
(4) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2067.
(5) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2069 or UN 2072.
(6) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2070.
(b) This section does not apply to Ammonium nitrate fertilizer, Class 9, UN 2071 or to any non-acidic ammonium nitrate mixed fertilizer containing 13 percent or less ammonium nitrate, less than 5 percent organic material, and no other oxidizing material, and which does not meet the criteria for any other hazard set forth in part 173 of this subchapter.
(c) When Division 1.5 (blasting agents) compatibility group D materials, ammonium nitrate, or any of the ammonium nitrate fertilizers listed in paragraph (a) of this section are transported by vessel:
(1) They must be stowed well away from any steam pipe, electric circuit, or other source of heat;
(2) Smoking is prohibited except in designated areas away from the material and "No-Smoking" signs must be posted in accordance with §176.60;
(3) Fire hoses must be connected, laid out, and tested before loading or unloading commences; and
(4) A fire watch must be posted in the hold or compartment where the material is being loaded or unloaded.
(d) When any of the hazardous materials listed in paragraph (a) of this section is transported in bags by vessel:
(1) The requirements specified in paragraph (c) of this section must be complied with;
(2) The temperature of the bagged material may not exceed 54 ^{o}C (130 ^{o}F);

(3) Minimum dunnage and sweatboards must be used to prevent any friction or abrasion of bags, and to allow for the circulation of air and access of water in the event of fire;
(4) The bags must be stowed from side to side, out to the sweatboards;
(5) A space of 46 cm (18 inches) must be provided between any transverse bulkhead and the bags;
(6) The bags must be stowed so as to provide a 46 cm (18 inch) athwartship trench along the centerline of the compartment, continuous from top to bottom;
(7) The bags must be stowed so as to provide a 46 cm (18 inch) amidship trench running fore and aft from bulkhead to bulkhead;
(8) The bags may not be stowed less than 46 cm (18 inches) from any overhead deck beam;
(9) The bags must be stowed so as to provide vent flues 36 cm (14 inches) square at each corner of the hatch continuous from top to bottom;
(10) Trenching must be accomplished by alternating the direction of the bags in each tier (bulkheading); and
(11) The bags must be blocked and braced as necessary to prevent shifting of the bagged cargo adjacent to any trench area.
(e) Notwithstanding §176.83(b) of this part, ammonium nitrate and ammonium nitrate fertilizers classed as Division 5.1 (oxidizers) materials, may be stowed in the same hold, compartment, magazine, or freight container with Class 1 materials (explosive), except those containing chlorates, in accordance with the segregation and separation requirements of §176.144 of this part applying to Explosives, blasting, type B, and Explosives, blasting, type E, Division 1.5 compatibility group D.
(f) No mixture containing ammonium nitrate and any ingredient which would accelerate the decomposition of ammonium nitrate under conditions incident to transportation may be transported by vessel.

[Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995]

§176.415 Permit requirements for Division 1.5 (blasting agents), ammonium nitrates, and certain ammonium nitrate fertilizers.

(a) Except as provided in paragraph (b) of this section, before any of the following material is loaded on or unloaded from a vessel at any waterfront facility, the owner/operator must obtain written permission from the nearest COTP:

(1) Ammonium nitrate UN 1942, ammonium nitrate fertilizers containing more than 60 percent ammonium nitrate, ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 2070, or Division 1.5 (blasting agent) compatibility group D materials packaged in a paper bag, burlap bag, or other nonrigid combustible packaging, or any rigid packaging with combustible inside packagings.

(2) Any other ammonium nitrate or ammonium nitrate fertilizer not listed in §176.410 (a) or (b) except ammonium nitrate fertilizer, Class 9, UN 2071.

(b) Any of the following may be loaded on or unloaded from a vessel at any waterfront facility without a permit:

(1) Ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 1942, in a rigid packaging with noncombustible inside packaging.

(2) Ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 2067, if the nearest COTP is notified at least 24 hours in advance of any loading or unloading in excess of 454 kg (1,000 pounds).

(3) Ammonium nitrate fertilizer, n.o.s., Division 5.1 (oxidizer) UN 2072, containing 40 percent or more fine calcium carbonate or dolomite.

(4) Non-acidic ammonium nitrate fertilizer, n.o.s., Division 5.1 (oxidizer) UN 2072, containing less than 5 percent organic material and 60 percent or less ammonium nitrate.

(5) Division 1.5 (blasting agents) compatibility group D material in a rigid packaging with non-combustible inside packaging.

(6) Ammonium nitrate fertilizer, Class 9, UN 2071.

(c) Before a permit may be issued, the following requirements must be met in addition to any others the COTP may impose:

(1) If the material is ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070; or Explosives, blasting, type E, Division 1.5 (blasting agents) compatibility group D, UN0332 in combustible packaging or in a rigid packaging with combustible inside packaging, it must be loaded or unloaded at a facility remote from populous areas or high value or high hazard industrial facilities so that in the event of fire or explosion loss of lives and property may be minimized;

(2) If the material is an ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070, containing more than 60 percent ammonium nitrate; or ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070 in rigid packagings with combustible inside packagings, it must be loaded or unloaded at a facility removed from congested areas or high value or high hazard industrial facilities;

(3) Each facility at which the material is to be loaded or unloaded must conform with the requirements of the port security and local regulations and must have an abundance of water readily available for fire fighting;

(4) Each facility at which the material is to be loaded or unloaded must be located so that each vessel to be loaded or unloaded has an unrestricted passage to open water. Each vessel must be moored bow to seaward, and must be maintained in a mobile status during loading, unloading, or handling operations by the presence of tugs or the readiness of engines. Each vessel must have two wire towing hawsers, each having an eye spice, lowered to the water's edge, one at the bow and the other at the stern; and

(5) If the material is ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070; an ammonium nitrate fertilizer, Division 5.1 (oxidizer) containing more than 60 percent ammonium nitrate; or a Division 1.5 (blasting agents) compatibility group D material in non-rigid combustible packaging and loaded in freight containers or transport vehicles, it may be loaded or unloaded at a non-isolated facility provided that facility is approved by

the COTP.

[Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-35, 59 FR 49134, Sept. 26, 1994]

Subpart K - [Reserved]

Subpart L - Detailed Requirements for Division 2.3 (Poisonous Gas) and Division 6.1 (Poisonous) Materials

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.600 General stowage requirements.

(a) Each package required to have a POISON GAS, POISON INHALATION HAZARD, or POISON label, being transported on a vessel, must be stowed clear of living quarters and any ventilation ducts serving living quarters and separated from foodstuffs, except when the hazardous materials and the foodstuffs are in different closed transport units.
(b) Each package required to have both a POISON GAS label and a FLAMMABLE GAS label thereon must be segregated as a Division 2.1 (flammable gas) material.
(c) Each package bearing a POISON label displaying the text "PG III" or bearing a "PG III" mark adjacent to the poison label must be stowed away from foodstuffs.
(d) Each package of Division 2.3 (poisonous gas) material or Division 6.1 (poison) material which also bears a FLAMMABLE LIQUID or FLAMMABLE GAS label must be stowed in a mechanically ventilated space, kept as cool as reasonably practicable, and be stowed away from all sources of heat and ignition.

[Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, as amended at 57 FR 45465, Oct. 1, 1992; Amdt. 176-35, 59 FR 49134, Sept. 26, 1994; Amdt. 176-42, 62 FR 1236, Jan. 8, 1997; 64 FR 10782, Mar. 5, 1999]

§176.605 Care following leakage or sifting of Division 2.3 (poisonous gas) and Division 6.1 (poisonous) materials.

A hold or compartment containing a package of a Division 2.3 (poisonous gas) or

Division 6.1 (poisonous) material which has leaked or sifted must be thoroughly cleaned and decontaminated after the cargo is unloaded and before the hold or compartment is used for the stowage of any other cargo.

Subpart M - Detailed Requirements for Radioactive Materials

Source: Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, unless otherwise noted.

§176.700 General stowage requirements.

(a) [Reserved]
(b) A package of radioactive materials which in still air has a surface temperature more than 5 ^{o}C (9 ^{o}F) above the ambient air may not be overstowed with any other cargo. If the package is stowed under deck, the hold or compartment in which it is stowed must be ventilated.
(c) Each fissile material, controlled shipment must be stowed in a separate hold, compartment, or defined deck area and be separated by a distance of at least six meters (20 feet) from all other RADIOACTIVE YELLOW-II or YELLOW-III labeled packages.
(d) For a shipment of radioactive materials requiring supplemental operational procedures, the shipper must furnish the master or person in charge of the vessel a copy of the necessary operational instructions.
(e) A person may not remain unnecessarily in a hold, or compartment, or in the immediate vicinity of any package on deck, containing radioactive materials.

(The information collection requirements in paragraph (d) were approved by the Office of Management and Budget under control numbers 2137-0534, 2137-0535 and 2137-0536)

[Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, as amended by Amdt. 176-15, 48 FR 31220, July 7, 1983; Amdt. 176-23, 50 FR 41523, Oct. 11, 1985; Amdt. 176-37, 60 FR 50333, Sept. 28, 1995]

§176.704 Requirements relating to transport indexes.

(a) The sum of the transport indexes for all packages of Class 7 (radioactive) materials on board a vessel may not exceed the limits specified in table III.

(b) For packages in freight containers, the radiation level may not exceed 2 mSv per hour (200 mrem per hour) at any point on the surface and 0.1 mSv per hour (10 mrem per hour) at two meters (6.6 feet) from the outside surface of the freight container.

(c) The limitations specified in table III do not apply to consignments of LSA materials if the packages are marked "RADIOACTIVE LSA" and no fissile Class 7 (radioactive) materials are included in the shipment.

(d) Each group of fissile packages must be separated from other Class 7 (radioactive) material by a distance of at least six meters (20 feet) at all times.

(e) The limitations specified in paragraphs (a) through (c) of this section do not apply when the entire vessel is reserved or chartered for use by a single offeror under exclusive use conditions if-

(1) The number of fissile packages of Class 7 (radioactive) materials aboard the vessel does not exceed the amount authorized in §§173.457 and 173.459 of this subchapter; and

(2) The entire shipment operation is approved by the Associate Administrator for Hazardous Materials Safety in advance.

(f) Table III is as follows:

Table III-TI Limits for Freight Containers and Conveyances

Type of freight container or conveyance	Limit on total sum of transport indexes in a single freight container or aboard a conveyance			
-	Not under exclusive use		Under exclusive use	
-	Non-fissile material	Fissile material	Non-fissile material	Fissile material
Freight container-Small	50	50	N/A	N/A.
Freight container-Large	50	50	No limit	100[b].
Vessel[c]:	-	-	-	-
1. Hold, compartment or defined deck area:	-	-	-	-
Packages, overpacks, small freight containers	50	50	No limit	100[b].
Large freight containers	200[d]	50	No limit	100[b].
2. Total vessel:	-	-	-	-
Packages, etc.	200[d]	200[d]	No limit[e].	200[e].
Large freight containers	No limit[d]	No limit[d]	No limit	No limit[d].

[a]Provided that transport is direct from the consignor to the consignee without any intermediate in-transit storage, where the total TI exceed 50.

[b]In cases in which the total TI is greater than 50, the consignment must be so handled and stowed so that it is always separated from any package, overpack, portable tank or freight container carrying Class 7 (radioactive) materials by at least 6 meters (20 feet).

[c]For vessels the requirements given in 1 and 2 must be fulfilled.

[d]Provided that the packages, overpacks, portable tanks or freight containers, as applicable, are stowed so that the total sum of the TI's in any group does not exceed 50, and that each group is handled and stowed so that the groups are separate from each

other by at least 6 meters (20 feet).

[e]Packages or overpacks carried in or on a transport vehicle which are offered for transport under the provisions of §173.441(b) of this subchapter may be transported by vessel provided that they are not removed from the vehicle at anytime while on board the vessel.

[Amdt. 176-37, 60 FR 50333, Sept. 28, 1995, as amended by 176-37, 61 FR 20753, May 8, 1996; 63 FR 52850, Oct. 1, 1998]

§176.708 Segregation distance table.

(a) Table IV applies to the stowage of packages of Class 7 (radioactive) materials on board a vessel with regard to transport index numbers which are shown on the labels of individual packages.

(b) RADIOACTIVE YELLOW-II or YELLOW-III labeled packages may not be stowed any closer to living accommodations, regularly occupied working spaces, spaces that may be continually occupied by any person (except those spaces exclusively reserved for couriers specifically authorized to accompany such packages), or undeveloped film than the distances specified in TABLE IV.

(c) Where only one consignment of a Class 7 (radioactive) material is to be loaded on board a vessel under exclusive use conditions, the appropriate segregation distance may be established by demonstrating that the direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 7.5 microsieverts per hour (0.75 mrem per hour).

(d) More than one consignment may be loaded on board a vessel with the appropriate segregation distance established by demonstrating that direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 7.5 microSieverts per hour (0.75 mrem per hour), provided that:

(1) The vessel has been chartered for the exclusive use of a competent person specialized in the carriage of Class 7 (radioactive) material; and

(2) Stowage arrangements have been predetermined for the entire voyage, including any Class 7 (radioactive) material to be loaded at ports of call enroute.

(e) The radiation level must be measured by a responsible person skilled in the use of monitoring instruments.

(f) Table IV is as follows:

Table IV

Sum of transport indexes of the packages	Minimum distance in feet from living accommodation or	Minimum distance in feet from undeveloped film and plates

	regularly occupied working space																										
-			1 day voyage			2 day voyage			4 day voyage			10 day voyage			20 day voyage			30 day voyage			40 day voyage			50 day voyage		
-	-	-																								-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(25)Cargo thickness in feet (unit density)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	Nil	3	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6
0.1 to 0.5	5	X	6	X	X	8	X	X	11	X	X	17	4	X	25	6	X	30	7	X	35	8	X	39	9	X
0.6 to 1	6	X	8	X	X	11	X	X	16	4	X	25	6	X	35	8	X	42	10	X	50	12	X	55	13	X
1.1 to 2	9	X	11	X	X	16	4	X	22	5	X	35	8	X	50	12	X	61	14	X	70	17	X	78	19	X
2.1 to 3	10	X	14	X	X	19	5	X	27	6	X	42	10	X	61	14	X	74	18	X	86	20	X	96	23	X
3.1 to 5	13	X	17	4	X	25	6	X	35	8	X	55	13	X	78	19	X	96	23	X	110	26	X	124	29	7
5.1 to 10	19	4	25	6	X	35	8	X	50	12	X	78	19	X	110	26	X	135	33	8	155	37	9	175	42	10
10.1 to 20	26	6	35	8	X	50	12	X	69	17	X	110	26	X	155	37	9	190	46	11	220	53	13	250	59	14
20.1 to 30	32	8	43	10	X	61	14	X	85	20	X	135	32	8	190	45	11	235	56	13	270	65	16	305	72	17
30.1 to 50	42	10	55	13	X	78	19	X	110	26	X	175	42	10	245	58	14	300	73	17	350	84	20	390	94	22
50.1 to 100	59	14	78	19	X	110	26	X	155	37	9	245	59	14	350	82	20	430	105	24	515	118	28	550	130	32
100.1 to 150	72	17	96	23	X	135	32	8	190	46	11	300	72	17	425	100	24	525	125	30	600	145	35	([7])	165	39
150.1 to 200	84	20	110	26	X	155	37	9	200	53	13	350	84	20	490	115	28	600	140	35	([7])	165	40	([7])	190	45
200.1 to 300	105	24	135	32	X	190	46	11	270	64	15	425	105	25	600	145	35	([7])	180	42	([7])	205	49	([7])	230	55
300.1 to 400	120	28	160	37	9	220	53	13	310	75	18	500	120	28	([7])	165	40	([7])	205	49	([7])	235	57	([7])	265	63

Note:

(1) X-indicates that thickness of screening cargo is sufficient without any additional segregation distance.

(2) By using 6 feet of intervening unit density cargo for persons and 10 feet for film and plates, no distance shielding is necessary for any length of voyage specified.

(3) Using 1 steel bulkhead or steel deck-multiply segregation distance by 0.8. Using 2 steel bulkheads or steel decks-multiply segregation distance by 0.64.

(4) "Cargo of Unit Density" means cargo stowed at a density of 1 ton (long) per 36 cubic feet; where the density is less than this the depth of cargo specified must be increased in proportion.

(5) "Minimum distance" means the least in any direction whether vertical or horizontal from the outer surface of the nearest package.

(6) The total consignment on board at any time must not exceed transport indexes

totalling 200 except if carried under the provisions of §176.704(f). The figures below the double line of the table should be used in such a contingency.

(7) Not to be carried unless screening by other cargo and bulkheads can be arranged in accordance with the other columns.

[Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, as amended by Amdt. 176-37, 60 FR 50334, Sept. 28, 1995]

§176.710 Care following leakage or sifting of radioactive materials.

(a) In case of fire, collision, or breakage involving any shipment of radioactive materials, other than materials of low specific activity, the radioactive materials must be segregated from unnecessary contact with personnel. In case of obvious leakage, or if the inside container appears to be damaged, the stowage area (hold, compartment, or deck area) containing this cargo must be isolated as much as possible to prevent radioactive material from entering any person's body through contact, inhalation, or ingestion. No person may handle the material or remain in the vicinity unless supervised by a qualified person.

(b) A hold or compartment in which leakage of radioactive materials has occurred may not be used for other cargo until it is decontaminated in accordance with the requirements of §176.715.

(c) For reporting requirements, see §171.15 of this subchapter.

§176.715 Contamination control.

Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 (radioactive) materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 5 microSieverts per hour (0.5 mrem per hour), and the removable (non-fixed) radioactive surface contamination is not greater than the limits prescribed in §173.443 of this subchapter.

[Amdt. 176-37, 60 FR 50334, Sept. 28, 1995]

Subpart N - Detailed Requirements for Class 8 (Corrosive Materials) Materials

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.800 General stowage requirements.

(a) Each package required to have a Class 8 (corrosive) label thereon being transported on a vessel must be stowed clear of living quarters, and away from foodstuffs and cargo of an organic nature.

(b) A package of Class 8 (corrosive material) material may not be stowed over any readily combustible material.

(c) Glass carboys containing Class 8 (corrosive material) material may not be stowed on board any vessel, other than a barge, more than two tiers high unless each carboy is boxed or crated with neck protection extending to the sides of the carboy box. This protective construction must be strong enough to permit stacking one on top of the other.

(d) A Class 8 (corrosive material) material may not be stowed over a hold or compartment containing cotton unless the deck is of steel and the hatch is fitted with a tight coaming. In addition, the deck must be tight against leakage and the Class 8 (corrosive material) material may not be stowed over the square of the hatch.

(e) Each package of Class 8 (corrosive material) which also bears a FLAMMABLE LIQUID label must be stowed away from all sources of heat and ignition.

[Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, as amended by Amdt. 176-39, 61 FR 18933, Apr. 29, 1996]

§176.805 On deck stowage.

When break bulk Class 8 (corrosive materials) materials being transported on a vessel are stowed on deck:

(a) Provisions must be made for leakage from any package to drain away from other cargo into an overboard scupper or freeing port. The drainage may not enter an enclosed drainage system other than a direct overboard scupper. If this stowage is not practical, sufficient clean dry sand must be placed under and around the lower tier of packages to absorb any leakage.

(b) Dunnage must be provided on the deck and arranged so that any leakage will be apparent.

(c) Any leakage that occurs must be washed down, using liberal quantities of water.

Subpart O - Detailed Requirements for Cotton and Vegetable Fibers, Motor Vehicles, and Asbestos

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.900 Packaging and stowage of cotton and vegetable fibers; general.

(a) Cotton, Class 9, NA 1365, Cotton, wet, Division 4.2, UN 1365, and other vegetable fibers, Division 4.1, being transported on a vessel must be securely baled and bound. Each bale of cotton or vegetable fibers must be covered with bagging on at least three-fourths of its surface, including both ends. Cut cotton linters may be accepted for transportation by vessel when baled and covered with bagging on the soft sides only if the bale is compressed to a density of at least 512 kg/m^3 (32 pounds per cubic foot) and it is bound with at least six bands per bale. Any poorly compressed bale or any bale having damaged bindings may not be transported by vessel.

(b) Each bale of Cotton, wet, Division 4.2, UN 1365 must be stowed separately from any bales of dry cotton or vegetable fibers, in a 'tween deck space, and not overstowed. Any bale of cotton or vegetable fibers which is saturated with water may not be transported by vessel.

(c) Bales of cotton or vegetable fibers showing contact with oil or grease may not be accepted for transportation by vessel.

(d) Cotton or vegetable fibers must be stowed in a hold or compartment in accordance with the following requirements:

(1) All traces of oil or residue in the hold or compartment must be removed;

(2) A recently painted hold or compartment may not be used unless it is thoroughly dry;

(3) Each ventilation cowl serving the hold or compartment must be fitted with a spark screen;

(4) When a bulkhead of the hold or compartment is common with a boiler room, engine room, coal bunker, or galley and subjected to heat, a wooden bulkhead must be erected between the bulkhead and any cotton or vegetable fibers. This wooden bulkhead must be at least 15 cm (6 inches) from a boiler room bulkhead, and at least 5 cm (2 inches) from an engine room, coal bunker, or galley bulkhead;

(5) Each 'tween deck hatch must be closed with hatch covers, tarpaulins, and dunnage; however, metal hatch covers which are sealed by other means to provide equivalent protection may be used;

(6) Each hold or compartment must be equipped with a carbon dioxide or overhead water sprinkler system or other approved fixed extinguishing system. Before loading, the extinguishing system must be examined to ensure that it is in good working condition; and

(7) Each hold or compartment must be clear of all debris and swept as clean as practicable before loading.

(e) Naked lights or any fire likely to produce sparks are not permitted on the vessel, dock area, or on any lighters alongside a vessel during loading or unloading of cotton or vegetable fibers.

(f) Upon completion of stowage, each opening must be completely closed. Where required, tarpaulins must be fitted and secured in place to provide a tight hold. During a

period of temporary stoppage of loading or unloading, a hatch may be left open. However, during that period, a fire watch, designated by the master or officer-in-charge, must be stationed in the hold or compartment in which the cotton or vegetable fibers are stowed.
(g) At least one fire hose must be connected while cotton or vegetable fibers are being loaded or unloaded. Each fire pump must be operated before any loading or unloading. Pressure must be maintained on each fire main during the loading and the fire hose laid out ready for immediate use. Portable fire extinguishers must be placed to be readily available. The fire hose, fire pumps, and fire extinguishers may be the vessel's equipment or shore equipment.
(h) Smoking is not permitted on a vessel during the loading or unloading of cotton or vegetable fibers except at those times and in those places designated by the master. "NO SMOKING" signs must be conspicuously posted in appropriate places, and the responsible person in charge of the loading or unloading (see §176.57 of this part) must ensure that they are observed.
(i) Cotton or vegetable fibers may be stowed in the same hold over bulk sulfur if the sulfur has been trimmed and leveled and the hold is thoroughly cleaned of sulfur dust. A tight floor of two layers of 2.54 cm (1 inch) crossed clean dunnage boards must be laid on the sulfur before cotton or vegetable fibers are stowed. These substances may be stowed alongside each other in the same hold if they are separated by a tight dustproof wood bulkhead.
(j) Cotton or vegetable fibers may not be stowed in a 'tween deck hold over bulk sulfur in a lower hold unless the 'tween deck hold has been thoroughly cleaned of all sulfur dust and the 'tween deck hatch covers are in place and covered with tarpaulins and dunnage.

§176.901 Stowage of cotton or vegetable fibers with rosin or pitch.
(a) Unless impracticable, cotton or vegetable fibers being transported on a vessel may not be stowed in the same hold or compartment with rosin or pitch being transported on the same vessel.
(b) When separate stowage is impracticable, the cotton or vegetable fibers may be stowed in the same hold or compartment with rosin or pitch if they are separated by clean dunnage or a cargo of a non-combustible nature. When such stowage within the same hold or compartment involves large amounts of cotton or fibers or of rosin or pitch, the rosin or pitch must be floored off with at least two layers of 2.54 cm (1 inch) dunnaging and the cotton or vegetable fibers stowed above.

§176.903 Stowage of cotton or vegetable fibers with coal.
Cotton or vegetable fibers being transported on a vessel may not be stowed in the same hold with coal. They may be stowed in adjacent holds if the holds are separated by a

tight steel bulkhead and the cotton or vegetable fibers are dunnaged at least 5 cm (2 inches) off the bulkhead. Cotton or vegetable fibers may be stowed in a hold above or below one in which coal is stowed if there is a tight steel intervening deck and all hatch covers are in place and covered with tarpaulins.

§176.905 Motor vehicles or mechanical equipment powered by internal combustion engines.

(a) A motor vehicle or any mechanized equipment powered by an internal combustion engine is subject to the following requirements when carried as cargo on a vessel:

(1) Before being loaded on a vessel, each motor vehicle or mechanical equipment must be inspected for fuel leaks and identifiable faults in the electrical system that could result in short circuit or other unintended electrical source of ignition. A motor vehicle or mechanical equipment showing any signs of leakage or electrical fault may not be transported.

(2) The fuel tank of a motor vehicle or mechanical equipment powered by liquid fuel may not be more than one-fourth full.

(3) Whenever possible, each vehicle or mechanical equipment must be stowed to allow for its inspection during transit.

(4) Motor vehicles or mechanical equipment may be refueled when necessary in the hold of a vessel in accordance with §176.78.

(5) When a motor vehicle or mechanical equipment with fuel in its tanks is stowed in a closed freight container, a warning, displayed on a contrasting background and readily legible from a distance of 8 meters (26 feet), must be affixed to the access doors to read as follows:

WARNING-MAY CONTAIN EXPLOSIVE MIXTURES WITH AIR-KEEP IGNITION SOURCES AWAY WHEN OPENING

(6) A motor vehicle or mechanical equipment's ignition key may not be in the ignition while the vehicle or mechanical equipment is stowed aboard a vessel.

(b) All equipment used for handling vehicles or mechanical equipment must be designed so that the fuel tank and fuel system of the vehicle or mechanical equipment are protected from stress that might cause rupture or other damage incident to handling.

(c) Two hand-held, portable, dry chemical fire extinguishers of at least 4.5 kg (10 pounds) capacity each must be separately located in an accessible location in each hold or compartment in which any motor vehicle or mechanical equipment is stowed.

(d) "NO SMOKING" signs must be conspicuously posted at each access opening to the hold or compartment.

(e) Each portable electrical light, including a flashlight, used in the stowage area must be an approved, explosion-proof type. All electrical connections for any portable light must be made to outlets outside the space in which any vehicle or mechanical equipment is stowed.

(f) Each hold or compartment must be ventilated and fitted with an overhead water sprinkler system or fixed fire extinguishing system.

(g) Each hold or compartment must be equipped with a smoke or fire detection system capable of alerting personnel on the bridge.

(h) All electrical equipment in the hold or compartment other than fixed explosion-proof lighting must be disconnected from its power source at a location outside the hold or compartment during the handling and transportation of any vehicle or mechanical equipment. Where the disconnecting means is a switch or circuit breaker, it must be locked in the open position until all vehicles have been removed.

(i) *Exceptions. A motor vehicle or mechanical equipment is excepted from the requirements of this subchapter if the following requirements are met:*

(1) The motor vehicle or mechanical equipment has an internal combustion engine using liquid fuel that has a flashpoint less than 38 ^{o}C (100 ^{o}F), the fuel tank is empty, and the engine is run until it stalls for lack of fuel;

(2) The motor vehicle or mechanical equipment has an internal combustion engine using liquid fuel that has a flashpoint of 38 ^{o}C (100 ^{o}F) or higher, the fuel tank contains 418 liters (110 gallons) of fuel or less, and there are no fuel leaks in any portion of the fuel system;

(3) The motor vehicle or mechanical equipment is stowed in a hold or compartment designated by the administration of the country in which the vessel is registered to be specially suited for vehicles. *See 46 CFR 70.10-44 and 90.10-38 for U.S. vessels;*

(4) The motor vehicle or mechanical equipment is electrically powered by wet electric storage batteries; or

(5) The motor vehicle or mechanical equipment is equipped with liquefied petroleum gas or other compressed gas fuel tanks, the tanks are completely emptied of liquid and the positive pressure in the tank does not exceed 2 bar (29 psi), the line from the fuel tank to the regulator and the regulator itself is drained of all trace of (liquid) gas, and the fuel shut-off valve is closed.

(j) Except as provided in §173.220(f) of this subchapter, the provisions of this subchapter do not apply to items of equipment such as fire extinguishers, compressed gas accumulators, airbag inflators and the like which are installed in the motor vehicle or mechanical equipment if they are necessary for the operation of the vehicle or equipment, or for the safety of its operator or passengers.

[Amdt. 176-43, 62 FR 24742, May 6, 1997]

Pt. 177

[CFR] PART 176 - CARRIAGE BY VESSEL

[TITLE 49] [SUBTITLE B] [PART 176]

Subpart A-General

Subpart B-General Operating Requirements

Subpart C-General Handling and Stowage

Subpart D-General Segregation Requirements

Subpart E-Special Requirements for Transport Vehicles Loaded With Hazardous Materials and Transported on Board Ferry Vessels

Subpart F-Special Requirements for Barges

Subpart G-Detailed Requirements for Class 1 (Explosive) Materials

Stowage

Subpart H-Detailed Requirements for Class 2 (Compressed Gas) Materials

Subpart I-Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials

Subpart J-Detailed Requirements for Class 4 (Flammable Solids), Class 5 (Oxidizers and Organic Peroxides), and Division 1.5 (Blasting Agents) Materials

Subpart K [Reserved]

Subpart L-Detailed Requirements for Division 2.3 (Poisonous Gas) and Division 6.1 (Poisonous) Materials

Subpart M-Detailed Requirements for Radioactive Materials

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Subpart A - General

§176.1 Purpose and scope.

This part prescribes requirements in addition to those contained in parts 171, 172, and 173 of this subchapter to be observed with respect to the transportation of hazardous materials by vessel.

§176.2 Definitions.

As used in this part-

Cantline means the v-shaped groove between two abutting, parallel horizontal cylinders.

Cargo net means a net made of fiber or wire used to provide convenience in handling loose or packaged cargo to and from a vessel.

Clear of living quarters means that the hazardous material must be located so that in the event of release of the material, leakage or vapors will not penetrate accommodations, machinery spaces or other work areas by means of entrances or other openings in bulkheads or ventilation ducts.

Closed freight container means a freight container which totally encloses its contents by permanent structures. A freight container formed partly by a tarpaulin, plastic sheet, or similar material is not a closed freight container.

Commandant (G-MTH) means the Chief, Marine Technical and Hazardous Materials Division, Office of Marine Safety, Security and Environmental Protection, United States Coast Guard, Washington, DC 20593-0001.

Compartment means any space on a vessel that is enclosed by the vessel's decks and its sides or permanent steel bulkheads.

CSC safety approval plate means the safety approval plate specified in Annex I of the International Convention for Safe Containers (1972) and conforming to the specifications in 49 CFR 451.23 and 451.25. The plate is evidence that a freight container was designed, constructed, and tested under international rules incorporated into U.S. regulations in 49 CFR parts 450 through 453. The plate is found in the door area of the container.

Deck structure means a structure of substantial weight and size located on the weather deck of a vessel and integral with the deck. This term includes superstructures, deck houses, mast houses, and bridge structures.

Draft means a load or combination of loads capable of being hoisted into or out of a vessel in a single lift.

Dunnage means lumber of not less than 25 mm (0.98 inch) commercial thickness or equivalent material laid over or against structures such as tank tops, decks, bulkheads, frames, plating, or ladders, or used for filling voids or fitting around cargo, to prevent damage during transportation.

Explosives anchorage means an anchorage so designated under 33 CFR part 110, subpart B.

Explosive article means an article or device which contains one or more explosive substances. Individual explosive articles are identified in the schedules for Class I (explosive) articles found in the IMDG Code.

Explosives handling facility means-

(1) A "designated waterfront facility" designated under 33 CFR part 126 when loading, handling, and unloading Class 1 (explosives) materials; or

(2) A facility for loading, unloading, and handling military Class 1 (explosives) materials which is operated or controlled by an agency of the Department of Defense.

Explosive substance means a solid or liquid material, or a mixture of materials, which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to its surroundings. Individual explosive substances are identified in the schedules for Class 1 (explosive) substances in the IMDG Code.

Handling means the operation of loading and unloading a vessel; transfer to, from, or within a vessel, and any ancillary operations.

Hold means a compartment below deck that is used exclusively for the carriage of cargo.

In containers or the like means in any clean, substantial, weatherproof box structure which can be secured to the vessel's structure, including a portable magazine or a closed transport unit. Whenever this stowage is specified, stowage in deckhouses, mast lockers and oversized weatherproof packages (overpacks) is also acceptable.

Incompatible materials means two materials whose stowage together may result in undue hazards in the case of leakage, spillage, or other accident.

Landing mat means a shock absorbing pad used in loading Class 1 (explosive) materials on vessels.

Machinery Spaces of Category A are those spaces, and trunks to such spaces, which contain:

(1) Internal combustion machinery used for main propulsion:

(2) Internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kw; or

(3) any oil-fired boiler or fuel unit.

Magazine means an enclosure designed to protect certain goods of Class 1 (explosive) materials from damage by other cargo and adverse weather conditions during loading, unloading, and when in transit; and to prevent unauthorized access. A magazine may be a fixed structure in the vessel, a closed freight container, a closed transport vehicle, or a portable magazine.

Master of the Vessel, as used in this part, includes the person in charge of an unmanned vessel or barge.

Open freight container means a freight container that does not totally enclose its contents by permanent structures.

Overstowed means a package or container is stowed directly on top of another. However, with regard to Class 1 (explosive) stowage, such goods may themselves be stacked to a safe level but other goods should not be stowed directly on top of them.

Pallet means a portable platform for stowing, handling, and moving cargo.

Palletized unit means packages or unpackaged objects stacked on a pallet, banded and secured to the pallet by metal, fabric, or plastic straps for the purpose of handling as a single unit.

Pie plate means a round, oval, or hexagonal pallet without sideboards, used in

conjunction with a cargo net to handle loose cargo on board a vessel.
Portable magazine means a strong, closed, prefabricated, steel or wooden, closed box or container, other than a freight container, designed and used to handle Class 1 (explosive) materials either by hand or mechanical means.
Readily combustible material means a material which may or may not be classed as a hazardous material but which is easily ignited and supports combustion. Examples of readily combustible materials include wood, paper, straw, vegetable fibers, products made from such materials, coal, lubricants, and oils. This definition does not apply to packaging material or dunnage.
Responsible person means a person empowered by the master of the vessel to make all decisions relating to his or her specific task, and having the necessary knowledge and experience for that purpose.
Safe working load means the maximum gross weight that cargo handling equipment is approved to lift.
Skilled person means a person having the knowledge and experience to perform a certain duty.
Skipboard means a square or rectangular pallet without sideboards, usually used in conjunction with a cargo net to handle loose cargo on board a vessel.
Splice as used in §176.172 of this part, means any repair of a freight container main structural member which replaces material, other than complete replacement of the member.
Transport unit means a transport vehicle or a freight container. A closed transport unit means a transport unit in which the contents are totally enclosed by permanent structures. An open transport unit means a transport unit which is not a closed transport unit. Transport units with fabric sides or tops are not closed transport units for the purposes of this part.
Tray means a type of pallet constructed to specific dimensions for handling a particular load.

[Amdt. 176-30, 55 FR 52687, Dec. 21, 1990]

§176.3 Unacceptable hazardous materials shipments.

(a) A carrier may not transport by vessel any shipment of a hazardous material that is not prepared for transportation in accordance with parts 172 and 173 of this subchapter.

(b) A carrier may not transport by vessel any explosive or explosive composition described in §173.54 of this subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.4 Port security and safety regulations.

(a) Each carrier, master, agent, and charterer of a vessel and all other persons engaged in handling hazardous materials on board vessels shall comply with the applicable provisions of 33 CFR parts 6, 109, 110, 125, 126, and 160.

(b) Division 1.1 and 1.2 (Class A and B explosive) materials may only be loaded on and unloaded from a vessel at-

(1) A facility of particular hazard as defined in 33 CFR 126.05(b);

(2) An explosives anchorage listed in 33 CFR part 110; or

(3) A facility operated or controlled by the Department of Defense.

(c) With the concurrence of the COTP, Division 1.1 and 1.2 (Class A and B explosive) materials may be loaded on or unloaded from a vessel in any location acceptable to the COTP.

[Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.5 Application to vessels.

(a) Except as provided in paragraph (b) of this section, this subchapter applies to each domestic or foreign vessel when in the navigable waters of the United States, regardless of its character, tonnage, size, or service, and whether self-propelled or not, whether arriving or departing, underway, moored, anchored, aground, or while in dry dock.

(b) This subchapter does not apply to:

(1) A public vessel not engaged in commercial service;

(2) A vessel constructed or converted for the principal purpose of carrying flammable or combustible liquid cargo in bulk in its own tanks, when only carrying these liquid cargoes;

(3) A vessel of 15 gross tons or smaller when not engaged in carrying passengers for hire;

(4) A vessel used exclusively for pleasure;

(5) A vessel of 500 gross tons or smaller when engaged in fisheries;

(6) A tug or towing vessel, except when towing another vessel having Class 1 (explosive) materials, Class 3 (flammable liquids), or Division 2.1 (flammable gas) materials, in which case the owner/operator of the tug or towing vessel shall make such provisions to guard against and extinguish fire as the Coast Guard may prescribe;

(7) A cable vessel, dredge, elevator vessel, fireboat, icebreaker, pile driver, pilot boat, welding vessel, salvage vessel, or wrecking vessel; or

(8) A foreign vessel transiting the territorial sea of the United States without entering the internal waters of the United States, if all hazardous materials being carried on board are being carried in accordance with the requirements of the IMDG Code.

(c) [Reserved]

(d) Except for transportation in bulk packagings (as defined in §171.8 of this subchapter), the bulk carriage of hazardous materials by water is governed by 46 CFR chapter I, subchapters D, I, N and O.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-14, 47 FR 44471, Oct. 7, 1982; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986; Amdt. 176-30, 55 FR 52688, Dec. 21, 1990; 56 FR 66281, Dec. 20, 1991; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.9 "Order-Notify" or "C.O.D." shipments.

A carrier may not transport Division 1.1 or 1.2 (Class A explosive) materials, detonators, or boosters with detonators which are:

(a) Consigned to "order-notify" or "C.O.D.", except on a through bill of lading to a place outside the United States; or

(b) Consigned by the shipper to himself unless he has a resident representative to receive the shipment at the port of discharge.

[Amdt. 176-30, 55 FR 52688, Dec. 21, 1990]

§176.11 Exceptions.

(a) A hazardous material may be offered and accepted for transport by vessel when in conformance with the IMDG Code, subject to the conditions and limitations set forth in §171.12 of this subchapter. The requirements of §§176.83, 176.84, and 176.112 through 176.174 are not applicable to shipments of Class 1 (explosive) materials made in accordance with the IMDG Code. A hazardous material which conforms to the provisions of this paragraph (a) is not subject to the requirement specified in §172.201(d) of this subchapter for an emergency response telephone number, when transportation of the hazardous material originates and terminates outside the United States and the hazardous material-

(1) Is not offloaded from the vessel; or

(2) Is offloaded between ocean vessels at a U.S. port facility without being transported by public highway.

(b) Canadian shipments and packages may be transported by vessel if they are transported in accordance with this subchapter. (See §171.12a of this subchapter.)

(c) The requirements of this subchapter governing the transportation of combustible liquids do not apply to the transportation of combustible liquids in non-bulk (see definitions in §171.8 of this subchapter) packages on board vessels.

(d) Transport vehicles, containing hazardous materials loaded in accordance with specific requirements of this subchapter applicable to such vehicles, may be transported on board a ferry vessel or carfloat, subject to the applicable requirements specified in §§176.76, 176.100, and subpart E of this part.

(e) Hazardous materials classed and shipped as ORM-D are not subject to the requirements of this part unless they are offered for transporation as hazardous wastes.

(f) Paragraph (a) of this section does not apply to hazardous materials, including certain hazardous wastes and hazardous substances as defined in §171.8 of this subchapter, which are not subject to the requirements of the IMDG Code.

(g) The requirements of this subchapter do not apply to atmospheric gases used in a refrigeration system.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.11, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.13 Responsibility for compliance and training.

(a) Unless this subchapter specifically provides that another person shall perform a particular duty, each carrier shall perform the duties specified and comply with all applicable requirements in this part and shall ensure its hazmat employees receive training in relation thereto.

(b) A carrier may not transport a hazardous material by vessel unless each of its hazmat employees involved in that transportation is trained as required by subpart H of part 172 of this subchapter.

(c) The record of training required by §172.704(d) of this subchapter for a crewmember who is a hazmat employee subject to the training requirements of this subchapter must be kept on board the vessel while the crewmember is in service on board the vessel.

[Amdt. 176-31, 57 FR 20954, May 15, 1992, as amended by Amdt. 176-35, 59 FR 49134, Sept. 26, 1994]

§176.15 Enforcement.

(a) An enforcement officer of the U.S. Coast Guard may at any time and at any place, within the jurisdiction of the United States, board any vessel for the purpose of enforcement of this subchapter and inspect any shipment of hazardous materials as defined in this subchapter.

(b) [Reserved]

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986]

§176.18 Assignment and certification.

(a) The National Cargo Bureau, Inc., is authorized to assist the Coast Guard in administering this subchapter with respect to the following:

(1) Inspection of vessels for suitability for loading hazardous materials;

(2) Examination of stowage of hazardous materials;

(3) Making recommendations for stowage requirements of hazardous materials cargo; and

(4) Issuance of certificates of loading setting forth that the stowage of hazardous materials is in accordance with the requirements of this subchapter.

(b) A certificate of loading issued by the National Cargo Bureau, Inc., may be accepted by the Coast Guard as prima facie evidence that the cargo is stowed in conformity with the requirements of this subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-24, 51 FR 5974, Feb. 18, 1986]

Subpart B - General Operating Requirements

§176.24 Shipping papers.

A carrier may not transport a hazardous material by vessel unless the material is properly described on the shipping paper in the manner prescribed in part 172 of this subchapter.

§176.27 Certificate.

(a) A carrier may not transport a hazardous material by vessel unless he has received a certificate prepared in accordance with §172.204 of this subchapter.

(b) In the case of an import or export shipment of hazardous materials which will not be transported by rail, highway, or air, the shipper may certify on the bill of lading or other shipping paper that the hazardous material is properly classed, described, marked, packaged, and labeled according to part 172 of this subchapter or in accordance with the requirements of the IMDG Code. See §171.12 of this subchapter.

(c)(1) A person responsible for packing or loading a freight container or transport vehicle containing hazardous materials for transportation by a manned vessel in ocean or coastwise service, must provide the vessel operator, at the time the shipment is offered for transportation by vessel, with a signed container packing certificate stating, at a minimum, that-

(i) The freight container or transport unit is serviceable for the materials loaded therein,

contains no incompatible goods, and is properly marked, labeled or placarded, as applicable; and
(ii) When the freight container or transport unit contains packages, those packages have been inspected prior to loading, are properly marked, labeled or placarded, as applicable; are not damaged; and are properly secured.
(2) The certification may appear on a shipping paper or on a separate document as a statement such as "It is declared that the packing of the container has been carried out in accordance with the provisions of 49 CFR 176.27(c)".

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-12, 45 FR 81572, Dec. 11, 1980; Amdt. 176-14, 47 FR 44471, Oct. 7, 1982; Amdt. 176-36, 59 FR 67518, Dec. 29, 1994]

§176.30 Dangerous cargo manifest.

(a) The carrier, its agents, and any person designated for this purpose by the carrier or agents shall prepare a dangerous cargo manifest, list, or stowage plan. This document may not include a material which is not subject to the requirements of 49 CFR or the IMDG Code. This document must be kept in a designated holder on or near the vessel's bridge. It must contain the following information:

(1) Name of vessel and official number. (If the vessel has no official number, the international radio call sign must be substituted.);

(2) Nationality of vessel;

(3) Shipping name and identification number of each hazardous material on board as listed in §172.101 of this subchapter or as listed in the IMDG Code and an emergency response telephone number as prescribed in subpart G of part 172 of this subchapter.

(4) The number and description of packages (barrels, drums, cylinders, boxes, etc.) and gross weight for each type of packaging;

(5) Classification of the hazardous material in accordance with either;

(i) The Hazardous Materials Table, the §172.101 table; or

(ii) The International Maritime Organization's IMDG Code.

(6) Any additional description required by §172.203 of this subchapter.

(7) Stowage location of the hazardous material on board the vessel.

(8) In the case of a vessel used for the storage of explosives or other hazardous materials, the following additional information is required:

(i) Name and address of vessel's owner;

(ii) Location of vessel's mooring;

(iii) Name of person in charge of vessel;

(iv) Name and address of the owner of the cargo; and

(v) A complete record, by time intervals of one week, of all receipts and disbursements of hazardous materials. The name and address of the consignor must be shown against all receipts and the name and address of the consignee against all deliveries.

(b) The hazardous material information on the dangerous cargo manifest must be the same as the information furnished by the shipper on the shipping order or other shipping paper, except that the IMO "correct technical name" and the IMO class may be indicated on the manifest as provided in paragraphs (a)(3) and (a)(5) of this section. The person who supervises the preparation of the manifest, list, or stowage plan shall ensure that the information is correctly transcribed, and shall certify to the truth and accuracy of this information to the best of his knowledge and belief by his signature and notation of the date prepared.

(c) The carrier and its agents shall insure that the master, or a licensed deck officer designated by the master and attached to the vessel, or in the case of a barge, the person in charge of the barge, acknowledges the correctness of the dangerous cargo manifest, list or stowage plan by his signature.

(d) For barges, manned or unmanned, the requirements of this section apply except for the following:

(1) In the case of a manned barge, the person in charge of the barge shall prepare the dangerous cargo manifest.

(2) In the case of an unmanned barge, the person responsible for loading the barge is responsible for the preparation of a dangerous cargo manifest, list, or stowage plan and must designate an individual for that purpose.

(3) For all barges, manned or unmanned, the dangerous cargo manifest must be on board the barge in a readily accessible location and a copy must be furnished to the person in charge of the towing vessel.

(e) Each carrier who transports or stores hazardous materials on a vessel shall retain a copy of the dangerous cargo manifest, list, or stowage plan for at least one year, and shall make that document available for inspection in accordance with §176.36(b) of this subchapter.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.30, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.31 Exemptions.

If a hazardous material is being transported by vessel under the authority of an exemption and a copy of the exemption is required to be on board the vessel, it must be kept with the dangerous cargo manifest.

§176.36 Preservation of records.

(a) When this part requires shipping orders, manifest, cargo lists, stowage plans,

reports, or any other papers, documents or similar records to be prepared, the carrier shall preserve them or copies of them in his place of business or office in the United States for a period of one year after their preparation.
(b) Any record required to be preserved must be made available upon request to an authorized representative of the Department of Transportation.

§176.39 Inspection of cargo.
(a) *Manned vessels. The carrier, its agents, and any person designated for this purpose by the carrier or agents shall cause an inspection of each hold or compartment containing hazardous materials to be made after stowage is complete, and at least once every 24 hours thereafter, weather permitting, in order to ensure that the cargo is in a safe condition and that no damage caused by shifting, spontaneous heating, leaking, sifting, wetting, or other cause has been sustained by the vessel or its cargo since loading and stowage. However, freight containers or individual barges need not be opened. A vessel's holds equipped with smoke or fire detecting systems having an automatic monitoring capability need not be inspected except after stowage is complete and after periods of heavy weather. The carrier, its agents, and any person designated for this purpose by the carrier or agents shall cause an entry to be made in the vessel's deck log book for each inspection of the stowage of hazardous materials performed.*
(b) Unmanned and magazine vessels. An inspection of the cargo must be made after stowage has been completed to ensure that stowage has been accomplished properly and that there are no visible signs of damage to any packages or evidence of heating, leaking, or sifting. This inspection must be made by the individual who is responsible to the carrier and who is in charge of loading and stowing the cargo on the unmanned vessels or the individual in charge in the case of a magazine vessel.
(c) The carrier, its agents, and any person designated for this purpose by the carrier or agents of each ocean-going vessel carrying hazardous material shall, immediately prior to entering a port in the United States, cause an inspection of that cargo to be made.
(d) When inspecting a cargo of hazardous materials capable of evolving flammable vapors, any artificial means of illumination must be of an explosion-proof type.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-8, 44 FR 23228, Apr. 19, 1979; Amdt. 176-9, 44 FR 49458, Aug. 23, 1979]

§176.45 Emergency situations.
(a) When an accident occurs on board a vessel involving hazardous materials, and the safety of the vessel, its passengers or crew are endangered, the master shall adopt such procedures as will, in his judgment, provide maximum safety for the vessel, its passengers, and its crew. When the accident results in damaged packages or the emergency use of unauthorized packagings, these packages may not be offered to any

forwarding carrier for transportation. The master shall notify the nearest Captain of the Port, U.S. Coast Guard, and request instructions for disposition of the packages.

(b) Hazardous materials may be jettisoned only if the master believes this action necessary to prevent or substantially reduce a hazard to human life or reduce a substantial hazard to property.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976]

§176.48 Situation requiring report.

(a) When a fire or other hazardous condition exists on a vessel transporting hazardous materials, the master shall notify the nearest Captain of the Port as soon as possible and shall comply with any instructions given by the Captain of the Port.

(b) When an incident occurs during transportation in which a hazardous material is involved, a report may be required (see §§171.15 and 171.16 of this subchapter).

(c) If a package, portable tank, freight container, highway or railroad vehicle containing hazardous materials is jettisoned or lost, the master shall notify the nearest Captain of the Port as soon as possible of the location, quantity, and type of the material.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-24, 51 FR 5974, Feb. 18, 1986; Amdt. 176-25, 52 FR 8592, Mar. 19, 1987]

§176.50 Acceptance of damaged or leaking packages.

A carrier may not transport by vessel any package that is so damaged as to permit the escape of its contents, that appears to have leaked, or that gives evidence of failure to properly contain the contents unless it is restored or repaired to the satisfaction of the master of the vessel. A package containing radioactive materials (other than low specific activity materials) may not be repaired or restored.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976]

§176.52 Rejections of shipments in violation.

(a) A carrier may not knowingly transport by vessel any hazardous material offered under a false or deceptive name, marking, invoice, shipping paper or other declaration, or without the shipper furnishing written information about the true nature of the material at the time of delivery.

(b) If a shipment in violation is found in transit, the master of the vessel shall adopt procedures which in his judgment provide maximum safety to the vessel, its passengers and its crew and which are in compliance with §176.45. If the vessel is in port, the material may not be delivered to any party, and the master shall immediately notify the nearest Captain of the Port and request instructions for disposition of the material.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976]

§176.54 Repairs involving welding, burning, and power-actuated tools and appliances.

(a) Except as provided in paragraph (b) of this section, repairs or work involving welding or burning, or the use of power-actuated tools or appliances which may produce intense heat may not be undertaken on any vessel having on board explosives or other hazardous materials as cargo.

(b) Paragraph (a) of this section does not apply if:

(1) The repairs or work are approved by the COTP under 33 CFR 126.15(c); or

(2) Emergency repairs to the vessel's main propelling or boiler plant or auxiliaries are necessary for the safety of the vessel. If such repairs are performed, the master of the vessel must immediately notify the nearest COTP.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

Subpart C - General Handling and Stowage

§176.57 Supervision of handling and stowage.

(a) Hazardous materials may be handled or stowed on board a vessel only under the direction and observation of a responsible person assigned this duty.

(b) For a vessel engaged in coastwise voyages, or on rivers, bays, sounds or lakes, including the Great Lakes when the voyage is not foreign-going, the responsible person may be an employee of the carrier and assigned this duty by the carrier, or a licensed officer attached to the vessel and assigned by the master of the vessel.

(c) For a domestic vessel engaged in a foreign-going or intercoastal voyage, the responsible person must be an officer possessing an unexpired license issued by the USCG and assigned this duty by the master of the vessel.

(d) For a foreign vessel, the responsible person must be an officer of the vessel assigned this duty by the master of the vessel.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.58 Preparation of the vessel.

(a) Each hold or compartment in which hazardous materials are to be stowed must be free of all debris before the hazardous materials are stowed. Bilges must be examined and all residue of previous cargo removed.

(b) All decks, gangways, hatches, and cargo ports over or through which hazardous materials must be passed or handled in loading or unloading must be free of all loose materials before cargo handling operations begin.

(c) No debris that creates a fire hazard or a hazardous condition for persons engaged in handling hazardous materials may be on the weather deck of a vessel during loading or unloading operations.

(d) Hatch beams and hatch covers may not be stowed in a location that would interfere with cargo handling.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.60 "No Smoking" signs.

When smoking is prohibited during the loading, stowing, storing, transportation, or unloading of hazardous materials by this part, the carrier and the master of the vessel are jointly responsible for posting "NO SMOKING" signs in conspicuous locations.

§176.63 Stowage locations.

(a) The table in §172.101 of this subchapter specifies generally the locations authorized for stowage of the various hazardous materials on board vessels. This part prescribes additional requirements with respect to the stowage of specific hazardous materials in addition to those authorized in §172.101 of this subchapter. This section sets forth the basic physical requirements for the authorized locations.

(b) To qualify as "on deck" stowage, the location must be on the weather deck. If it is in a house on the weather deck, it must have a permanent structural opening to the atmosphere, such as a door, hatch companionway or manhole, and must be vented to the atmosphere. It may not have any structural opening to any living quarters, cargo, or other compartment unless the opening has means for being closed off and secured. Any deck house containing living quarters, a steering engine, a refrigerating unit, a refrigerated stowage box, or a heating unit may not be used unless that area is isolated

from the cargo stowage area by a permanent, and tight metallic bulkhead. Stowage in a shelter or 'tween deck is not considered to be "on deck". A barge which is vented to the atmosphere and is stowed on deck on a barge-carrying ship is considered to be "on deck". When an entry in §172.101 of this subchapter requires "on-deck" stowage and is qualified by the requirement "shade from radiant heat", the stowage must be protected from the direct rays of the sun by means of structural erections or awnings except that such protection is not required for shipment in portable tanks.
(c) To qualify as "under deck" stowage, the location must be in a hold or compartment below the weather deck capable of being ventilated and allotted entirely to the carriage of cargo. It must be bounded by permanent steel decks and bulkheads or the shell of the vessel. The deck openings must have means for effectively closing the hold or compartment against the weather, and in the case of superimposed holds, for effectively closing off each hold. A hold or compartment containing a crew passage formed by battens or by mesh or wire screen bulkhead may not be used for the stowage of any hazardous material unless a watchman is provided for this area.
(d) To qualify as "under deck away from heat", the location must be under deck and have built-in means for ventilation. If it is subject to heat from any artificial source, it only qualifies for the stowage of those hazardous materials for which "under deck" stowage is authorized.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-12, 45 FR 81572, Dec. 11, 1980]

§176.65 Alternative stowage procedures.

When a hazardous material is to be loaded on board a vessel and it is shown to the satisfaction of the Coast Guard Captain of the Port for the place where the vessel is being loaded that it is impracticable to comply with a stowage location requirement specified in the §172.101 table of this subchapter or a segregation, handling or stowage requirement specified in this part, the Captain of the Port may authorize in writing the use of an alternative stowage location or method of segregation, handling or stowage subject to such conditions as he finds will insure a level of safety at least equal to that afforded by the regulatory requirement concerned.

[Amdt. 176-30, 55 FR 52689, Dec. 21, 1990]

§176.69 General stowage requirements for hazardous materials.

(a) Hazardous materials (except as provided in paragraph (c) of this section and Class 9 (miscellaneous hazardous) materials) must be stowed in a manner that will facilitate inspection during the voyage, their removal from a potentially dangerous situation, and the removal of packages in case of fire.

(b) Each package marked in accordance with §172.312(a)(2) of this subchapter must be stowed as to remain in the position indicated during transportation.

(c) If a vessel designed for and carrying hazardous materials in freight containers or a vessel designed for and carrying hazardous materials in barges is equipped with a fixed fire extinguishing and fire detection system, the freight containers or barges need not be stowed in the manner required by paragraph (a) of this section. When freight containers or barges containing hazardous materials are stowed on deck, they need not be stowed in the manner required by paragraph (a) of this section if fire fighting equipment capable of reaching and piercing the freight container or barge is on board the vessel.

(d) Packages of hazardous materials must be secured and dunnaged to prevent movement in any direction. Vertical restraints are not required if the shape of the package and the stuffing pattern preclude shifting of the load.

(e) Packages of hazardous materials must be braced and dunnaged so that they are not likely to be pierced by the dunnage or crushed by a superimposed load.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-12, 45 FR 81573, Dec. 11, 1980; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; 56 FR 66282, Dec. 20, 1991]

§176.70 Stowage requirements for marine pollutants.

(a) Marine pollutants must be properly stowed and secured to minimize the hazards to the marine environment without impairing the safety of the ship and the persons on board.

(b) Where stowage is permitted "on deck or under deck", under deck stowage is preferred except when a weather deck provides equivalent protection.

(c) Where stowage "on deck only" is required, preference should be given to stowage on well-protected decks or to stowage inboard in sheltered areas of exposed decks.

[Amdt. 176-31, 57 FR 52940, Nov. 5, 1992]

§176.72 Handling of break-bulk hazardous materials.

(a) A metal bale hook may not be used for handling any package of hazardous materials.

(b) The use of equipment designed to lift or move cargo by means of pressure exerted on the packages may not be used for handling any package of hazardous materials if the device can damage the package or the package is not designed to be moved in that manner.

(c) Pallets, slings, cargo nets and other related equipment used in loading packages of hazardous materials must give adequate support to the packages. The packages must be contained so that they are not able to fall during loading.

§176.74 On deck stowage of break-bulk hazardous materials.

(a) Packages containing hazardous materials must be secured by enclosing in boxes, cribs or cradles and proper lashing by use of wire rope, strapping or other means, including shoring and bracing, or both. Lashing of deck cargo is permitted if eye pads are used to attach the lashings. Lashings may not be secured to guard rails. Bulky articles must be shored.

(b) A packaging susceptible to weather or water damage must be protected so that it will not be exposed to the weather or to sea water.

(c) Not more than fifty percent of the total open deck area should be used for stowage of hazardous materials (except Class 9 (miscellaneous hazardous) materials material).

(d) Fireplugs, hoses, sounding pipes, and access to these must be free and clear of all cargo.

(e) Crew and passenger spaces and areas set aside for the crew's use may not be used to stow any hazardous material.

(f) A hazardous material may not be stowed within a horizontal distance of 25 feet of an operating or embarkation point of a lifeboat.

(g) Hazardous materials must be stowed to permit safe access to the crew's quarters and to all parts of the deck required in navigation and necessary working of the vessel.

(h) When runways for use of the crew are built over stowed hazardous materials, they must be constructed and fitted with rails and lifelines so as to afford complete protection to the crew when in use.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1B, 41 FR 57072, Dec. 30, 1976; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; 56 FR 66282, Dec. 20, 1991]

§176.76 Transport vehicles, freight containers, and portable tanks containing hazardous materials.

(a) Except as provided in paragraphs (b) through (f) of this section, hazardous materials authorized to be transported by vessel may be carried on board a vessel in a transport vehicle or freight container, subject to the following conditions (see additional requirements concerning the transport of Class 1 (explosive) materials in §§176.168 through 176.172 of this subchapter):

(1) The material must be in proper condition for transportation according to the requirements of this subchapter;

(2) All packages in the transport vehicle or freight container must be secured to prevent movement in any direction. Vertical restraint is not required if the shape of the

packages, loading pattern, and horizontal restraint preclude vertical movement of the load within the freight container or transport vehicle;

(3) Bulkheads made of dunnage which extend to the level of the cargo must be provided unless the packages are stowed flush with the sides or ends;

(4) Dunnage must be secured to the floor when the cargo consists of dense materials or heavy packages;

(5) Each package marked in accordance with §172.312(a)(2) of this subchapter must be stowed as marked;

(6) Any slack spaces between packages must be filled with dunnage;

(7) The weight in a container must be distributed throughout as evenly as possible and the maximum permissible weight must not be exceeded;

(8) Adjacent levels of baggaged and baled cargo must be stowed in alternate directions so that each tier binds the tier above and below it;

(9) [Reserved]

(10) The lading must be contained entirely within the freight container or vehicle body without overhang or projection except that oversized machinery such as tractors or vehicles with batteries attached may overhang or project outside the intermodal container provided all of that portion of the lading that consists of hazardous materials is contained entirely within the freight container. No open-bed container or vehicle is permitted to carry hazardous materials unless it is equipped with a means of properly securing the lading.

(b) A transport vehicle containing hazardous materials may be carried only on board a trailership, trainship, ferry vessel or car float.

(c) [Reserved]

(d) A transport vehicle or freight container equipped with heating or refrigeration equipment may be operated on board a vessel. However, the equipment may not be operated in any hold or compartment in which any flammable liquid or gas is stowed. Any heating or air conditioning equipment having a fuel tank containing a flammable liquid or gas may be stowed only "on deck". Equipment electrically powered and designed to operate within an environment containing flammable vapors may be operated below deck in a hold or compartment containing a flammable liquid or gas. (See §176.79.)

(e) A transport vehicle, loaded with any hazardous material which is required to be stowed "on deck" by §172.101 of this subchapter, may be stowed one deck below the weather deck when transported on a trainship or trailership which is unable to provide "on deck" stowage because of the vessel's design. Otherwise, the transport vehicle or container must be transported "on deck."

(f) A hazardous material may be carried on board a vessel in a portable tank subject to the following conditions:

(1) Small passenger vessels of 100 gross tons, or less, may carry a hazardous material in a portable tank only when 16 or less passengers are on board and only when specifically authorized by the Officer-in-Charge, Marine Inspection, by endorsement of the vessel's Certificate of Inspection.

(2) Portable tanks containing Flammable liquids or gases, Combustible liquids with

flashpoints below 141 ^{o}F. that are insoluble in water, or organic peroxides, spontaneously combustible materials, or water reactive materials must be stowed on deck irrespective of the stowage authorized in §172.101 of this subchapter. Portable tanks containing hazardous materials not restricted to on deck stowage by the previous sentence must be stowed in accordance with the requirements specified in §172.101 of this subchapter.

(3) Aluminum, magnesium, and their alloys are specifically prohibited as materials of construction of portable tanks.

(g) *Cryogenic liquids. For shipment of cryogenic liquids on board a vessel the packaging must be designed and filled so that:*

(1) Any cryogenic liquid being transported in a cargo tank, regardless of the pressure in the package, must be contained in a steel jacketed Specification MC-338 (§178.338 of this subchapter) insulated cargo tank.

(2) Any valve or fitting with moving or abrading parts that may come in contact with any cryogenic liquid may not be made of aluminum.

(3) For a flammable cryogenic liquid being transported in a cargo tank, the elapsed time between the loading of the cargo tank and the subsequent unloading of the cargo tank at its final destination may not exceed the marked rated holding time (MRHT) of the cargo tank for the cryogenic liquid being transported, which must be displayed on or adjacent to the specification plate.

(4) Portable tanks, cargo tanks, and tank cars containing cryogenic liquids must be stowed "on deck" regardless of the stowage authorized in §172.101 of this subchapter. Cargo tanks or tank cars containing cryogenic liquids may be stowed one deck below the weather deck when transported on a trailership or trainship that is unable to provide "on deck" stowage because of the vessel's design. Tank cars must be Class DOT-113 or AAR-204W tank cars.

(h) A fumigated transport unit may only be transported on board a vessel subject to the following conditions and limitations:

(1) The fumigated transport unit may be placed on board a vessel only if at least 24 hours have elapsed since the unit was last fumigated;

(2) The fumigated transport unit is accompanied by a document showing the date of fumigation and the type and amount of fumigant used;

(3) Prior to loading, the master is informed of the intended placement of the fumigated transport unit on board the vessel and the information provided on the accompanying document;

(4) Equipment that is capable of detecting the fumigant and instructions for the equipment's use is provided on the vessel;

(5) The fumigated transport unit must be stowed at least five meters from any opening to accommodation spaces;

(6) Fumigated transport units may only be transported on deck on vessels carrying more than 25 passengers; and

(7) Fumigants may not be added to transport units while on board a vessel.

(i) Containers packed or loaded with flammable gases or liquids having a flashpoint of 23^{o} C or less and carried on deck must be stowed "away from" possible sources of ignition.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §176.76, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§176.77 Stowage of barges containing hazardous materials on board barge-carrying vessels.

(a) A barge which contains hazardous materials may be transported on board a barge-carrying vessel if it is stowed in accordance with the requirements of this section.
(b) A barge which contains hazardous materials for which only "on deck" stowage is authorized must be stowed above the weather deck and be vented to the atmosphere.
(c) A barge which contains hazardous materials for which both "on deck" and "below deck" storage is authorized may be stowed above or below the weather deck.

§176.78 Use of power-operated industrial trucks on board vessels.

(a) *Power Operated trucks. A power-operated truck (including a power-operated tractor, forklift, or other specialized truck used for cargo handling) may not be used on board a vessel in a space containing a hazardous material unless the truck conforms to the requirements of this section. The COTP may suspend or prohibit the use of cargo handling vehicles or equipment when that use constitutes a safety hazard.*
(b) Each truck must have a specific designation of Underwriter's Laboratories or Factory Mutual Laboratories. Any repair or alteration to a truck must be equivalent to that required on the original designation.
(c) *Description of designations. The recognized testing laboratory type designations are as follows:*
(1) An "E" designated unit is an electrically-powered unit that has minimum acceptable safeguards against inherent fire hazards.
(2) An "EE" designated unit is an electrically-powered unit that has, in addition to all the requirements for the "E" unit, the electric motor and all other electrical equipment completely enclosed.
(3) An "EX" designated unit is an electrically-powered unit that differs from the "E" and "EE" unit in that the electrical fittings and equipment are so designed, constructed, and assembled that the unit may be used in certain atmospheres containing flammable vapors or dusts.
(4) A "G" designated unit is a gasoline-powered unit having minimum acceptable safeguards against inherent fire hazards.
(5) A "GS" designated unit is a gasoline-powered unit that is provided with additional

safeguards to the exhaust, fuel, and electrical systems.
(6) An "LP" designated unit is similar to a "G" unit except that it is powered by liquefied petroleum gas instead of gasoline.
(7) An "LPS" designated unit is a unit similar to a "GS" unit except that liquefied petroleum gas is used for fuel instead of gasoline.
(8) A "D" designated unit is a unit similar to a "G" unit except that it is powered by a diesel engine instead of a gasoline engine.
(9) A "DS" designated unit is a unit powered by a diesel engine provided with additional safeguards to the exhaust, fuel, and electrical systems.
(d) *Class 1 (explosive) materials. No power-operated truck may be used to handle Class 1 (explosive) materials or other cargo in an area near Class 1 (explosive) materials on board a vessel except:*
(1) A power-operated truck designated EE or EX.
(2) A power-operated truck designated LPS, GS, D, or DS may be used under conditions acceptable to the COTP.
(e) *Other hazardous materials. (1) Only an "EX", "EE", "GS", "LPA", or "DS" truck may be used in a hold or compartment containing Division 2.1 (flammable gas) materials, Class 3 (flammable liquids), Class 4 (flammable solids) materials, or Class 5 (oxidizers or organic peroxides) materials, cottons or other vegetable fibers, or bulk sulfur.*
(2) Only a designated truck may be used to handle any other hazardous material not covered in paragraph (d) or (e)(1) of this section.
(f) *Minimum safety features. In addition to the construction and design safety features required, each truck must have at least the following minimum safety features:*
(1) The truck must be equipped with a warning horn, whistle, gong, or other device that may be heard clearly above normal shipboard noises.
(2) When the truck operation may expose the operator to danger from a falling object, the truck must be equipped with a driver's overhead guard. When the overall height of the truck with forks in the lowered position is limited by head room the overhead guard may be omitted. This overhead guard is only intended to offer protection from impact of small packages, boxes, bagged material, or similar hazards.
(3) A forklift truck used to handle small objects or unstable loads must be equipped with a load backrest extension having height, width, and strength sufficient to prevent any load, or part of it, from falling toward the mast when the mast is in a position of maximum backward tilt. The load backrest extension must be constructed in a manner that does not interfere with good visibility.
(4) The forks on a fork lift truck must be secured to the carriage so as to prevent any unintentional lifting of the toe which could create a hazard. The forks may not display permanent deformation when subjected to a test load of three times the rated capacity.
(5) Each fork extension or other attachment must be secured to prevent unintentional lifting or displacement on primary forks.
(6) Tires extending beyond the confines of the truck shall be provided with a guard to prevent the tires from throwing particles at the operator.
(7) Unless the steering mechanism is a type that prevents road reactions from causing the steering handwheel to spin, a mushroom type steering knob must be used to

engage the palm of the operator's hand, or the steering mechanism must be arranged in some other manner to prevent injury. The knob must be mounted within the perimeter of the wheel.
(8) All steering controls must be confined within the clearnace of the truck or guarded so that movement of the controls will not result in injury to the operator when passing stanchions, obstructions or other.
(g) *Special operating conditions. (1) A truck may not be used on board a vessel unless prior notification of its use is given to the master or senior deck officer on board.*
(2) Before a truck is operated on board a vessel, it must be in a safe operating condition as determined by the master or senior deck officer on board.
(3) Any truck that emits sparks or flames from the exhaust system must immediately be removed from service and may not be returned to service until the cause of these sparks or flames has been eliminated.
(4)-(5) [Reserved]
(6) All truck motors must be shut off immediately when a breakage or leakage of packages containing flammable liquids or gases, flammable solids, oxidizers, or organic peroxides occurs or is discovered.
(7) The rated capacity of the truck must be posted on the truck at all times in a conspicuous place. This capacity may not be exceeded.
(8) At least one Coast Guard approved marine type size 1 Type B, or UL approved 5BC portable fire extinguisher, or its approved equivalent, must be affixed to the truck in a readily accessible position or must be kept in close proximity, available for immediate use.
(9) The vessel's fire fighting equipment, both fixed (where installed) and portable, must be kept ready for immediate use in the vicinity of the space being worked.
(h) *Refueling. (1) A truck using gasoline as fuel may not be refueled in the hold or on the weather deck of a vessel unless a portable non-spilling fuel handling system of not over five gallons capacity is used. Gasoline may not be transferred to a portable non-spilling fuel handling device on board the vessel.*
(2) A truck using liquefied petroleum gas as fuel may not be refueled in the hold or on the weather deck of a vessel unless it is fitted with a removable tank and the hand-operated shutoff valve of the depleted tank is closed. In addition, the motor must be run until it stalls from lack of fuel and then the hand-operated shut off valve closed before the quick disconnect fitting to the fuel tank is disconnected.
(3) A truck using diesel oil as fuel may not be refueled on the weather deck or in the hold of a vessel unless a portable container of not over a five gallon capacity is used. A truck may be refueled or a portable container may be refilled from a larger container of diesel fuel on the weather deck of a vessel if a suitable pump is used for the transfer operation and a drip pan of adequate size is used to prevent any dripping of fuel on the deck.
(4) Refueling must be performed under the direct supervision of an experienced and responsible person specifically designated for this duty by the person in charge of the loading or unloading of the vessel.
(5) Refueling may not be undertaken with less than two persons specifically assigned

and present for the complete operation, at least one of whom must be experienced in using the portable fire extinguishers required in the fuel area.
(6) At least one Coast Guard approved marine type size 1 Type B or UL approved 5BC portable fire extinguisher or its approved equivalent, must be provided in the fueling area. This is in addition to the extinguisher required by paragraph (g)(8) of this section.
(7) The location for refueling trucks must be designated by the master or senior deck officer on board the vessel. "NO SMOKING" signs must be conspicuously posted in the area.
(8) The location designated for refueling must be adequately ventilated to insure against accumulation of any hazardous concentration of vapors. When a truck is being refueled, the ventilation requirements of §176.79 apply.
(9) Before any truck in a hold is refueled or before any fuel handling device or unmounted liquefied petroleum gas cylinder is placed in a hold, the motors of all trucks in the same hold must be stopped.
(10) All fuel handling devices and unmounted liquefied petroleum gas containers must be removed from a hold before any truck motor is started and the trucks are placed in operation in that hold.
(i) *Replacing batteries. Batteries for electrically powered trucks and for the ignition systems of internal combustion powered trucks may be changed in the hold of a vessel subject to the following conditions:*
(1) Only suitable handling equipment may be employed.
(2) Adequate precautions must be taken to avoid damage to the battery, short circuiting of the battery, and spillage of the electrolyte.
(j) *Charging of batteries. Batteries of industrial trucks may be recharged in a hold of a vessel subject to the following conditions:*
(1) The batteries must be housed in a suitable, ventilated, portable metal container with a suitable outlet at the top for connection of a portable air hose, or must be placed directly beneath a suitable outlet at the top for connection of a portable air hose. The air hose must be permanently connected to an exhaust duct leading to the open deck and terminate in a gooseneck or other suitable weather head. If natural ventilation is not practicable or adequate, mechanical means of exhaust must be employed in conjunction with the duct. The air outlet on the battery container must be equipped with an interlock switch so arranged that the charging of the battery cannot take place unless the air hose is properly connected to the box.
(2) If mechanical ventilation is used, an additional interlock must be provided between the fan and the charging circuit so that the fan must be in operation in order to complete the charging circuit for operation. It is preferable that this interlock switch be of a centrifugal type driven by the fan shaft.
(3) The hold may not contain any hazardous materials.
(4) The charging facilities may be part of the truck equipment or may be separate from the truck and located inside or outside the cargo hold. The power supply or charging circuit (whichever method is used) must be connected to the truck by a portable plug connection of the break-away type. This portable plug must be so engaged with the truck battery charging outlet that any movement of the truck away from the charging

station will break the connection between the plug and receptacle without exposing any live parts to contact with a conducting surface or object and without the plug falling to the deck where it may become subject to damage.
(5) All unmounted batteries must be suitably protected or removed from an area in the hold of the vessel before any truck is operated in that area.
(k) *Stowage of power-operated industrial trucks on board a vessel. Trucks stowed on board a vessel must meet vessel stowage requirements in §176.905.*
(l) Packaging and stowage of fuel on board a vessel. Division 2.1 (flammable gas) materials and flammable liquids used as fuel for industrial trucks must be packaged and stowed as authorized in 46 CFR 147.60 or 46 CFR 147.45, respectively.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40687, Sept. 20, 1976; Amdt. 176-30, 55 FR 52689, Dec. 21, 1990; Amdt. 176-39, 61 FR 18933, Apr. 29, 1996; Amdt. 176-43, 62 FR 24741, May 6, 1997]

Subpart D - General Segregation Requirements

§176.80 Application.

(a) This subpart sets forth segregation requirements in addition to any segregation requirements set forth elsewhere in this subchapter.

(b) Hazardous materials in limited quantities when loaded in transport vehicles and freight containers, are excepted from the segregation requirements of this subpart and any additional segregation specified in this subchapter for transportation by vessel.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-3, 42 FR 57967, Nov. 7, 1977]

§176.83 Segregation.

(a) *General. (1) The requirements of this section apply to all cargo spaces on deck or under deck of all types of vessels, and to all cargo transport units.*

(2) Segregation is obtained by maintaining certain distances between incompatible hazardous materials or by requiring the presence of one or more steel bulkheads or decks between them or a combination thereof. Intervening spaces between such hazardous materials may be filled with other cargo which is not incompatible with the hazardous materials.

(3) The general requirements for segregation between the various classes of dangerous goods are shown in the segregation table. In addition to these general

requirements, there may be a need to segregate a particular material from other materials which would contribute to its hazard. Such segregation requirements are indicated by code numbers in Column 10B of the §172.101 Table.

(4) Segregation is not required between hazardous materials of different classes which comprise the same substance but vary only in their water content (e.g., sodium sulphide in Division 4.2 or Class 8).

(5) Whenever hazardous materials are stowed together, whether or not in a transport unit, the segregation of such hazardous materials from others must always be in accordance with the most restrictive requirements for any of the hazardous materials concerned.

(6) When the §172.101 table or §172.402 requires packages to bear a subsidiary hazard label or labels, the segregation appropriate to the subsidiary hazards must be applied when that segregation is more restrictive than that required by the primary hazard. For the purposes of this paragraph, the segregation requirements corresponding to an explosive subsidiary hazard are-except for organic peroxides which are those corresponding to Division 1.3-those for Division 1.4 (Class C explosive) materials.

(7) Where, for the purposes of segregation, terms such as "away from" a particular hazard class are used in the §172.101 table, the segregation requirement applies to:

(i) All hazardous materials within the hazard class; and

(ii) All hazardous materials for which a secondary hazard label of that class is required.

(8) Notwithstanding the requirements of paragraphs (a)(6) and (a)(7) of this section, hazardous materials of the same class may be stowed together without regard to segregation required by secondary hazards (subsidiary risk label(s)), provided the substances do not react dangerously with each other and cause:

(i) Combustion and/or evolution of considerable heat;

(ii) Evolution of flammable, toxic or asphyxiant gases;

(iii) The formation of corrosive substances; or

(iv) The formation of unstable substances.

(9) Stowage in a shelter-'tween deck cargo space is not considered to be "on deck" stowage.

(10) Where the code in column (10B) of the §172.101 Table specifies that "Segregation as for. . ." applies, the segregation requirements applicable to that class in the §176.83(b) General Segregation Table must be applied. However, for the purposes of paragraph (a)(8) of this section, which permits substances of the same class to be stowed together provided they do not react dangerously with each other, the segregation requirements of the class as represented by the primary hazard class in the §172.101 Table entry must be applied.

(b) *General Segregation Table. The following table sets forth the general requirements for segregation between the various classes of hazardous materials. The properties of materials within each class may vary greatly and may require greater segregation than is reflected in this table. If the §172.101 table sets forth particular requirements for segregation, they take precedence over these general requirements.*

Table §176.83(b)-General Segregation Requirements for Hazardous Materials
[Segregation must also take account of a single secondary hazard label, as required by paragraph (a)(6) of this section.]

Class	1.1 1.2 1.5	1.3	1.4 1.6	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8	9
Explosives, 1.1, 1.2, 1.5	(*)	(*)	(*)	4	2	2	4	4	4	4	4	4	2	4	2	4	X
Explosives, 1.3	(*)	(*)	(*)	4	2	2	4	3	3	4	4	4	2	4	2	2	X
Explosives, 1.4, 1.6	(*)	(*)	(*)	2	1	1	2	2	2	2	2	2	X	4	2	2	X
Flammable gases 2.1	4	4	2	X	X	X	2	1	2	X	2	2	X	4	2	1	X
Non-toxic, non-flammable gases 2.2	2	2	1	X	X	X	1	X	1	X	X	1	X	2	1	X	X
Poisonous gases 2.3	2	2	1	X	X	X	2	X	2	X	X	2	X	2	1	X	X
Flammable liquids 3	4	4	2	2	1	2	X	X	2	1	2	2	X	3	2	X	X
Flammable solids 4.1	4	3	2	1	X	X	X	X	1	X	1	2	X	3	2	1	X
Spontaneously combustible substances 4.2	4	3	2	2	1	2	2	1	X	1	2	2	1	3	2	1	X
Substances which are dangerous when wet 4.3	4	4	2	X	X	X	1	X	1	X	2	2	X	2	2	1	X
Oxidizing substances 5.1	4	4	2	2	X	X	2	1	2	2	X	2	1	3	1	2	X
Organic peroxides 5.2	4	4	2	2	1	2	2	2	2	2	2	X	1	3	2	2	X
Poisons 6.1	2	2	X	X	X	X	X	X	1	X	1	1	X	1	X	X	X
Infectious substances 6.2	4	4	4	4	2	2	3	3	3	2	3	3	1	X	3	3	X
Radioactive materials 7	2	2	2	2	1	1	2	2	2	2	1	2	X	3	X	2	X
Corrosives 8	4	2	2	1	X	X	X	1	1	1	2	2	X	3	2	X	X
Miscellaneous dangerous substances 9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Numbers and symbols relate to the following terms as defined in this section:

1-"Away from."

2-"Separated from."

3-"Separated by a complete compartment or hold from."

4-"Separated longitudinally by an intervening complete compartment or hold from."

X-The segregation, if any, is shown in the §172.101 table.

*-See §176.144 of this part for segregation within Class 1.

(c) *Segregation requirements for breakbulk cargo. (1) The requirements of this paragraph apply to the segregation of packages containing hazardous materials and stowed as breakbulk cargo;*

(2) Definition of the segregation terms:

(i) Legend:

(A) Package containing incompatible goods.

[ILLUSTRATION GOES HERE]

EC02MR91.070

(B) Reference package.

[ILLUSTRATION GOES HERE]

EC02MR91.071

(C) Deck resistant to fire and liquid.

[ILLUSTRATION GOES HERE]

EC02MR91.072

Note: Full vertical lines represent transverse bulkheads between compartments or holds resistant to fire and liquid.

(ii) *"Away from": Effectively segregated so that the incompatible materials cannot interact dangerously in the event of an accident but may be carried in the same compartment or hold or on deck provided a minimum horizontal separation of 3 meters (10 feet) projected vertically is obtained.*

[ILLUSTRATION GOES HERE]

EC02MR91.073

(iii) "Separated From": In different compartments or holds when stowed under deck. If the intervening deck is resistant to fire and liquid, a vertical separation (i.e., in different compartments accepted as equivalent to this segregation. For "on deck" stowage, this segregation means a separation by a distance of at least 6 meters (20 feet) horizontally.

[ILLUSTRATION GOES HERE]

EC02MR91.091

(iv) "Separated by a complete compartment or hold from": Either a vertical or horizontal separation. If the intervening decks are not resistant to fire and liquid, then only a longitudinal separation (i.e., by a intervening complete compartment or hold) is acceptable. For "on deck" stowage, this segregation means a separation by a distance of at least 12 meters (39 feet) horizontally. The same distance must be applied if one

package is stowed "on deck, and the other one in an upper compartment.

[ILLUSTRATION GOES HERE]

EC02MR91.074

Note: One of the two decks must be resistant to fire and liquid.

(v) "Separated longitudinally by an intervening complete compartment or hold from": Vertical separation alone does not meet this requirement. Between a package "under deck" and one "on deck" a minimum distance of 24 meters (79 feet) including a complete compartment must be maintained longitudinally. For "on deck" stowage, this segregation means a separation by a distance of at least 24 meters (79 feet) longitudinally.

[ILLUSTRATION GOES HERE]

EC02MR91.075

(d) Segregation in transport units: Two hazardous materials for which any segregation is required may not be stowed in the same transport unit.

(e) Segregation of hazardous materials stowed as breakbulk cargo from those packed in transport units: (1) Hazardous materials stowed as breakbulk cargo must be segregated from materials packed in open transport units in accordance with paragraph (c) of this section.

(2) Hazardous materials stowed as breakbulk cargo must be segregated from materials packed in closed transport units in accordance with paragraph (c) of this section, except that:

(i) Where "away from" is required, no segregation between packages and the closed transport units is required; and

(ii) Where "separated from" is required, the segregation between the packages and the closed transport units may be the same as for "away from".

(f) *Segregation of containers on board container vessels: (1) This paragraph applies to the segregation of freight containers which are carried on board container vessels, or on other types of vessels provided these cargo spaces are properly fitted for permanent stowage of freight containers during transport.*

(2) For container vessels which have cargo spaces used for breakbulk cargo or any other method of stowage, the appropriate paragraph of this section applies to the relevant cargo space.

(3) *Segregation Table: Table §176.83(f) sets forth the general requirements for segregation between freight containers on board container vessels.*

(4) In table §176.83(f), a container space means a distance of not less than 6 m (20

feet) fore and aft or not less than 2.5 m (8 feet) athwartship.

Table 176.83(f)-Segregation of Containers on Board Container Ships

Segregation requirement	Vertical			Horizontal						
-	Closed versus closed	Closed versus open	Open versus open		Closed versus closed		Closed versus open		Open versus open	
-	-	-	-	-	On deck	Under deck	On deck	Under deck	On deck	Under deck
1. "Away from"	One on top of the other permitted	Open on top of closed permitted Otherwise as for open versus open	Not in the same vertical line unless segregated by a deck	Fore and aft Athwart ships	No restriction No restriction	No restriction No restriction	No restriction No restriction	No restriction No restriction	One container space One container space	One container space or one bulkhead. One container space.
2. "Separated from"	Not in the same vertical line unless segregated by a deck	As for open versus open	Not in the same vertical line unless segregated by a deck	Fore and aft Athwart ships	One container space One container space	One container space or one bulkhead One container space	One container space One container space	One container space or one bulkhead Two container spaces	One container space. Two container spaces.	One bulkhead. One bulkhead.
3. "Separated by a complete compartment or hold from"	Not in the same vertical line unless segregated by a deck	As for open versus open	Not in the same vertical line unless segregated by a deck	Fore and aft Athwart ships	One container space Two container spaces	One bulkhead One bulkhead	One container space Two container spaces	One bulkhead One bulkhead	Two container spaces Three container spaces	Two bulkheads. Two bulkheads.
4. "Separated longitudinally by an intervening complete compart	Prohibited	-	-	Fore and aft Athwart ships	Four container spaces Prohibited	One bulkhead and four container spaces * Prohibited	Four container spaces Prohibited	Two bulkheads Prohibited	Four container spaces Prohibited	Two bulkheads. Prohibited.

ment or hold from"										

*Containers not less than 6 meters (20 feet) from intervening bulkhead.

Note: All bulkheads and decks must be resistant to fire and liquid.

(g) *Segregation of transport units on board trailerships: (1) The requirements of this paragraph apply to the segregation of transport units which are carried on board trailerships or in "roll-on/roll-off" cargo spaces.*

(2) For trailerships which have spaces suitable for breakbulk cargo, containers, or any other method of stowage, the appropriate paragraph of this section applies to the relevant cargo space.

(3) *Segregation Table. Table §176.83(g) sets forth the general requirements for segregation between transport units on board trailerships.*

Table 176.83(g)-Segregation of Transport Units on Board Trailerships and Trainships.

Segregation requirement							
-		Closed versus closed		Closed versus open		Open versus open	
-	-	On deck	Under deck	On deck	Under deck	On deck	Under deck
1. "Away From"	Fore and aft	No restriction	No restriction	No restriction	No restriction	At least 3 meters	At least 3 meters.
-	Athwartships	No restriction	No restriction	No restriction	No restriction	At least 3 meters	At least 3 meters.
2. "Separated from"	Fore and aft Athwartships	At least 6 meters At least 3 meters	At least 6 meters or one bulkhead At least 3 meters or one bulkhead	At least 6 meters At least 3 meters	At least 6 meters or one bulkhead At least 6 meters or one bulkhead	At least 6 meters At least 6 meters	At least 12 meters or one bulkhead At least 12 meters or one bulkhead
3. "Separated by a complete compartment or hold from"	Fore and aft Athwartships	At least 12 meters At least 12 meters	At least 24 meters + deck At least 24 meters + deck	At least 24 meters At least 24 meters	At least 24 meters + deck At least 24 meters + deck	At least 36 meters At least 36 meters	Two decks or two bulkheads. Prohibited.
4. "Separated longitudinally by an intervening complete	Fore and aft	At least 36	Two bulkhea	At least 36	At least 48	At least 48	Prohibited.

compartment or hold from"	Athwartships	meters Prohibited	ds or at least 36 meters + two decks Prohibited	meters Prohibited	meters including two bulkheads Prohibited	meters Prohibited	Prohibited.

NOTE: All bulkheads and decks must be resistant to fire and liquid.

(h) *Segregation on board barge carrying vessels: (1) The requirements of this section apply to the segregation in shipborne barges as well as to the segregation between shipborne barges carried on board vessels specially designed and equipped to carry such barges.*

(2) On barge-carrying vessels which incorporate other stowage spaces or any other method of stowage, barges containing hazardous materials must be segregated from hazardous materials not stowed in barges as prescribed in paragraphs (b) and (j) of this section.

(i) *Segregation in shipborne barges: Hazardous materials transported in shipborne barges must be segregated as prescribed in paragraphs (a), (b), and (c) of this section.*

(j) Segregation between shipborne barges on barge-carrying vessels: (1) When a shipborne barge is loaded with two or more hazardous materials with different requirements for segregation, the most stringent applicable segregation requirement must be applied.

(2) "Away from" and "separated from" require no segregation between shipborne barges.

(3) For barge-carrying vessels with vertical holds, "Separated by a complete compartment or hold from" means that separate holds are required. On barge-carrying vessels having horizontal barge levels, separate barge levels are required and the barges may not be in the same vertical line.

(4) "Separated longitudinally by an intervening complete compartment or hold from" means, for barge-carrying vessels with vertical holds, that separation by an intervening hold or engine room is required. On barge-carrying vessels having horizontal barge levels, separate barge levels and a longitudinal separation by at least two intervening barge spaces are required.

(k) *Segregation requirements for ferry vessels: A ferry vessel (when operating either as a passenger or cargo vessel) that cannot provide the separation required in this section may carry incompatible hazardous materials in separate transport vehicles if they are stowed to give the maximum possible separation.*

[Amdt. 176-30, 55 FR 52690, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995; 64 FR 10781, 10782, Mar. 5, 1999]

§176.84 Other requirements for stowage and segregation for cargo vessels and passenger vessels.

(a) *General. When column 10B of the §172.101 table refers to a numbered or alpha-numeric stowage provision for water shipments, the meaning and requirements of that provision are as set forth in this section. Terms in quotation marks are defined in §176.83.*

(b) Table of provisions:

Code	Provisions
1	[Reserved]
2	Temperature controlled material.
3	Do not stow with high explosives.
4	[Reserved]
5	[Reserved]
6	Emergency temperature material.
7	[Reserved]
8	Glass carboys not permitted on passenger vessels.
9	Glass carboys not permitted under deck.
10	Glass bottles not permitted under deck.
11	Keep away from heat and open flame.
12	Keep as cool as reasonably practicable.
13	Keep as dry as reasonably practicable.
14	For metal drums, stowage permitted under deck on cargo vessels.
15	May be stowed in portable magazine or metal locker.
16	No other cargo may be stowed in the same hold with this material.
17	Segregation same as for flammable gases but "away from" dangerous when wet.
18	Prohibited on any vessel carrying explosives (except explosives in Division 1.4, Compatibility group S).
19	Protect from sparks and open flames.
20	Segregation same as for corrosives.
21	Segregation same as for flammable liquids.
22	Segregation same as for flammable liquids if flash point below 61°C (142°F).
23	Segregation same as for flammable liquids if flash point between 23°C (73°F) and 61°C (142°F).
24	Segregation same as for flammable solids.
25	Shade from radiant heat.
26	Stow "away from" acids.
27	Stow "away from" alkaline compounds.
28	Stow "away from" flammable liquids.
29	Stow "away from" ammonium compounds.
30	Stow "away from" animal or vegetable oils.
31	Stow "away from" combustible materials.
32	Stow "away from" copper, its alloys and its salts.
33	Stow "away from" fluorides.
34	Stow "away from" foodstuffs.
35	Stow "away from" all odor-absorbing cargo.
36	Stow "away from" heavy metals and their compounds.
37	Stow "away from" hydrazine.
38	Stow "away from" all other corrosives.

39	Stow "away from" liquid halogenated hydrocarbons.
40	Stow "clear of living quarters".
41	Stow "away from" mercury and its compounds.
42	Stow "away from" nitric acids and perchloric acids not exceeding 50 percent acid by weight.
43	Stow "away from" organic materials.
44	Stow "away from" oxidizers.
45	Stow "away from" permanganates.
46	Stow "away from" powdered metals.
47	Stow "away from" sodium compounds.
48	Stow "away from" sources of heat.
49	Stow "away from" corrosives.
50	Stow "away from" sources of heat where temperatures in excess of 55°C (131°F) for a period of 24 hours or more will be encountered.
51	Stow "separated from" acetylene.
52	Stow "separated from" acids.
53	Stow "separated from" alkaline compounds.
54	Stow "separated from" animal or vegetable oils.
55	Stow "separated from" ammonia.
56	Stow "separated from" ammonium compounds.
57	Stow "separated from" chlorine.
58	Stow "separated from" cyanides.
59	Stow "separated from" combustible materials.
60	Stow "separated from" chlorates, chlorites, hypochlorites, nitrites, perchlorates, permanganates, and metallic powders.
61	Stow "separated from" corrosive materials.
62	Stow "separated from" diborane.
63	Stow "separated from" diethylene triamine.
64	Stow "separated from" explosives.
65	Stow "separated from" flammable substances.
66	Stow "separated from" flammable solids.
67	Stow "separated from" halides.
68	Stow "separated from" hydrogen.
69	Stow "separated from" hydrogen peroxide.
70	Stow "separated from" mercury salts.
71	Stow "separated from" nitric acid.
72	Stow "separated from" nitrogen compounds.
73	Stow "separated from" chlorates.
74	Stow "separated from" oxidizers.
75	Stow "separated from" permanganates.
76	Stow "separated by a complete compartment or hold from" organic peroxides.
77	Stow "separated longitudinally by a complete compartment or hold from" explosives.
78	Stow "separated longitudinally by an intervening complete compartment or hold from" explosives.
79	The maximum net quantity in one package for this material shipped aboard a passenger vessel is limited to 22.7 kg (50 pounds).
80	Toy torpedoes must not be packed with other special fireworks.
81	Under deck stowage permitted only if an indicating substance such as chloropicrin has been added.
82	Under deck stowage is permitted only if containing not more than 36 percent by weight of hydrazine.
83	[Reserved]
84	Under deck stowage must be in well-ventilated space.
85	Under deck stowage must be in mechanically ventilated space.
86	Stow "separated by a complete compartment or hold from" explosives Division 1.3.

87	Stow "separated from" Class 1 (explosives) except Division 1.4.
88	Stow "separated by a complete compartment or hold from" Class 1 (explosives) except Division 1.4.
89	Segregation same as for oxidizers.
90	Stow "separated from" radioactive materials.
91	Stow "separated from" flammable liquids.
92	Stow "separated from" powdered materials.
93	Stow not accessible to unauthorized persons on passenger vessels.
94	Plastic jerricans and plastic drums not permitted under deck.
95	Stow "separated from" foodstuffs.
96	Glass carboys not permitted under deck on passenger vessels.
97	Stow "away from" azides.
98	Stow "away from" all flammable materials.
99	Only new metal drums permitted on passenger vessels.
100	Stow "away from" flammable solids.
101	Stow "separated from" iron oxide.
102	Stow "separated from" all odor absorbing cargoes.
103	Only to be loaded under dry weather conditions.
104	Stow "separated from" bromine.
105	As approved by the Competent Authority of the country concerned.
106	Stow "separated from" powdered metal.
107	Stow "separated from" peroxides and superoxides.
108	The transport temperature should be indicated on the tank.
109	Label as a flammable liquid if flash point is 61°C (142°F) or below.
110	Packaging Group II if concentration does not exceed 70 percent acid.
111	If concentration exceeds 50 percent acid, notes 66, 74, 89, and 90 apply.
112	Packaging Group II for concentrations not less that 50 percent and Packaging Group III for concentrations less than 50 percent.
113	Packaging Group II if concentrations does not exceed 60 percent acid.
114	Corrosive subsidiary risk label required unless concentration is less than 80 percent.
115	If packaged in glass or earthenware inner packagings in wooden or fiberboard outer packagings, the maximum quantity on any vessel is 500 kg (equivalent to 450 liters).
116	In a cargo space capable of being opened up in an emergency. The possible need to open hatches in case of fire to provide maximum ventilation and to apply water in an emergency and the consequent risk to the stability of the ship through flooding of the cargo space should be considered before loading.
117	In a clean cargo space capable of being opened up in an emergency. In the case of bagged fertilizer in freight containers, it is sufficient if in the case of an emergency, the cargo is accessible through free approaches (hatch entries) and mechanical ventilation enables the master to exhaust any gases or fumes resulting from decomposition. The possible need to open hatches in case of fire to provide maximum ventilation and to apply water in an emergency and the consequent risk to the stability of the ship through flooding of the cargo space should be considered before loading.
118	Stowage-Category D, Category E freight containers and pallet boxes only. Ventilation may be required. The possible need to open hatches in a case of fire to provide maximum ventilation and to supply water in an emergency, and the consequent risk to the stability of the ship through flooding of the cargo space, should be considered before loading.
119	Double strip stowage recommended.
120	Provide good surface and through ventilation.
121	Packaging group III when the flash point of the flammable liquid is 23°C (73°F) or above.
122	Stow "separated from" infectious substances.
123	Stow "away from" infectious substances.
M1-M6	[Reserved]

(c) *Provisions for the stowage of Class 1 (explosive) materials: (1) Unless otherwise specified in column 10B of the §172.101 table, explosive substances and explosive articles must be stowed as follows:*

(i) On deck: In containers or the like.

(ii) Under deck: Ordinary stowage.

(2) The following notes in column 10B of the §172.101 table apply to the transport of Class 1 (explosive) materials by vessel:

Note	Provision
1E	Cargo vessel, on deck, in containers or the like.
2E	Cargo vessel, on deck, in portable magazines.
3E	Cargo vessel, on deck, secured to the vessel's structure.
4E	Cargo vessel, under deck, Magazine, Type A.
5E	Cargo vessel, under deck, Magazine, Type B.
6E	Cargo vessel, under deck, Magazine, Type C.
7E	Cargo vessel, under deck, Ordinary Stowage.
8E	Cargo vessel, under deck, Special Stowage.
9E	Passenger vessel, stowage as for cargo vessel.
10E	Magazine, Type B, if in effectively sealed dust-tight packages; otherwise, Magazine, Type A.
11E	On-deck portable magazine must be steel.
12E	Stowage as specified by Competent Authority.
13E	On deck, in containers not exceeding 2.5 metric ton gross per container or group. There may not be more than 2 such containers or groups; they must be separated from each other, and from any other explosive substance or article by at least 9 m (30 feet). Containers or groups must be at least 9 m (30 feet) from the bridge or accommodation.
14E	On deck, in steel portable magazines or steel freight containers.
15E	On-deck, containers must be leakproof.
16E	On deck, in containers or sheeted stacks. The gross weight of each stack or group of containers may not exceed 2.5 metric ton. There may not be more than 2 stacks or groups of containers; they must be separated from each other, and from any other explosive substances or articles by at least 9 m (30 feet). Stacks or containers must be at least 9 m (30 feet) from the bridge or accommodation.
17E	On deck stowage is recommended.
18E	For international shipments, stow in the same manner as is required for "cartridges for weapons' inert projectile" UN 0012, Division 1.4S.
19E	Substances which contain ammonium nitrate or other ammonium salts must be stowed "away from" Explosives, Blasting, Type C, UN 0083.
20E	Stow in accordance with §176.84(c)(3) of this subchapter.
21E	Cargo space ventilation must be carefully controlled to avoid excessive condensation.
22E	May not be stowed together with explosive substances containing ammonium nitrate or other ammonium salts.
23E	Segregate from other Class 1 (explosive) materials in the same manner as is required for flammable liquids.
24E	Passenger vessels, on deck or under deck, in portable magazines only.
25E	Passenger vessels, in containers or the like, on deck only.
26E	Cargo vessel, on deck, in containers or the like (non-metallic lining is necessary if not in sealed dust tight packages).
27E	Cargo vessel, on deck, in containers or the like (non-metallic lining is necessary).
28E	Cargo vessel, when items are transported as projectiles or cartridges for guns, cannons, or mortars, notes 1E and 7E are applicable. All other times, notes 14E, 15E, and 8E are

	applicable.

(3) Explosive articles designated by special provision "20E" in column 10B of the 172.101 table must be stowed as follows:

(i) Projectiles for guns, cannon, or mortars:

(A) *On deck: in containers or the like.*

(B) Under deck: ordinary stowage.

(ii) All other types:

(A) *On deck: in steel portable magazines or steel freight containers which are capable of preventing leakage of their contents.*

(B) Under deck: Special stowage.

[Amdt. 176-30, 55 FR 52693, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-43, 62 FR 24742, May 6, 1997]

Subpart E - Special Requirements for Transport Vehicles Loaded With Hazardous Materials and Transported on Board Ferry Vessels

§176.88 Application.

The requirements in this subpart are applicable to transport vehicles containing hazardous materials being transported on board ferry vessels and are in addition to any prescribed elsewhere in this subchapter. Vessels in a service similar to a ferry service, but not over a designated ferry route, may be treated as a ferry vessel for the purpose of this subpart if approved in writing by the District Commander.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-1A, 41 FR 40690, Sept. 20, 1976]

§176.89 Control of transport vehicles.

(a) A transport vehicle containing hazardous materials may be transported on board a ferry vessel, subject to the following conditions:

(1) The operator or person in charge of the vehicle shall deliver to the vessel's representative a copy of the shipping papers and certificate required by §§176.24 and 176.27;

(2) The vehicle shall be placed at the location indicated by the vessel's representative;

(3) The parking brakes of the vehicle shall be set securely to prevent movement;

(4) The motor of a highway vehicle shall be shut off and not restarted until the vessel has completed its voyage and docked;

(5) All vehicle lights shall be cut off and not relighted until the vessel has completed its voyage and docked;

(6) The operator of a highway vehicle shall remain with the vehicle;

(7) No repairs or adjustments must be made to the vehicle while it is on the vessel;

(8) No hazardous materials are to be released from the vehicle; and

(9) Any instructions given by the vessel's representative during the voyage, and during "roll on" and "roll off" operations must be observed.

(b) Smoking by any person in or around a vehicle is prohibited.

§176.90 Private automobiles.

A private automobile which is carrying any Class 1 (explosive) material (except permitted fireworks or small arms ammunition) may not be transported on a passenger-carrying ferry vessel unless the Class 1 (explosive) material is in compliance with packaging, labeling, marking, and certification requirements of this subchapter. Permitted fireworks and small arms ammunition may be carried without the required packaging, labeling, marking, or certification if they are in tight containers.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.91 Motorboats.

A motorboat may be transported on board a ferry vessel with gasoline in the tank and two other containers not exceeding 23 L (six gallons) capacity each if they are in the motorboat, closed, and in good condition.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.92 Cylinders laden in vehicles.

Any cylinder of Class 2 (compressed gas) material which is required to have a valve protection cap fitted in place may be transported on board a ferry vessel without having the valve protection cap in place when it is laden in a transport vehicle and is not removed from the vehicle while on the vessel.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.93 Vehicles having refrigerating or heating equipment.

(a) A transport vehicle fitted with refrigerating or heating equipment using a flammable liquid or Division 2.1 (flammable gas) material, or diesel oil as fuel, may be transported on a ferry vessel. However, the refrigerating or heating equipment may not be operated while the vehicle is on the vessel, unless the equipment complies with the following requirements:

(1) The installation is rigidly mounted and free of any movement other than normal vibration in operation;

(2) An easily accessible shutoff control is fitted to the fuel and electrical supply of the refrigerating or heating equipment; and

(3) The fuel storage tank, the fuel lines, the carburetor and any other fuel devices are tight and show no signs of leakage.

(b) If the vehicle operator desires to operate the refrigerating or heating equipment while on the vessel and the equipment is not fitted with automatic starting and stopping devices, it must be started before the vehicle is taken on board. It may continue in operation while the vehicle is on the vessel, but if the motor stops it may not be restarted.

(c) In the case of a ferry vessel on a voyage exceeding 30 minutes' duration, stowage must be provided for transport vehicles having refrigerating or heating equipment operated by internal combustion engines which will permit ready diffusion of exhaust gases to the open air. Passenger vehicles may not be stowed in a position adjacent to vehicles operating internal combustion motors which expose the occupants of the passenger vehicles to excessive concentrations of exhaust fumes from such motors.

(d) A transport vehicle containing solid carbon dioxide as a refrigerant may be transported on a ferry vessel only if it is stowed in a well ventilated location.

[Amdt. 176-1, 41 FR 16110, Apr. 15, 1976, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

Subpart F - Special Requirements for Barges

Source: Amdt. 176-8, 44 FR 23228, Apr. 19, 1979, unless otherwise noted.

§176.95 Application.

The requirements prescribed in this subpart are applicable to the transportation of packaged hazardous materials on board barges. The requirements prescribed elsewhere in this subchapter for vessels similarly apply, except as provided in this subpart, to the transportation of packaged hazardous materials on board barges.

§176.96 Materials of construction.
Barges used to transport hazardous materials must be constructed of steel.

[Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.97 Prohibition of dump scows.
Dump scows are barges having cargo carrying compartments of the hopper type and fitted with a bottom dump or a side dump. This type of barge is prohibited from the carriage of any class of hazardous material.

§176.98 Stowage of hazardous materials on board barges.
A material for which "on deck" stowage only is required by column (10) of the Hazardous Materials Table (§172.101 of this subchapter) may be stowed "under deck" on unmanned barges.

[Amdt. 176-8, 44 FR 23228, Apr. 19, 1979, as amended by Amdt. 176-30, 55 FR 52695, Dec. 21, 1990]

§176.99 Permit requirements for certain hazardous materials.
The permits required by §§176.100 and 176.415 for loading, unloading, and handling Divisions 1.1 and 1.2 (Class A and B explosives) materials, Division 1.5 (blasting agents) materials, ammonium nitrate and certain ammonium nitrate mixtures and fertilizers must be obtained before these materials may be loaded on, unloaded from, or handled on board a barge or barge-carrying vessel. However, a barge loaded with these materials being placed on, removed from, or handled on board a barge-carrying vessel is not subject to these permit requirements.

[Amdt. 176-30, 55 FR 52695, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

Subpart G - Detailed Requirements for Class 1 (Explosive) Materials

Source: Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, unless otherwise noted.

§176.100 Permit for Divisions 1.1 and 1.2 (Classes A and B explosive) materials.
Before Divisions 1.1 and 1.2 (Classes A and B explosive) materials may be discharged from, loaded on, handled or restowed on board a vessel at any place in the United States, the carrier must obtain a permit from the COTP in accordance with the procedures in 33 CFR 126.19. Exceptions to this permit requirement may be authorized by the COTP.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.102 Supervisory detail.

(a) Except as provided in paragraph (c) of this section, the COTP may assign a USCG supervisory detail to any vessel to supervise the loading, handling or unloading of Class 1 (explosive) materials.

(b) The owner, agent, charterer, master or person in charge of the vessel, and all persons engaged in the handling, loading, unloading, and stowage of Class 1 (explosive) materials shall obey all orders that are given by the officer in charge of the supervisory detail.

(c) If Class 1 (explosive) materials are loaded onto or unloaded from a vessel at a facility operated or controlled by the Department of Defense, the Commanding Officer of that facility may decline the USCG supervisory detail. Whenever the supervisory detail is declined, the Commanding Officer of the facility shall ensure compliance with the regulations in this part.

§176.104 Loading and unloading Class 1 (explosive) materials.

(a) Packages of Class 1 (explosive) materials may not be thrown, dropped, rolled, dragged, or slid over each other or over a deck.

(b) When Class 1 (explosive) materials are stowed in a hold below one in which any cargo is being handled, the hatch in the deck dividing the two holds must have all covers securely in place.

(c) Drafts of Class 1 (explosive) materials must be handled in accordance with the

following:
(1) A draft may not be raised, lowered, or stopped by sudden application of power or brake.
(2) A draft may not be released by tripping or freeing one side of the cargo-handling equipment and tumbling the Class 1 (explosive) materials off.
(3) All drafts, beams, shackles, bridles, slings, and hoods must be manually freed before the winch takes control.
(4) Slings may not be dragged from under a draft by winching except for the topmost layer in the hold when power removal is the only practical method and when the cargo cannot be toppled.
(5) Handles or brackets on packages in a draft may not be used for slinging purposes.
(d) A combination woven rope and wire sling or a sling that is formed by use of an open hook may not be used in handling Class 1 (explosive) materials.
(e) Only a safety hook or a hook that has been closed by wire may be used in handling drafts of Class 1 (explosive) materials.
(f) Wire rope or wire rope assemblies, including splices and fittings, used in handling Class 1 (explosive) materials must be unpainted and kept bare to permit inspection of their safe working condition. A mechanical end fitting (pressed fitting) may be used in place of a eye splice, if the efficiency of the mechanical end fitting is at least equal to the efficiency of an eye splice prepared as prescribed in 29 CFR 1918.51(c)(1).
(g) Packages of Division 1.1 and 1.2 (Class A and B explosive) materials which are not part of a palletized unit must be loaded and unloaded from a vessel using a chute or conveyor as described in §176.163, or a mechanical hoist and a pallet, skipboard, tray, or pie plate fitted with a cargo net or sideboards.
(h) Packages of Division 1.1 and 1.2 (Class A and B explosive) materials must be loaded or unloaded in accordance with the following:
(1) A cargo net with a pallet, skipboard, tray, or pie plate, must be loaded so that no more than a minimum displacement of packages occurs when it is lifted.
(2) A cargo net must completely encompass the bottom and sides of the draft. The mesh of the cargo net must be of a size and strength that will prevent a package in the draft from passing through the net.
(3) When a tray is used in handling packages, no package may extend more than one-third its vertical dimension above the sideboard of the tray.
(i) A landing mat must be used when a draft of nonpalletized Division 1.1 or 1.2 (Class A and B explosive materials) is deposited on deck. The landing mat must have dimensions of at least l m (3 feet) wide, 2 m (7 feet) long, and 10 cm (3.9 inches) thick, and be made of woven hemp, sisal, or similar fiber, or foam rubber, polyurethane or similar resilient material.
(j) In addition to the other requirements of this section, packages of Division 1.1 and 1.2 (Class A and B explosive) materials must be handled in accordance with the following:
(1) Packages may not be loaded or unloaded through a hatch at the same time that other cargo is being handled in any hold served by that hatch.
(2) Packages may not be loaded or unloaded from the same hatch by using two pieces of cargo equipment unless the equipment is positioned at the forward and aft ends of

the hatch.
(3) Packages may not be lifted over any hazardous materials.
(4) The height of any structure, equipment, or load on a deck over which packages must be lifted may not be higher than the hatch coaming or bulwark, or 1 m (3 feet), whichever is greater.
(k) Unpackaged explosive devices may not be handled by their lifting lugs or suspension lugs.
(l) A chute may not be used when loading or unloading Class 1 (explosive) materials in compatibility group A or B.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-40, 61 FR 27175, May 30, 1996]

§176.108 Supervision of Class 1 (explosive) materials during loading, unloading, handling and stowage.

(a) During the loading, unloading, handling and stowage of Class 1 (explosive) materials, a responsible person shall be in constant attendance during the entire operation to direct the loading, unloading, handling and stowage of Class 1 (explosive) materials, including the preparation of the holds. The responsible person must be aware of the hazards involved and the steps to be taken in an emergency, and must maintain sufficient contact with the master to ensure proper steps are taken in an emergency.

(b) Each person involved in the handling of Class 1 (explosive) materials on a vessel shall obey the orders of the responsible person.

(c) The responsible person must inspect all cargo-handling equipment to determine that it is in safe operating condition before it is used to handle Class 1 (explosive) materials.

Stowage

§176.112 Application of stowage provisions.

The provisions of §§176.116(e), 176,118, and 176.120 of this subpart do not apply to Division 1.4 (Class C explosive) materials, compatibility group S. Such materials may be stowed together with all other Class 1 (explosive) materials except those of compatibility group A or L. They must be segregated from other hazardous materials in accordance with table 176.83(b) of this part.

§176.116 General stowage conditions for Class 1 (explosive) materials.

(a) *Heat and sources of ignition: (1) Class 1 (explosive) materials must be stowed in a cool part of the ship and must be kept as cool as practicable while on board. Stowage*

must be well away from all sources of heat, including steam pipes, heating coils, sparks, and flame.
(2) Except where the consignment of Class 1 (explosive) materials consists only of explosive articles, the wearing of shoes or boots with unprotected metal nails, heels, or tips of any kind is prohibited.
(b) Wetness: (1) Spaces where Class 1 (explosive) materials are stowed below deck must be dry. In the event of the contents of packages being affected by water when on board immediate advice must be sought from the shippers; pending this advice handling of the packages must be avoided.
(2) Bilges and bilge sections must be examined and any residue of previous cargo removed before Class 1 materials (explosive) are loaded onto the vessel.
(c) *Security: All compartments, magazines, and transport units containing Class 1 (explosive) materials must be locked or suitably secured in order to prevent unauthorized access.*
(d) Secure stowage: Class 1 (explosive) materials must be securely stowed to prevent movement in transit; where necessary, precautions must be taken to prevent cargo sliding down between the frames at the ship's sides.
(e) Separation from accommodation spaces and machinery spaces: (1) Class 1 (explosive) materials must be stowed as far away as practicable from any accommodation spaces or any machinery space and may not be stowed directly above or below such a space. The requirements in paragraphs (e)(2) through (e)(4) of this section are minimum requirements in addition to the applicable requirements of 46 CFR chapter I. Where the requirements of this subpart are less stringent than those of 46 CFR chapter I, the 46 CFR chapter I requirements must be satisfied for ships to which they are applicable.
(2) There must be a permanent A Class steel bulkhead between any accommodation space and any compartment containing Class 1 (explosive) materials. Division 1.1 and 1.2 (Class A and B explosive) materials, 1.3 (Class B explosive) materials, or 1.5 (blasting agents) materials may not be stowed within 3 m (10 feet) of this bulkhead; in the decks immediately above or below an accommodation space they must be stowed at least 3 m (10 feet) from the line of this bulkhead projected vertically.
(3) There must be a permanent A Class steel bulkhead between a compartment containing Class 1 (explosive) materials and any machinery space. Class 1 (explosive) materials, except those in Division 1.4 (Class C explosive), may not be stowed within 3 m (10 feet) of this bulkhead; and in the decks above or below the machinery space they must be stowed at least 3 m (10 feet) from the line of this bulkhead projected vertically. In addition to this separation, there must be insulation to Class A60 standard as defined in 46 CFR 72.05-10(a)(1) if the machinery space is one of Category `A' unless the only Class 1 (explosive) materials carried are in Division 1.4S (Class C explosive).
(4) Where Class 1 (explosive) materials are stowed away from bulkheads bounding any accommodation space or machinery space, the intervening space may be filled with cargo that is not readily combustible.

§176.118 Electrical requirement.

(a) Electrical equipment and cables installed in compartments in which Class 1 (explosive) materials are stowed which do not need to be energized during the voyage must be isolated from the supply so that no part of the circuit within the compartment is energized. The method of isolation may be by withdrawal of fuses, opening of switches or circuit breakers, or disconnection from bus bars. The means, or access to the means, of disconnection/reconnection must be secured by a locked padlock under the control of a responsible person.

(b) Electrical equipment and cables in a cargo space in which Class 1 (explosive) materials are stowed which are energized during the voyage for the safe operation of the ship must meet the requirements of subchapter J of 46 CFR chapter I. Before Class 1 (explosive) materials are loaded aboard a vessel, all cables must be tested by a skilled person to ensure that they are safe and to determine satisfactory grounding, insulation resistance, and continuity of the cable cores, metal sheathing or armoring.

(c) All Class 1 (explosive) materials must be stowed in a safe position relative to electrical equipment and cables. Additional physical protection must be provided where necessary to minimize possible damage to the electrical equipment or cables, especially during loading and unloading.

(d) Cable joints in the compartments must be enclosed in metal-clad junction boxes.

(e) All lighting equipment and cables must be of the fixed type, and must meet the relevant inspection, test, and installation standards of 46 CFR chapter I, subchapter J.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-34, 58 FR 51533, Oct. 1, 1993]

§176.120 Lightning protection.

A lightning conductor grounded to the sea must be provided on any mast or similar structure on a vessel on which Class 1 (explosive) materials are stowed unless effective electrical bonding is provided between the sea and the mast or structure from its extremity and throughout to the main body of the hull structure. (Steel masts in ships of all welded construction comply with this requirement).

§176.122 Stowage arrangements under deck.

When stowed under deck, Class 1 (explosive) materials must be in conformance with one of the stowage arrangements described in §§176.124 through 176.136 of this subpart.

§176.124 Ordinary stowage.

(a) Ordinary stowage is authorized for most explosive articles carried by vessel. The exceptions are those for which this subpart prescribes "magazine" or "special" stowage.
(b) Class 1 (explosive) materials requiring ordinary stowage must be stowed in accordance with §176.116 of this subpart.

§176.128 Magazine stowage, general.

(a) Magazine stowage is sub-divided into three different types of magazines designated by the letters A, B, and C. A magazine may be a fixed structure in the vessel, a closed freight container, or a portable magazine unit. Freight containers, portable magazines, and vehicles must be properly secured in position. Magazines may be positioned in any part of the vessel conforming to the general stowage conditions for Class 1 (explosive) materials, except magazines which are fixed structures must be constructed in a location in which their doors, where fitted, are easily accessible.
(b) Magazine stowage is required for all explosive substances, except "Explosive Substances, n.o.s." in compatibility groups G, L, or S. Magazine stowage type A is required for those substances which must be kept clear of steelwork. All other explosive substances must be given magazine stowage type B, except those in compatibility group A for which magazine stowage type C is prescribed.
(c) Magazine stowage type B is required for Charges, propelling, for cannon. UN 0279, UN 0414, and UN 0242, and Charges, supplemental, explosive, UN 0600, in compatibility group C or D; and magazine stowage type C is required for detonators and similar articles in divisions and compatibility group 1.1B and 1.2B (Class A and B explosive).

§176.130 Magazine stowage Type A.

(a) In addition to protecting the Class 1 (explosive) materials and preventing unauthorized access, magazine stowage type A guards against friction between any spilled contents of packages and the vessel's sides and bulkheads.
(b) Class 1 (explosive) materials requiring magazine stowage type A must be stowed in a magazine which is tightly sheathed with wood on its inner sides and floor.
(c) When utilized as part of the magazine structure, the vessel's sides and bulkheads must be clean, free from rust or scale, and protected by battening or sweatboards spaced not more than 150 mm (6 inches) apart. All stanchions and other unprotected structural members must be similarly clean and battened. The underside of the deck above the magazine must be clean and free of rust and scale, but need not be battened.
(d) The top of the stow within the magazine must be at least 30 cm (12 inches) from the underside of the deck above.
(e) A type A magazine constructed in the square of a cargo space may not be loaded

from the top.
(f) When other Class 1 (explosive) materials are stowed with Class 1 (explosive) materials for which magazine stowage type A is required, they or their packagings may have no exposed external parts made of ferrous metal or aluminum alloy.

§176.132 Magazine stowage Type B.

(a) Magazine stowage type B is the same as magazine stowage type A as prescribed in §176.130 of this part, except:
(1) The floor need not be tightly sheathed with wood but must be sparred or protected by wooden pallets or dunnage; and
(2) Battening of the vessel's sides, bulkheads, and stanchions is not required.
(b) A compartment may be used for magazine stowage type B without a magazine structure provided that:
(1) The Class 1 (explosive) materials are stowed on wooden gratings, pallets, or dunnage, directly on the deck and not on other cargo;
(2) Other cargo stowed in the same compartment is not readily combustible material; and
(3) The position of the stowage is such that there is direct access to the hatchway.
(c) Class 1 (explosive) materials and other cargo in the same compartment must be secured to eliminate the possibility of significant movement. Where an entire deck is used as a magazine, the stowage must be so arranged that the Class 1 (explosive) materials stowed therein will be removed from the ship before working any cargo in any decks above or below the space in the same hatch.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.133 Magazine stowage Type C.

The construction requirements for magazine stowage type C are the same as for magazine stowage Type B as prescribed in §176.132 of this part, except that the magazine must be located as near as practicable to the centerline of the vessel and must not be closer to the vessel's side than a distance equal to one-eighth of the vessel's beam or 2.5 m (8.2 feet). whichever is less.

§176.134 Vehicles.

Closed vehicles may be used to transport Class 1 (explosive) materials requiring magazine stowage when carried by vessel if they meet the requirements of the appropriate magazine stowage type. See §176.168 of this subpart for additional requirements relating to the transport of Class 1 (explosive) materials in vehicles.

§176.136 Special stowage.

(a) Special stowage is required for certain articles presenting both explosive and chemical hazards, such as smoke or lachrymatory (compatibility group G or H), toxic (compatibility group K), or substances and articles which present a special risk (compatibility group L). Except as permitted in paragraph (c) of this section, Class 1 (explosive) materials requiring special stowage must be stowed on deck unless such stowage is impracticable and the COTP authorizes special stowage below deck.
(b) Class 1 (explosive) materials for which special stowage is required must be stowed as far away as practicable from living, accommodation, and working areas, and may not be overstowed. Steel portable magazines and freight containers in which such Class 1 (explosive) materials are stowed may not be located closer to the vessel's side than a distance equal to one-eighth of the vessel's beam or 2.5 m (8.2 feet), whichever is less.
(c) Explosive articles having UN number, UN 0015, UN 0016, UN 0018, UN 0019, UN 0301, or UN 0303 may be given ordinary stowage in a lower hold or 'tween deck. Other Class 1 (explosive) materials in compatibility groups G and H may be in open stowage out to the ship's side on a floodable lower hold or deep tank in such a position that other cargo cannot be contaminated by leakage; in all other cases such Class 1 (explosive) materials must be stowed in steel portable magazines or in freight containers. If a freight container is used for this purpose, the floor of the freight container must be leakproof; for example, an all-metal container may be used and a fillet of cement or other material worked across the bottom of the door pening.
(d) Class 1 (explosive) materials stowed in one compartment may not be of more than one compatibility group, except the COTP may allow Class 1 (explosive) materials of compatibility groups G and H in separate steel portable magazines to be stowed in the same compartment, not less than 3 m (10 feet) apart.
(e) Class 1 (explosive) materials in compatibility groups K and L must be stowed in a steel portable magazine regardless of the stowage position in the vessel.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995]

§176.137 Portable magazine.

(a) Each portable magazine used for the stowage of Class 1 (explosive) materials on board vessels must meet the following requirements:

(1) It must be weather-tight, constructed of wood or metal lined with wood at least 2 cm (0.787 inch) thick, and with a capacity of no more than 3.1 cubic m (110 cubic feet).

(2) All inner surfaces must be smooth and free of any protruding nails, screws or other projections.

(3) If constructed of wood, a portable magazine must be framed of nominal 5 cm x 10 cm (2x4 inch) lumber, and sheathed with nominal 20 mm (0.787 inch) thick boards or plywood.
(4) When constructed of metal, the metal must be not less than 3.2 mm (0.126 inch) thick.
(5) Runners, bearers, or skids must be provided to elevate the magazine at least 10 cm (3.9 inches) from the deck. Padeyes, ring bolts, or other suitable means must be provided for securing.
(6) If the portable magazine has a door or hinged cover, the door or cover must have a strong hasp and padlock or equally effective means of securing.
(7) The portable magazine must be marked on its top and four sides, in letters at least 8 cm (3 inches) high, as follows:

EXPLOSIVES-HANDLE CAREFULLY-KEEP LIGHTS AND FIRE AWAY.

(b) A portable magazine which meets the requirements for a type 2 or type 3 magazine under 27 CFR part 55 subpart K may be used for the stowage of Class 1 (explosive) materials on board vessels.
(c) A portable magazine with a capacity exceeding 3.1 m^3, (110 cubic feet) may be used for the stowage of Class 1 (explosive) materials under such construction, handling, and stowage requirements as the COTP approves.

§176.138 Deck stowage.

(a) Class 1 (explosive) materials stowed on deck must be carried as close to the vessel's centerline as practicable.
(b) Class 1 (explosive) materials may not be stowed within a horizontal distance of 6 m (20 feet) from any fire, machinery exhaust, galley uptake, locker used for combustible stores, or other potential sources of ignition. They must be clear of walkways and cargo working areas, fire hydrants, steam pipes, and means of access; away from all other facilities necessary for the safe working of the vessel, and not less than a horizontal distance of 8 m (26 feet) from the bridge, accommodation areas, and lifesaving appliances.
(c) Where vessels are fitted with container fastening arrangements, freight containers containing Class 1 (explosive) materials may be overstowed by containers of compatible Class 1 (explosive) materials or non-hazardous cargo. Where vessels are not fitted with container fastening arrangements, freight containers loaded with Class 1 (explosive) materials may be stowed only on the bottom tier of the stowage.

Segregation

§176.140 Segregation from other classes of hazardous materials.

(a) Class 1 (explosive) materials must be segregated from other packaged hazardous materials in accordance with §176.83.

(b) Class 1 (explosive) materials must be segregated from bulk solid dangerous cargoes in accordance with the General Introduction to the IMDG Code. Notwithstanding §176.83(b), ammonium nitrate and sodium nitrate may be stowed together with blasting explosives, except those containing chlorates, provided the mixed stowage is treated as blasting explosives (see §176.410(e)).

§176.142 Hazardous materials of extreme flammability.

(a) Except as allowed by paragraph (b) of this section, certain hazardous materials of extreme flammability may not be transported in a vessel carrying Class 1 (explosive) materials. This prohibition applies to the following hazardous materials:

-	-	-
Carbon disulfide	UN 1131	Class 3
Diethyl zinc	UN 1366	Division 4.2
Dimethyl zinc	UN 1370	Division 4.2
Magnesium alkyls	UN 3053	Division 4.2
Nickel carbonyl	UN 1259	Division 6.1
Pyrophoric liquids, n.o.s	UN 2845	Division 4.2

(b) The hazardous materials listed in paragraph (a) of this section may be transported in a vessel carrying the following Class 1 (explosive) materials as cargo:

(1) Division 1.4 (Class C explosive) materials, compatibility group S.

(2) Explosive articles having the following proper shipping names and identification numbers (see column (4) of the §172.101 table) if designed for lifesaving purposes and their total net explosive mass (weight) does not exceed 50 kg (110 lbs) per vessel:

(i) ARTICLES, PYROTECHNIC: UN Nos. 0428, 0429, 0430, 0431.

(ii) CARTRIDGES, FLASH: UN Nos. 0049, 0050.

(iii) CARTRIDGES, SIGNAL: UN Nos. 0054, 0312.

(iv) SIGNAL DEVICES, HAND: UN No. 0191.

(v) SIGNALS, DISTRESS: UN Nos. 0194, 0195.

(vi) SIGNALS, SMOKE: UN Nos. 0196, 0197, 0313.

(3) Class 1 (explosive) materials in compatibility groups C, D, and E if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(4) Explosive articles in compatibility group G, except fireworks and Class 1 (explosive) materials requiring special stowage if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(c) When a vessel carrying Class 1 (explosive) materials allowed under paragraph (b) of this section also carries a hazardous material of extreme flammability, that hazardous material must be stowed in a part of the vessel as remote as practicable from the Class

1 (explosive) materials.

§176.144 Segregation of Class 1 (explosive) materials.

(a) Except as provided in §176.145 of this subpart, Class 1 (explosive) materials may be stowed within the same compartment, magazine, portable magazine, or transport unit as indicated in table 176.144(a).

Table 176.144(a)-Authorized Mixed Stowage for Explosives
[An "X" indicates that explosives in the two different compatibility groups reflected by the location of the "X" may not be stowed in the same compartment, portable magazine, or transport unit]

Compatibility groups	A	B	C	D	E	F	G	H	J	K	L	N	S
A	-	X	X	X	X	X	X	X	X	X	X	X	X
B	X	-	X	X	X	X	X	X	X	X	X	X	-
C	X	X	-	-	-	X	1	X	X	X	X	-	-
D	X	X	-	-	-	X	1	X	X	X	X	-	-
E	X	X	-	-	-	X	1	X	X	X	X	-	-
F	X	X	X	X	X	-	X	X	X	X	X	X	-
G	X	X	1	1	1	X	-	X	X	X	X	X	-
H	X	X	X	X	X	X	X	-	X	X	X	X	-
J	X	X	X	X	X	X	X	X	-	X	X	X	-
K	X	X	X	X	X	X	X	X	X	-	X	X	-
L	X	X	X	X	X	X	X	X	X	X	2	X	X
N	X	X	-	-	-	X	X	X	X	X	X	-	-
S	X	-	-	-	-	-	-	-	-	-	X	-	-

NOTES: 1. Explosive articles in compatibility group G, other than fireworks and those requiring special stowage, may be stowed with articles of compatibility groups C, D, and E, provided no explosive substances are carried in the same compartment, portable magazine or transport unit.

2. Explosives in compatibility group L may only be stowed in the same compartment, magazine or transport unit with identical explosives within compatibility group L.

(b) Where Class 1 (explosive) materials of different compatibility groups are allowed to be stowed in the same compartment, magazine, portable magazine, or transport unit, the stowage arrangements must conform to the most stringent requirements for the entire load.

(c) Where a mixed load of Class 1 (explosive) materials of different hazard divisions and/or stowage arrangements is carried within a compartment, magazine, or transport unit, the entire load must be treated as belonging to the hazard division having the greatest hazard. (For example, if a load of Division 1.1 (Class A explosive) materials is mixed with Division 1.3 (Class B explosive) materials, the load is treated as a Division

1.1 (Class A explosive) material as defined in §173.50(b) of this subchapter and the stowage must conform to the most stringent requirements for the entire load).

(d) If some of the Class 1 (explosive) materials in a stowage mixture require magazine stowage, Class 1 (explosive) materials requiring ordinary stowage may be stowed in the same magazine. When the magazine is used for substances requiring Type A stowage, the other Class 1 (explosive) materials stowed therein must have no exposed parts of any ferrous metal or aluminum alloy, unless separated by a partition.

(e) Segregation on deck: When Class 1 (explosive) materials in different compatibility groups are carried on deck, they must be stored not less than 6 m (20 feet) apart unless they are allowed under table 176.144(a) to be stowed in the same compartment, magazine, or transport unit.

(f) On a barge used to transfer class 1 (explosive) materials from a waterfront facility to a vessel at an explosives anchorage (or from the vessel to the water front facility), if compliance with paragraph (e) of this section is not practicable, a sandbag barrier at least 0.6 m (2 feet) in thickness may be substituted for the 6 m (20 feet) separation.

§176.145 Segregation in single hold vessels.

(a) On board a vessel having a single cargo hold, Class 1 (explosive) materials in hazard division/compatibility group 1.1B and 1.2B may be stowed in the same compartment with substances of compatibility group D, provided:

(1) The net explosive weight of the compatibility group B explosive does not exceed 50 kg (110 pounds); and

(2) The compatibility group B explosive materials are stowed in a steel portable magazine that is stowed at least 6 m (20 feet) from the compatibility group D substances.

(b) Division/compatibility group 1.4B (Class C explosive) materials may be stowed in the same compartment with substances of compatibility group D provided the Class 1 (explosive) materials of different compatibility groups are separated by either a distance of at least 6 m (20 feet) or by a steel partition.

§176.146 Segregation from non-hazardous materials.

(a) Except as required by paragraphs (b) and (c) of this section, Class 1 (explosive) materials need not be segregated from other cargo of a non-dangerous nature.

(b) Mail, baggage, and personal and household effects may not be stowed in the same compartment as, or in compartments immediately above or below, Class 1 (explosive) materials other than those in compatibility group S.

(c) Where Class 1 (explosive) materials are stowed against an intervening bulkhead, any mail on the other side of the bulkhead must be stowed away from it.

(d) In order to avoid contamination:

(1) An explosive substance or article which has a secondary POISON hazard label must

be stowed "separated from" all foodstuffs, except when such materials are stowed in separate closed transport units, the requirements for "away from" segregation apply.
(2) An explosive substance or article which has a secondary CORROSIVE hazard label must be stowed "away from" foodstuffs.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

Precautions During Loading and Unloading

§176.148 Artificial lighting.

Electric lights, except arc lights, are the only form of artificial lighting permitted when loading and unloading Class 1 (explosive) materials.

§176.150 Radio and radar.

(a) Except as provided in paragraph (b) of this section, when Class 1 (explosive) materials (other than explosive articles in Division 1.4 [Class C explosive] or any explosive substance) are loaded, unloaded, or handled, the responsible person must ensure that all sources of electromagnetic radiation such as radio and radar transmitters are deenergized by opening the main switches controlling the sources and tagging them to warn that the devices are not to be energized until loading or unloading has ceased.
(b) During the loading or unloading of all explosive articles (except those in Division 1.4 [Class C explosive]), no radio or radar transmitter may be used within 50 m (164 feet) of such articles except for VHF transmitters the power output of which does not exceed 25 watts and of which no part of the antenna system is within 2 m (7 feet) of the Class 1 (explosive) materials.
(c) Explosive articles which are sensitive to electromagnetic radiation from external sources must be stowed at a safe distance from the vessel's radio cabin, receiving and transmitting apparatus radio antenna or lead-in, and radar installation, with due regard to the character of the vessel and the degree of screening-off of the explosive articles.

§176.154 Fueling (bunkering).

(a) Class 1 (explosive) materials, except those in compatibility group S, may not be loaded or unloaded when fueling (bunkering) is in progress except with the prior authorization of the COTP, and under conditions prescribed by that officer.
(b) Vessels containing Class 1 (explosive) materials may not be fueled (bunkered) with the hatches open unless authorized by the COTP.

§176.156 Defective packages.
(a) No leaking, broken, or otherwise defective package containing Class 1 (explosive) materials, including packages which have been adversely affected by moisture, may be accepted for shipment. The master or person in charge of a vessel on which there is a defective package containing Class 1 (explosive) materials must seek advice from the shipper concerning withdrawal, repair, or replacement. No repair of damaged or defective package containing Class 1 (explosive) materials may be performed on board a vessel.
(b) No Class 1 (explosive) material, which for any reason has deteriorated or undergone a change of condition that increases the hazard attendant upon its conveyance or handling, may be moved in the port area, except as directed by the COTP.
(c) If any package of Class 1 (explosive) materials, or seal of a package of Class 1 (explosive) materials, appears to be damaged, that package must be set aside for examination and repair or otherwise legally disposed of as directed by the shipper.
(d) If any Class 1 (explosive) materials are spilled or released from a package, the responsible person must ensure that an appropriate emergency response is undertaken in accordance with the emergency response information required under §172.602 of this subchapter. The master of the vessel must report each incident involving spillage or release of Class 1 (explosive) materials to the COTP as soon as practicable.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.160 Protection against weather.
Any person loading or unloading packages containing Class 1 (explosive) materials shall take adequate measures to prevent these packages from becoming wet.

§176.162 Security.
A responsible person must be present at all times when the hatches of spaces containing Class 1 (explosive) materials are open. No unauthorized person may be permitted to access spaces in which Class 1 (explosive) materials are stowed. Magazines must be secured against unauthorized entry when loading has been completed, or when loading or unloading is stopped. Packages containing Class 1 (explosive) materials may not be opened on board ship.

§176.164 Fire precautions and firefighting.
(a) Matches, lighters, fire, and other ignition sources are prohibited on and near any

vessel on which Class 1 (explosive) materials are being loaded, unloaded, or handled except in places designated by the master or the COTP.
(b) A fire hose of sufficient length to reach every part of the loading area with an effective stream of water must be laid and connected to the water main, ready for immediate use.
(c) No repair work may be carried out in a cargo space containing Class 1 (explosive) materials other than those of Division 1.4 (Class C explosive). No welding, burning, cutting, or riveting operations involving the use of fire, flame, spark, or arc-producing equipment may be conducted on board except in an emergency; and, if in port, with the consent of the COTP.
(d) Each compartment, including a closed vehicle deck space, which contains Class 1 (explosive) materials must be provided with a fixed fire extinguishing system. Each adjacent cargo compartment either must be protected by a fixed fire extinguishing installation or must be accessible for firefighting operations.
(e) A vessel must have two sets of breathing apparatus and a power-operated fire pump, which, together with its source of power and sea connections, must be located outside the machinery space.

Passenger Vessels

§176.166 Transport of Class 1 (explosive) materials on passenger vessels.

(a) Only the following Class 1 (explosive) materials may be transported as cargo on passenger vessels:

(1) Division 1.4 (Class C explosive) materials, compatibility group S.

(2) Explosive articles designed for lifesaving purposes as identified in §176.143(b)(2), if the total net explosive mass (weight) does not exceed 50 kg (110 pounds).

(3) Class 1 (explosive) materials in compatibility groups C, D, and E, if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(4) Articles in compatibility group G other than those requiring special stowage, if the total net explosive mass (weight) does not exceed 10 kg (22 pounds) per vessel.

(5) Articles in compatibility group B, if the total net explosive mass (weight) does not exceed 5 kg (11 pounds).

(b) Class 1 (explosive) materials which may be carried on passenger vessels are identified in column (10) of the §172.101 table. They must be stowed in accordance with table 176.166(b).

Table 176.166(b)-Stowage Arrangements in Passenger Vessels

Class/Division	Samples, explosive	Goods, N.O.S. Class 1	Goods shipped under a specific proper shipping name												
-	-	-	Compatibility group												
-	-	-	A	B	C	D	E	F	G	H	J	K	L	N	S

1.1	d	d	c	e	e	e	e	c	e	-	c	-	c	-	-
1.2	d	d	-	e	e	e	e	c	e	c	c	c	c	-	-
1.3	d	d	-	-	e	e	-	c	e	c	c	c	c	-	-
1.4	d	d	-	b	b	b	b	c	b	-	-	-	-	-	a
1.5	d	d	-	-	-	e	-	-	-	-	-	-	-	-	-
1.6	d	d	-	-	-	-	-	-	-	-	-	-	-	e	-

a-As for cargo ships, on deck or under deck.

b-As for cargo ships, on deck or under deck, in portable magazines only.

c-Prohibited.

d-As specified by the Associate Administrator for Hazardous Materials Safety, or the competent authority of the country in which the Class 1 (explosive) materials are loaded on the vessel.

e-In containers or the like, on deck only.

(c) Notwithstanding the provisions of paragraph (a) of this section, a combination of the substances and articles listed in paragraphs (a)(1) through (a)(5) of this section may be transported on the same passenger vessel provided the total net explosive mass (weight) of the combination of Class 1 (explosive) materials carried does not exceed the smallest quantity specified for any one of the substances or articles in the combination.

Transport Units and Shipborne Barges

§176.168 Transport of Class 1 (explosive) materials in vehicle spaces.

(a) All transport vehicles and cargo must be properly secured.

(b) All transport vehicles used for the carriage of Class 1 (explosive) materials must be structurally serviceable as defined in §176.172(a)(2).

(c) Vehicles used to transport Class 1 (explosive) materials must conform to the requirements in §§177.834 and 177.835 of this subchapter.

(d) Class 1 (explosive) materials which require special stowage must be transported in transport vehicles approved for the purpose by the Associate Administrator for Hazardous Materials Safety except that Class 1 (explosive) materials in compatibility group G or H may be carried in steel portable magazines or freight containers. Closed transport vehicles may be used as magazines; transport vehicles of other types may be used to transport Class 1 (explosive) materials which require ordinary stowage.

(e) Class 1 (explosive) materials of different compatibility groups may not be stowed in the same vehicle except as allowed in §176.144 of this subpart.

(f) Vehicles containing different Class 1 (explosive) materials require no segregation from each other, except that these materials may be carried together under the provisions of §176.144 of this subchapter. In all other instances, the vehicles must be "separated from" one another.

(g) All transport vehicles used for the transport of Class 1 (explosive) materials must have lashing arrangements for securing the vehicle on the ship and preventing the movement of the vehicle on its springs during the sea passage.

(h) Where a portable magazine or closed freight container is carried on a chassis, twist locks or other suitable securing arrangements must be provided and made secure.

§176.170 Transport of Class 1 (explosive) materials in freight containers.

(a) When Class 1 (explosive) materials are stowed in a freight container, the freight container, for the purposes of this subpart, may be regarded as a magazine but not as a separate compartment.
(b) Freight containers exceeding 6 m (20 feet) in length may not carry more than 5000 kg (11,023 pounds) net explosive weight of explosive substances, except explosive substances in Division 1.4.
(c) Freight containers used to transport Class 1 (explosive) materials for which magazine stowage type A is required must have a floor consisting of tightly fitted wooden boards, plywood or equivalent non-metallic material, and a non-metallic lining.
(d) Class 1 (explosive) materials of different compatibility groups may not be stowed within the same freight container except as allowed in §176.144 of this subpart.
(e) On vessels, other than specially fitted container ships, freight containers containing Class 1 (explosive) materials must be stowed only in the lowest tier.
(f) Freight containers carrying different Class 1 (explosive) materials require no segregation from each other, if the provisions of §176.144 of this subpart allow the Class 1 (explosive) materials to be carried together in the same compartment. In all other instances, the containers must be "separated from" one another in accordance with §176.83(f) of this part.
(g) Freight containers carrying Class 1 (explosive) materials may not be handled on board a vessel with fork lift trucks unless approved by the COTP. This does not preclude the use of front-loading trucks using side-frame lifting equipment.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.172 Structural serviceability of freight containers and vehicles carrying Class 1 (explosive) materials on ships.

(a) A freight container may not be offered for the carriage of Class 1 (explosive) materials unless the container is structurally serviceable as evidenced by a current CSC (International Convention for Safe Containers) approval plate and verified by a detailed visual examination as follows:

(1) Before a freight container or transport vehicle is packed with Class 1 (explosive) materials, it must be visually examined by the shipper to ensure it is structurally serviceable, free of any residue of previous cargo, and its interior walls and floors are free from protrusions.

(2) *Structurally serviceable means the freight container or the vehicle cannot have*

major defects in its structural components, such as top and bottom side rails, top and bottom end rails, door sill and header, floor cross members, corner posts, and corner fittings in a freight container. Major defects include-

(i) Dents or bends in the structural members greater than 19 mm (0.75 inch) in depth, regardless of length;

(ii) Cracks or breaks in structural members;

(iii) More than one splice or an improper splice (such as a lapped splice) in top or bottom end rails or door headers;

(iv) More than two splices in any one top or bottom side rail;

(v) Any splice in a door sill or corner post;

(vi) Door hinges and hardware that are seized, twisted, broken, missing, or otherwise inoperative;

(vii) Gaskets and seals that do not seal; or

(viii) For freight containers, any distortion of the overall configuration great enough to prevent proper alignment of handling equipment, mounting and securing chassis or vehicle, or insertion into ships' cells.

(3) In addition, deterioration of any component of the freight container or vehicle, regardless of the material of construction, such as rusted-out metal in sidewalls or disintegrated fiberglass, is prohibited. Normal wear, however, including oxidation (rust), slight dents and scratches, and other damage that does not affect serviceability or the weather-tight integrity of the units, is not prohibited.

(b) As used in paragraph (a) of this section, *splice means any repair of a freight container main structural member which replaces material, except complete replacement of the member.*

(c) All shipments of Class 1 (explosive) materials except those in Division 1.4 (Class C explosive) must be accompanied by a statement, which may appear on the shipping paper, certifying that the freight container or the vehicle is structurally serviceable as defined in paragraph (a)(2) of this section.

§176.174 Transport of Class 1 (explosive) materials in shipborne barges.

(a) Fixed magazines may be built within a shipboard barge. Portable magazines and freight containers may be used as magazines with a barge.

(b) Shipborne barges may be used for the carriage of all types of Class 1 (explosive) materials. When carrying Class 1 (explosive) materials requiring special stowage, the following requirements apply:

(1) Class 1 (explosive) materials in compatibility group G or H must be stowed in steel portable magazines or freight containers.

(2) Class 1 (explosive) materials in compatibility group K or L must be stowed in steel portable magazines.

(c) Class 1 (explosive) materials of different compatibility groups may not be stowed within the same shipborne barge unless under §176.144(b) of this subpart they are authorized to be stowed in the same compartment.

§176.176 Signals.

When Class 1 (explosive) materials are being loaded, handled, or unloaded on a vessel, the vessel must exhibit the following signals:

(a) By day, flag "B" (Bravo) of the international code of signals; and

(b) By night, an all-round fixed red light.

§176.178 Mooring lines.

(a) All lines used in mooring the vessel must be of sufficient strength, type, and number for the size of the vessel and local conditions.

(b) While the vessel is moored or anchored in a port area, towing wires of adequate size and length must be properly secured to mooring bits at the bow and stern ready for immediate use with the towing eyes passed outboard and kept at about water level.

(c) The mooring arrangements must be such that the vessel can be released quickly in an emergency.

§176.180 Watchkeeping.

Whenever Class 1 (explosive) materials are on board a vessel in port, there must be sufficient crew on board to maintain a proper watch and to operate the propulsion and firefighting equipment in case of an emergency.

§176.182 Conditions for handling on board ship.

(a) *Weather conditions. Class 1 (explosive) materials may not be handled in weather conditions which may seriously increase the hazards presented by the Class 1 (explosive) materials. During electrical storms, cargo operations must be halted and all hatches containing Class 1 (explosive) materials must be closed.*

(b) Darkness. Class 1 (explosive) materials may not be handled on board a vessel during the hours of darkness unless prior consent has been obtained from the COTP.

(c) Lighting. The area where Class 1 (explosive) materials are handled, or where preparations are being made to handle Class 1 (explosive) materials, must be illuminated with lighting that is sufficient to safely perform the handling operation.

(d) Protective equipment. (1) A sufficient quantity of appropriate protective equipment must be provided for the personnel involved in handling Class 1 (explosive) materials.

(2) The protective equipment must provide adequate protection against the hazards specific to the Class 1 (explosive) materials handled.

(e) *Intoxicated persons. No person under the influence of alcohol or drugs to such an extent that the person's judgment or behavior is impaired may participate in any operation involving the handling of Class 1 (explosive) materials. The master of the vessel must keep any such person clear of any areas where Class 1 (explosive) materials are being handled.*
(f) Smoking. (1) Smoking is prohibited on the vessel while Class 1 (explosive) materials are being handled or stowed except in places designated by the master of the vessel.
(2) Conspicuous notices prohibiting smoking must be posted and clearly visible at all locations where Class 1 (explosive) materials are handled or stored.
(g) All hatches and cargo ports opening into a compartment in which Class 1 (explosive) materials are stowed must be kept closed except during loading and unloading of the compartment. After loading, hatches must be securely closed.

§176.184 Class 1 (explosive) materials of Compatibility Group L.
Class 1 (explosive) materials in compatibility group L may not be handled in a port area without the special permission of, and subject to any special precautions required by, the COTP.

§176.190 Departure of vessel.
When loading of Class 1 (explosive) materials is completed, the vessel must depart from the port area as soon as is reasonably practicable.

§176.192 Cargo handling equipment for freight containers carrying Class 1 (explosive) materials.
(a) Except in an emergency, only cargo handling equipment that has been specifically designed or modified for the handling of freight containers may be used to load, unload, or handle freight containers containing Division 1.1 or 1.2 (Class A and B explosive) materials.
(b) The gross weight of a freight container containing Class 1 (explosive) materials may not exceed the safe working load of the cargo handling equipment by which it is handled.

Magazine Vessels

§176.194 Stowage of Class 1 (explosive) materials on magazine vessels.
(a) *General. The requirements of this section are applicable to magazine vessels and are in addition to any other requirements in this subchapter.*

(b) Type vessel authorized. A single deck vessel with or without a house on deck is the only type vessel that may be used as a magazine vessel. A magazine vessel may not be moved while Class 1 (explosive) materials are on board.

(c) Location of explosives. Division 1.1, 1.2, or 1.3 (Class A and B explosive) materials, in excess of 2268 kg (5000 pounds), stored in any magazine vessel must be stowed below deck. No Class 1 (explosive) materials may be stowed on deck unless the vessel is fitted with a deck house having a stowage area which meets the requirements in this subpart for the stowage of Class 1 (explosive) materials. Detonators, detonator assemblies and boosters with detonators, Division 1.1 (Class A explosive) may not be stored on the same magazine vessel with other Division 1.1, 1.2. and 1.3 (Class A or B explosive) materials.

(d) Class 1 (explosive) materials storage spaces. Any compartment on a magazine vessel used for the stowage of Class 1 (explosive) materials must be completely sealed with wood so as to provide a smooth interior surface. Each metal stanchion in the compartment must be boxed in the same manner. An overhead ceiling is not required when the overdeck is weather tight. All nail and bolt heads must be countersunk and any exposed metal must be covered with wood.

(e) Initiating explosives, detonators and boosters with detonators. No explosive substance in Division 1.1, compatibility group A may be stowed in the same compartment with any other Class 1 (explosive) materials when there are explosive substances in Division 1.1 or 1.2 (Class A explosive) on the same magazine vessel. Detonators, detonator assemblies and boosters with detonators must be stowed at least 8 m (26 feet) from any bulkhead forming a boundary of a compartment containing any other Class 1 (explosive) materials.

(f) Dry storage spaces. A magazine vessel having a dry storage space capable of being used for any purpose whatsoever must have a cofferdam at least 61 cm (24 inches) wide fitted between the dry storage space and each adjacent compartment containing Class 1 (explosive) materials. The cofferdam must be constructed of wood or steel, formed by two tight athwartship bulkheads extending from the skin of the vessel to the overdeck. If the cofferdam extends to the weather deck. a watertight hatch must be fitted in the deck to provide access to the cofferdam.

(g) Lighting. Non-sparking, battery-powered, self-contained electric lanterns or non-sparking hand flashlights are the only means of artificial light authorized.

(h) Living quarters. Living quarters must be fitted on the inside with a non-combustible material approved by the Commandant, USCG. Bracketed ship's lamps are the only lighting fixtures authorized to be used in the living quarters. Any stove used for heating or cooking must be securely fastened and may not be mounted closer than 15 cm (5.9 inches) to the deck or sides of the house. Any smoke pipe for the stove which passes through the roof of the house must be kept at least 8 cm (3 inches) away from any woodwork. Each smoke pipe must be protected by a layer of non-combustible material approved by the Commandant, USCG, an air space of at least 2.54 cm (1 inch), and a metal collar of at least 1.5 mm (0.059 inch) sheet secured only on the weather side of the roof. There may be no opening from any living quarters into any stowage compartment.

(i) Storage of other hazardous materials. Magazine vessels having Class 1 (explosive) materials on board may not be used for the storage of any other hazardous material.

(j) Magazine vessel's stores. Hazardous materials used as stores on board any magazine vessel must comply with the requirements of 46 CFR part 147.

(k) Matches. Safety matches requiring a prepared surface for ignition are the only type of matches authorized to be possessed or used on board a magazine vessel. They must be kept in a metal box or can with a metal cover and stored in the custodian's living quarters.

(l) Firearms. Firearms and ammunition (other than cargo) are not permitted on board a magazine vessel.

(m) Fire extinguishing equipment. No Class 1 (explosive) materials may be loaded or stowed in, unloaded from, or handled on any magazine vessel unless four fire extinguishers that meet the requirements for Type A Size II or Type B Size III in 46 CFR part 95, subpart 95.50 are near and accessible to the magazines.

(n) Supervision. A magazine vessel containing Class 1 (explosive) materials must be continuously attended by a custodian employed for that purpose by the vessel's owner.

(o) Unauthorized persons on magazine vessels. The custodian of a magazine vessel shall prevent unauthorized persons from coming on board unless it is necessary to abate a hazard to human life or a substantial hazard to property.

(p) Repacking of Class 1 (explosive) materials on board. No Class 1 (explosive) materials may be repacked on board a magazine vessel. Broken or damaged packages must be handled in accordance with the requirements of §176.156. Packages requiring an emergency response must be handled in accordance with the emergency response information required under §172.602 of this subchapter.

(q) Work boat. Each magazine vessel must be equipped with a work boat.

(r) Life preservers. One approved personal flotation device must be available for each person employed on a magazine vessel.

(s) Fenders. Each magazine vessel must be fitted with fenders in sufficient number and size to prevent any vessel tieing up alongside from coming in contact with the hull.

[Amdt. 176-30, 55 FR 52696, Dec. 21, 1990, as amended by Amdt. 176-41, 61 FR 51339, Oct. 1, 1996]

Subpart H - Detailed Requirements for Class 2 (Compressed Gas) Materials

Source: Amdt. 176-30, 55 FR 52704, Dec. 21, 1990, unless otherwise noted.

§176.200 General stowage requirements.
(a) Each package of Class 2 (compressed gas) material being transported by vessel must be prevented from making direct contact with the vessel's deck, side, or bulwark by dunnage, shoring, or other effective means.
(b) When cylinders of Class 2 (compressed gas) materials being transported by vessel are stowed in a horizontal position, each tier must be stowed in the cantlines of the tier below it, and the valves on cylinders in adjacent tiers must be at alternate ends of the stow. Each tier may be stepped back and the ends alternated in order to clear the flange. Lashing must be provided to prevent any movement.
(c) When cylinders of Class 2 (compressed gas) materials being transported by vessel are stowed in a vertical position they must be stowed upright in a block and cribbed or boxed in with suitable dunnage. The box or crib must be dunnaged at least 10 cm (3.9 inches) off any metal deck. The cylinders in the box or crib must be braced to prevent any movement. The box or crib must be securely chocked and lashed to prevent any movement.
(d) Any package containing Division 2.3 (poison gas) materials must be stowed separate from all foodstuffs.
(e) Class 2 (compressed gas) materials may not be stowed "on deck" over a hold or compartment containing coal.
(f) Class 2 (compressed gas) material must be kept as cool as practicable and be stowed away from all sources of heat and ignition.

§176.205 Under deck stowage requirements.
(a) When a Class 2 (compressed gas) material is stowed below deck, it must be stowed in a mechanically ventilated cargo space with no source of artificial heat and clear of living quarters. No bulkhead or deck of that hold or compartment may be a common boundary with any boiler room, engine room, coal bunker, galley or boiler room uptake.
(b) When Division 2.1 (flammable gas) materials are stowed below deck, they must be stowed in a hold or compartment which complies with paragraph (a) of this section and the following requirements:
(1) Each hold or compartment must be ventilated.
(2) Each hold or compartment must be equipped with an overhead water sprinkler system or fixed fire extinguishing system.
(3) Each electrical power line in the hold or compartment must be protected by a strong metal covering to prevent crushing by cargo being stowed against it.
(4) Except when fitted with electrical fixtures of the explosion-proof type, each electrical circuit serving the hold or compartment must be disconnected from all sources of power. No circuit may be energized until the Division 2.1 (flammable gas) cargo and any vapors have been removed from the hold or compartment. Explosion-proof portable lighting may be used if the source of power is from electrical outlets outside the hold or compartment and above the weather deck.
(5) Any opening in a common bulkhead of an adjacent hold or compartment must be

securely closed off and made gas-tight, unless the adjacent hold or compartment is also used for the stowage of Division 2.1 (flammable gas) materials.
(6) Full and efficient hatch covers must be used. Tarpaulins, if fitted, must be protected by dunnaging before overstowing with any cargo. Each tarpaulin must be in one piece and free of rents, tears, and holes.
(7) A fire screen must be fitted at the weather end of each vent duct leading from the hold or compartment. The fire screen must completely cover the open area. It must consist of two layers of corrosion-resistant metal wire of 20x20 mesh or finer, spaced not less than 1 cm (0.4 inch) or more than 4 cm (1.6 inches) apart. The screen may be removable if means for securing it in place when in service are provided.
(8) The hold or compartment may not be fitted with any gooseneck type vent trunk head.
(9) Any electrical apparatus located in the hold or compartment must be capable of being disconnected from its power source by a positive means located outside the hold or compartment.

[Amdt. 176-30, 55 FR 52704, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.210 On deck stowage requirements.

Cylinders of Class 2 (compressed gas) materials being transported by vessel must be protected from radiant heat which, including the direct rays of the sun by structural erections or awnings. A tarpaulin covering the cylinders is not acceptable if it comes in contact with them.

§176.220 Smoking or open flame and posting of warning signs.

(a) Smoking or the use of open flame is prohibited in any hold or compartment containing a Division 2.1 (flammable gas) material, near any Division 2.1 (flammable gas) material stowed on deck, or near any ventilator leading to a hold containing this material.
(b) A sign carrying the legend:

176.220
FLAMMABLE VAPORS
KEEP LIGHTS AND FIRE AWAY
NO SMOKING

must be conspicuously posted at each approach to an "on deck" Division 2.1 (flammable gas) material stowage area and near each cargo hold ventilator leading to a hold containing this material. The sign must be painted on a white background using red letters. The letters may not be less than 8 cm (3 inches) high.

§176.225 Stowage of chlorine.

Chlorine (UN 1017) must be stowed separate from copper or brass leaf sheets and from finely divided organic material.

§176.230 Stowage of Division 2.1 (flammable gas) materials.

Division 2.1 (flammable gas) materials transported in Specification 106A or 110A multi-unit car tanks must be stowed on deck only, and must be shaded from radiant heat.

Subpart I - Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials

Source: Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, unless otherwise noted.

§176.305 General stowage requirements.

(a) A Class 3 (flammable) or combustible liquid must be kept as cool as reasonably practicable and be stowed away from all sources of heat and ignition.
(b) Except as otherwise provided in §176.76(g), a package containing a Class 3 (flammable) liquid and equipped with a vent or safety relief device must be stowed "on deck" only.
(c) The following requirements apply to each hold or compartment in which any Class 3 (flammable) or combustible liquids are being transported:
(1) The hold or compartment must be ventilated except that the stowage of non-bulk packages of Class 3 (flammable) liquids with a flash point above 23^{o}C (73^{o}F) (see 49 CFR 171.8 definitions) may be in non-ventilated holds.
(2) Stowage of a Class 3 (flammable) or combustible liquid within 6 m (20 feet) of a bulkhead which forms a boundary or deck of a boiler room, engine room, coal bunker, galley, or boiler room uptake is not permitted. If the amount of the liquid to be stowed in a hold will not permit compliance with the requirement for a 6 m (20 foot) separation,

less separation distance is authorized if at least one of the following conditions exists:
(i) The bulkhead or deck is covered with at least 8 cm (3 inches) of insulation on the entire area subject to heat;
(ii) A temporary wooden bulkhead at least 5 cm (2 inches) thick is constructed in the hold at least 8 cm (3 inches) off an engine room or 15 cm (5.9 inches) off a boiler room bulkhead, covering the entire area of the bulkhead that is subject to heat, and the space between the permanent bulkhead and the temporary wooden bulkhead is filled with mineral wool or equivalent bulk noncombustible insulating material; or
(iii) A temporary wooden bulkhead is constructed of at least 2.5 cm (1 inch) thick tongue and groove sheathing, located 1 m (3 feet) from the boiler room or engine room bulkhead, and filled with sand to a height of 2 m (7 feet) above the tank top, or, if the cargo compartment is located between decks, 1 m (3 feet) of sand.
(3) Combustible liquids may not be stowed in a hold within 6 m (20 feet) of a common bulkhead with the engine room unless the means of vessel propulsion is internal combustion engines.
(4) Each cargo opening in a bulkhead of an adjacent hold must be securely closed off and made gas-tight, unless the adjacent hold is also used for the stowage of a Class 3 (flammable) or combustible liquid.
(d) In addition to the requirements specified in paragraph (b) of this section, the following requirements apply to each hold or compartment in which a Class 3 (flammable) liquid is transported:
(1) Full and effective hatch covers must be used. Tarpaulins, if fitted, must be protected by dunnaging before overstowing with any cargo. Each tarpaulin must be in one piece and free of rents, tears, and holes;
(2) If Class 3 (flammable) liquids in excess of 1016 kg (2240 pounds) are stowed under deck in any one hold or compartment, a fire screen must be fitted at the weather end of each vent duct leading from that hold or compartment. The fire screen must completely cover the open area. It must consist of two layers of corrosion-resistant metal wire of 20x20 mesh or finer, spaced not less than 1 cm (0.4 inch) or more than 4 cm (1.6 inches) apart. The screen may be removable only if means for securing it in place when in service are provided;
(3) Each electrical power line in the hold or compartment must be protected by a strong metal covering to prevent crushing by cargo being stowed against it;
(4) Except when fitted with explosion-proof type electrical fixtures, each electrical circuit serving the hold or compartment must be disconnected from all sources of power from a point outside the hold or compartment containing flammable liquids. No circuit may be energized until the flammable liquids and any vapors have been removed from the hold or compartment. Explosion-proof type portable lighting may be used if the source of power is from electrical outlets outside the hold or compartment and above the weather deck; and
(5) A Class 3 (flammable) liquid in excess of 1016 kg (2240 pounds) may not be transported in any hold or compartment that is fitted with a gooseneck type of vent head.
(e) On a passenger vessel, each hold or compartment used to transport a Class 3

(flammable) liquid must be equipped with an overhead water sprinkler system or fixed fire-extinguishing system.
(f) On a passenger vessel, each hold or compartment used to transport Class 3 (flammable) liquids under a passenger space must have an overdeck of an A-60 type construction (see 46 CFR 72.05-10(c)(1)) or equivalent or have its underside covered with at least 8 cm (3 inches) of noncombustible insulation.
(g) No Class 3 (flammable) liquid in a drum or wooden case, having inside packagings of more than 1 L (0.3 gallon) capacity each, may be stowed as a beam filler. A wooden barrel, a wooden box or a fiberboard box, with any Class 3 (flammable) liquid material in inside packagings of not more than 1 L (0.3 gallon) capacity each, may only be stowed as a beam filler if it is possible to stow and observe any "THIS SIDE UP" marking.

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.315 Fire protection requirements.

(a) For each 79,500 liters (21,000 U.S. gallons) or part thereof of any Class 3 (flammable) or combustible liquid being transported on board a vessel in a portable tank, rail tank car, or a motor vehicle cargo tank, there must be provided at least one B-V semiportable foam (152 liter/40 gallon capacity) (see 46 CFR 95.50), dry chemical (45.4 kg (100 pounds) minimum capacity) or equivalent fire extinguisher, or a fire hose fitted with an approved portable mechanical foam nozzle with pick-up tube and two 19 liter (5 gallon) cans of foam liquid concentrate. Each foam system must be suitable for use with each Class 3 (flammable) or combustible liquid for which it is required. Each fire extinguisher must be accessible to the tank it is intended to cover.

(b) The fire hose at each fire hydrant in the vicinity of Class 3 (flammable) and combustible liquids stowage areas must be fitted with an approved combination solid stream and water spray nozzle.

(c) The pressure must be maintained in the vessel's fire mains during the loading and unloading of any Class 3 (flammable) or combustible liquids.

(d) Two 7 kg (15-pound) capacity hand portable dry chemical or two portable 10 L (2.6 gallons) foam-type extinguishers must be accessible to any packaged Class 3 (flammable) or combustible liquid and suitable for use with the lading.

(e) The requirements of this section do not apply to portable tanks and their contents authorized under 46 CFR part 98 or 46 CFR part 64.

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991]

§176.320 Use of hand flashlights.

Each hand flashlight used on deck near or in any hold or compartment containing a Class 3 (flammable) liquid, must be suitable for use in hazardous locations where fire or explosion hazards may exist.

§176.325 Smoking or open flame and posting of warning signs.
(a) Smoking or the use of open flame is prohibited in any hold or compartment containing a Class 3 (flammable) or combustible liquid, near any Class 3 (flammable) or combustible liquid stowed on deck, or near any ventilator leading to a hold containing such material.
(b) A sign carrying the legend:

176.325
FLAMMABLE VAPORS
KEEP LIGHTS AND FIRE AWAY
NO SMOKING

must be conspicuously posted at each approach to a Class 3 (flammable) or combustible liquid stowed "on deck" and near each cargo hold ventilator leading to a hold or compartment containing this material. This sign must be painted on a white background using red letters. The letters may not be less than 8 cm (3 inches) high.

§176.340 Combustible liquids in portable tanks.
Combustible liquids, having a flash point of 38°C (100°F) or higher, may be transported by vessel only in one of the portable tanks as specified below:
(a) Portable tanks authorized in §173.241 of this subchapter.
(b) In nonspecification portable tanks, subject to the following conditions:
(1) Each portable tank must conform to a DOT specification 57 portable tank, except as otherwise provided in this paragraph;
(2) The rated capacity of the tank may not exceed 4,542 liters (1,200 gallons), and the rated gross weight may not exceed 13,608 kg (30,000 pounds);
(3) The vibration test need not be performed;
(4) When the total surface area of the tank exceeds 14.9 square meters (160 square feet), the total emergency venting capacity must be determined in accordance with table I in §178.345-10 of this subchapter;
(5) In place of a specification identification marking, the tank must be marked, on two sides in letters at least 5 cm (2 inches) high on contrasting background: "FOR

COMBUSTIBLE LIQUIDS ONLY" and "49 CFR 176.340". This latter marking constitutes certification by the person offering the combustible liquid materials for transportation that the portable tank conforms to this paragraph;

(6) Each tank must be made of steel;

(7) The design pressure of the tank must be not less than 62 kPa (9 psi);

(8) No pressure relief device may open at less than 34.4 kPa (5 psi);

(9) Each tank must be retested and marked at least once every 2 years in accordance with the requirements applicable to a DOT specification 57 portable tank in §173.32(e) (2), (3), and (4) of this subchapter; and

(10) Each tank must conform to the provisions of §173.24 of this subchapter and paragraphs (g), (h), (i), and (k) of §173.32 of this subchapter.

(c) Portable tanks approved by the Commandant, USCG (G-MSO).

[Amdt. 176-30, 55 FR 52705, Dec. 21, 1990, as amended by Amdt. 176-41, 61 FR 51339, Oct. 1, 1996; 62 FR 51561, Oct. 1, 1997]

Subpart J - Detailed Requirements for Class 4 (Flammable Solids), Class 5 (Oxidizers and Organic Peroxides), and Division 1.5 (Blasting Agents) Materials

Source: Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, unless otherwise noted.

§176.400 Stowage of Division 1.5 (blasting agents), Class 4 (flammable solids) and Class 5 (oxidizers and organic peroxides) materials.

(a) Class 4 (flammable solid) material and Division 5.2 (organic peroxide) material must be kept as cool as reasonably practicable and be stowed away from all sources of heat and ignition.

(b) Division 5.2 (organic peroxide) material must be stowed away from living quarters or access to them. Division 5.2 (organic peroxide) material not requiring temperature control should be protected from radiant heat, which includes direct rays of the sun, and stowed in a cool, well-ventilated area.

(c) No Division 1.5 (blasting agents) or Class 5 (oxidizers and organic peroxides) material being transported by vessel may be stowed in the same hold or compartment with any readily combustible material such as a combustible liquid, a textile product, or with a finely divided substance, such as an organic powder.

(d) No Division 1.5 (blasting agents) or Class 5 (oxidizers and organic peroxides) material being transported by vessel may be stowed in a hold or compartment containing sulfur in bulk, or in any hold or compartment above, below, or adjacent to one containing sulfur in bulk.

§176.405 Stowage of charcoal.

(a) Before stowing charcoal Division 4.2 (flammable solid), UN 1361, NA 1361, or UN 1362 on a vessel for transportation, the hold or compartment in which it is to be stowed must be swept as clean as practicable. All residue of any former cargo, including especially a petroleum product, a vegetable or animal oil, nitrate, or sulfur, must be removed.

(b) Charcoal packed in bags and offered for transportation on board a vessel in a quantity over 1016 kg (2240 pounds) must be loaded so that the bags are laid horizontally and stacked with space for efficient air circulation. If the bags are not compactly filled and closed to avoid free space within, vertical and horizontal dunnage strips must be laid between the bags. Space for ventilating must be maintained near bulkheads, the shell of the vessel, the deck, and the overhead. No more than 40,600 kg (89,508 pounds) of charcoal may be stowed in a hold or compartment when other stowage space is available. If the unavailability of hold or compartment space requires the stowage of a larger amount, the arrangement of the stow for ventilation must be adjusted to ensure a sufficient venting effect.

(c) Any loose material from bags broken during loading must be removed. Broken bags may be repacked or have the closures repaired and the repaired bags restowed.

(d) Charcoal "screenings" packed in bags must be stowed to provide spaces for air circulation between tiers regardless of the quantity stowed.

§176.410 Division 1.5 (blasting agents) materials, ammonium nitrate and ammonium nitrate mixtures.

(a) This section prescribes requirements to be observed with respect to transportation of each of the following hazardous materials by vessel:

(1) Explosives, blasting, type E, and Explosives, blasting, type B, Division 1.5 (blasting agent) compatibility group D, UN 0331 and UN 0332.

(2) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 1942.

(3) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2068.

(4) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2067.

(5) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2069 or UN 2072.

(6) Ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN 2070.

(b) This section does not apply to Ammonium nitrate fertilizer, Class 9, UN 2071 or to any non-acidic ammonium nitrate mixed fertilizer containing 13 percent or less ammonium nitrate, less than 5 percent organic material, and no other oxidizing material, and which does not meet the criteria for any other hazard set forth in part 173 of this subchapter.

(c) When Division 1.5 (blasting agents) compatibility group D materials, ammonium nitrate, or any of the ammonium nitrate fertilizers listed in paragraph (a) of this section

are transported by vessel:
(1) They must be stowed well away from any steam pipe, electric circuit, or other source of heat;
(2) Smoking is prohibited except in designated areas away from the material and "No-Smoking" signs must be posted in accordance with §176.60;
(3) Fire hoses must be connected, laid out, and tested before loading or unloading commences; and
(4) A fire watch must be posted in the hold or compartment where the material is being loaded or unloaded.
(d) When any of the hazardous materials listed in paragraph (a) of this section is transported in bags by vessel:
(1) The requirements specified in paragraph (c) of this section must be complied with;
(2) The temperature of the bagged material may not exceed 54 ^{o}C (130 ^{o}F);
(3) Minimum dunnage and sweatboards must be used to prevent any friction or abrasion of bags, and to allow for the circulation of air and access of water in the event of fire;
(4) The bags must be stowed from side to side, out to the sweatboards;
(5) A space of 46 cm (18 inches) must be provided between any transverse bulkhead and the bags;
(6) The bags must be stowed so as to provide a 46 cm (18 inch) athwartship trench along the centerline of the compartment, continuous from top to bottom;
(7) The bags must be stowed so as to provide a 46 cm (18 inch) amidship trench running fore and aft from bulkhead to bulkhead;
(8) The bags may not be stowed less than 46 cm (18 inches) from any overhead deck beam;
(9) The bags must be stowed so as to provide vent flues 36 cm (14 inches) square at each corner of the hatch continuous from top to bottom;
(10) Trenching must be accomplished by alternating the direction of the bags in each tier (bulkheading); and
(11) The bags must be blocked and braced as necessary to prevent shifting of the bagged cargo adjacent to any trench area.
(e) Notwithstanding §176.83(b) of this part, ammonium nitrate and ammonium nitrate fertilizers classed as Division 5.1 (oxidizers) materials, may be stowed in the same hold, compartment, magazine, or freight container with Class 1 materials (explosive), except those containing chlorates, in accordance with the segregation and separation requirements of §176.144 of this part applying to Explosives, blasting, type B, and Explosives, blasting, type E, Division 1.5 compatibility group D.
(f) No mixture containing ammonium nitrate and any ingredient which would accelerate the decomposition of ammonium nitrate under conditions incident to transportation may be transported by vessel.

[Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-34, 58 FR 51533, Oct. 1, 1993; Amdt. 176-38, 60 FR 49111, Sept. 21, 1995]

§176.415 Permit requirements for Division 1.5 (blasting agents), ammonium nitrates, and certain ammonium nitrate fertilizers.

(a) Except as provided in paragraph (b) of this section, before any of the following material is loaded on or unloaded from a vessel at any waterfront facility, the owner/operator must obtain written permission from the nearest COTP:

(1) Ammonium nitrate UN 1942, ammonium nitrate fertilizers containing more than 60 percent ammonium nitrate, ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 2070, or Division 1.5 (blasting agent) compatibility group D materials packaged in a paper bag, burlap bag, or other nonrigid combustible packaging, or any rigid packaging with combustible inside packagings.

(2) Any other ammonium nitrate or ammonium nitrate fertilizer not listed in §176.410 (a) or (b) except ammonium nitrate fertilizer, Class 9, UN 2071.

(b) Any of the following may be loaded on or unloaded from a vessel at any waterfront facility without a permit:

(1) Ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 1942, in a rigid packaging with noncombustible inside packaging.

(2) Ammonium nitrate fertilizer, Division 5.1 (oxidizer) UN 2067, if the nearest COTP is notified at least 24 hours in advance of any loading or unloading in excess of 454 kg (1,000 pounds).

(3) Ammonium nitrate fertilizer, n.o.s., Division 5.1 (oxidizer) UN 2072, containing 40 percent or more fine calcium carbonate or dolomite.

(4) Non-acidic ammonium nitrate fertilizer, n.o.s., Division 5.1 (oxidizer) UN 2072, containing less than 5 percent organic material and 60 percent or less ammonium nitrate.

(5) Division 1.5 (blasting agents) compatibility group D material in a rigid packaging with non-combustible inside packaging.

(6) Ammonium nitrate fertilizer, Class 9, UN 2071.

(c) Before a permit may be issued, the following requirements must be met in addition to any others the COTP may impose:

(1) If the material is ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070; or Explosives, blasting, type E, Division 1.5 (blasting agents) compatibility group D, UN0332 in combustible packaging or in a rigid packaging with combustible inside packaging, it must be loaded or unloaded at a facility remote from populous areas or high value or high hazard industrial facilities so that in the event of fire or explosion loss of lives and property may be minimized;

(2) If the material is an ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070, containing more than 60 percent ammonium nitrate; or ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070 in rigid packagings with combustible inside packagings, it must be loaded or unloaded at a facility removed from congested areas or high value or high hazard industrial facilities;

(3) Each facility at which the material is to be loaded or unloaded must conform with

the requirements of the port security and local regulations and must have an abundance of water readily available for fire fighting;

(4) Each facility at which the material is to be loaded or unloaded must be located so that each vessel to be loaded or unloaded has an unrestricted passage to open water. Each vessel must be moored bow to seaward, and must be maintained in a mobile status during loading, unloading, or handling operations by the presence of tugs or the readiness of engines. Each vessel must have two wire towing hawsers, each having an eye spice, lowered to the water's edge, one at the bow and the other at the stern; and

(5) If the material is ammonium nitrate fertilizer, Division 5.1 (oxidizer), UN2070; an ammonium nitrate fertilizer, Division 5.1 (oxidizer) containing more than 60 percent ammonium nitrate; or a Division 1.5 (blasting agents) compatibility group D material in non-rigid combustible packaging and loaded in freight containers or transport vehicles, it may be loaded or unloaded at a non-isolated facility provided that facility is approved by the COTP.

[Amdt. 176-30, 55 FR 52706, Dec. 21, 1990, as amended at 56 FR 66282, Dec. 20, 1991; Amdt. 176-35, 59 FR 49134, Sept. 26, 1994]

Subpart K - [Reserved]

Subpart L - Detailed Requirements for Division 2.3 (Poisonous Gas) and Division 6.1 (Poisonous) Materials

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.600 General stowage requirements.

(a) Each package required to have a POISON GAS, POISON INHALATION HAZARD, or POISON label, being transported on a vessel, must be stowed clear of living quarters and any ventilation ducts serving living quarters and separated from foodstuffs, except when the hazardous materials and the foodstuffs are in different closed transport units.
(b) Each package required to have both a POISON GAS label and a FLAMMABLE GAS label thereon must be segregated as a Division 2.1 (flammable gas) material.
(c) Each package bearing a POISON label displaying the text "PG III" or bearing a "PG III" mark adjacent to the poison label must be stowed away from foodstuffs.
(d) Each package of Division 2.3 (poisonous gas) material or Division 6.1 (poison)

material which also bears a FLAMMABLE LIQUID or FLAMMABLE GAS label must be stowed in a mechanically ventilated space, kept as cool as reasonably practicable, and be stowed away from all sources of heat and ignition.

[Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, as amended at 57 FR 45465, Oct. 1, 1992; Amdt. 176-35, 59 FR 49134, Sept. 26, 1994; Amdt. 176-42, 62 FR 1236, Jan. 8, 1997; 64 FR 10782, Mar. 5, 1999]

§176.605 Care following leakage or sifting of Division 2.3 (poisonous gas) and Division 6.1 (poisonous) materials.

A hold or compartment containing a package of a Division 2.3 (poisonous gas) or Division 6.1 (poisonous) material which has leaked or sifted must be thoroughly cleaned and decontaminated after the cargo is unloaded and before the hold or compartment is used for the stowage of any other cargo.

Subpart M - Detailed Requirements for Radioactive Materials

Source: Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, unless otherwise noted.

§176.700 General stowage requirements.

(a) [Reserved]

(b) A package of radioactive materials which in still air has a surface temperature more than 5 ^{o}C (9 ^{o}F) above the ambient air may not be overstowed with any other cargo. If the package is stowed under deck, the hold or compartment in which it is stowed must be ventilated.

(c) Each fissile material, controlled shipment must be stowed in a separate hold, compartment, or defined deck area and be separated by a distance of at least six meters (20 feet) from all other RADIOACTIVE YELLOW-II or YELLOW-III labeled packages.

(d) For a shipment of radioactive materials requiring supplemental operational procedures, the shipper must furnish the master or person in charge of the vessel a copy of the necessary operational instructions.

(e) A person may not remain unnecessarily in a hold, or compartment, or in the immediate vicinity of any package on deck, containing radioactive materials.

(The information collection requirements in paragraph (d) were approved by the Office of Management and Budget under control numbers 2137-0534, 2137-0535 and 2137-0536)

[Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, as amended by Amdt. 176-15, 48 FR 31220, July 7, 1983; Amdt. 176-23, 50 FR 41523, Oct. 11, 1985; Amdt. 176-37, 60 FR 50333, Sept. 28, 1995]

§176.704 Requirements relating to transport indexes.

(a) The sum of the transport indexes for all packages of Class 7 (radioactive) materials on board a vessel may not exceed the limits specified in table III.

(b) For packages in freight containers, the radiation level may not exceed 2 mSv per hour (200 mrem per hour) at any point on the surface and 0.1 mSv per hour (10 mrem per hour) at two meters (6.6 feet) from the outside surface of the freight container.

(c) The limitations specified in table III do not apply to consignments of LSA materials if the packages are marked "RADIOACTIVE LSA" and no fissile Class 7 (radioactive) materials are included in the shipment.

(d) Each group of fissile packages must be separated from other Class 7 (radioactive) material by a distance of at least six meters (20 feet) at all times.

(e) The limitations specified in paragraphs (a) through (c) of this section do not apply when the entire vessel is reserved or chartered for use by a single offeror under exclusive use conditions if-

(1) The number of fissile packages of Class 7 (radioactive) materials aboard the vessel does not exceed the amount authorized in §§173.457 and 173.459 of this subchapter; and

(2) The entire shipment operation is approved by the Associate Administrator for Hazardous Materials Safety in advance.

(f) Table III is as follows:

Table III-TI Limits for Freight Containers and Conveyances

Type of freight container or conveyance	Limit on total sum of transport indexes in a single freight container or aboard a conveyance			
-	Not under exclusive use		Under exclusive use	
-	Non-fissile material	Fissile material	Non-fissile material	Fissile material
Freight container-Small	50	50	N/A	N/A.
Freight container-Large	50	50	No limit	100[b].
Vessel[c]:	-	-	-	-
1. Hold, compartment or defined deck area:	-	-	-	-
Packages, overpacks, small freight containers	50	50	No limit	100[b].
Large freight containers	200[d]	50	No limit	100[b].
2. Total vessel:	-	-	-	-
Packages, etc.	200[d]	200[d]	No limit[e].	200[e].

Large freight containers	No limit[d]	No limit[d]	No limit	No limit[d].

[a]Provided that transport is direct from the consignor to the consignee without any intermediate in-transit storage, where the total TI exceed 50.

[b]In cases in which the total TI is greater than 50, the consignment must be so handled and stowed so that it is always separated from any package, overpack, portable tank or freight container carrying Class 7 (radioactive) materials by at least 6 meters (20 feet).

[c]For vessels the requirements given in 1 and 2 must be fulfilled.

[d]Provided that the packages, overpacks, portable tanks or freight containers, as applicable, are stowed so that the total sum of the TI's in any group does not exceed 50, and that each group is handled and stowed so that the groups are separate from each other by at least 6 meters (20 feet).

[e]Packages or overpacks carried in or on a transport vehicle which are offered for transport under the provisions of §173.441(b) of this subchapter may be transported by vessel provided that they are not removed from the vehicle at anytime while on board the vessel.

[Amdt. 176-37, 60 FR 50333, Sept. 28, 1995, as amended by 176-37, 61 FR 20753, May 8, 1996; 63 FR 52850, Oct. 1, 1998]

§176.708 Segregation distance table.

(a) Table IV applies to the stowage of packages of Class 7 (radioactive) materials on board a vessel with regard to transport index numbers which are shown on the labels of individual packages.

(b) RADIOACTIVE YELLOW-II or YELLOW-III labeled packages may not be stowed any closer to living accommodations, regularly occupied working spaces, spaces that may be continually occupied by any person (except those spaces exclusively reserved for couriers specifically authorized to accompany such packages), or undeveloped film than the distances specified in TABLE IV.

(c) Where only one consignment of a Class 7 (radioactive) material is to be loaded on board a vessel under exclusive use conditions, the appropriate segregation distance may be established by demonstrating that the direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 7.5 microsieverts per hour (0.75 mrem per hour).

(d) More than one consignment may be loaded on board a vessel with the appropriate segregation distance established by demonstrating that direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 7.5 microSieverts per hour (0.75 mrem per hour), provided that:

(1) The vessel has been chartered for the exclusive use of a competent person specialized in the carriage of Class 7 (radioactive) material; and

(2) Stowage arrangements have been predetermined for the entire voyage, including

any Class 7 (radioactive) material to be loaded at ports of call enroute.

(e) The radiation level must be measured by a responsible person skilled in the use of monitoring instruments.

(f) Table IV is as follows:

Table IV

Sum of transport indexes of the packages	Minimum distance in feet from living accommodation or regularly occupied working space		Minimum distance in feet from undeveloped film and plates																							
-			1 day voyage			2 day voyage			4 day voyage			10 day voyage			20 day voyage			30 day voyage			40 day voyage			50 day voyage		
-	-	-																								-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(25)Cargo thickness in feet (unit density)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	Nil	3	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6	Nil	3	6
0.1 to 0.5	5	X	6	X	X	8	X	X	11	X	X	17	4	X	25	6	X	30	7	X	35	8	X	39	9	X
0.6 to 1	6	X	8	X	X	11	X	X	16	4	X	25	6	X	35	8	X	42	10	X	50	12	X	55	13	X
1.1 to 2	9	X	11	X	X	16	4	X	22	5	X	35	8	X	50	12	X	61	14	X	70	17	X	78	19	X
2.1 to 3	10	X	14	X	X	19	5	X	27	6	X	42	10	X	61	14	X	74	18	X	86	20	X	96	23	X
3.1 to 5	13	X	17	4	X	25	6	X	35	8	X	55	13	X	78	19	X	96	23	X	110	26	X	124	29	7
5.1 to 10	19	4	25	6	X	35	8	X	50	12	X	78	19	X	110	26	X	135	33	8	155	37	9	175	42	10
10.1 to 20	26	6	35	8	X	50	12	X	69	17	X	110	26	X	155	37	9	190	46	11	220	53	13	250	59	14
20.1 to 30	32	8	43	10	X	61	14	X	85	20	X	135	32	8	190	45	11	235	56	13	270	65	16	305	72	17
30.1 to 50	42	10	55	13	X	78	19	X	110	26	X	175	42	10	245	58	14	300	73	17	350	84	20	390	94	22
50.1 to 100	59	14	78	19	X	110	26	X	155	37	9	245	59	14	350	82	20	430	105	24	515	118	28	550	130	32
100.1 to 150	72	17	96	23	X	135	32	8	190	46	11	300	72	17	425	100	24	525	125	30	600	145	35	([7])	165	39
150.1 to 200	84	20	110	26	X	155	37	9	200	53	13	350	84	20	490	115	28	600	140	35	([7])	165	40	([7])	190	45
200.1 to 300	105	24	135	32	X	190	46	11	270	64	15	425	105	25	600	145	35	([7])	180	42	([7])	205	49	([7])	230	55
300.1 to 400	120	28	160	37	9	220	53	13	310	75	18	500	120	28	([7])	165	40	([7])	205	49	([7])	235	57	([7])	265	63

Note:

(1) X-indicates that thickness of screening cargo is sufficient without any additional segregation distance.

(2) By using 6 feet of intervening unit density cargo for persons and 10 feet for film and plates, no distance shielding is necessary for any length of voyage specified.

(3) Using 1 steel bulkhead or steel deck-multiply segregation distance by 0.8. Using 2 steel bulkheads or steel decks-multiply segregation distance by 0.64.

(4) "Cargo of Unit Density" means cargo stowed at a density of 1 ton (long) per 36 cubic feet; where the density is less than this the depth of cargo specified must be increased in proportion.

(5) "Minimum distance" means the least in any direction whether vertical or horizontal from the outer surface of the nearest package.

(6) The total consignment on board at any time must not exceed transport indexes totalling 200 except if carried under the provisions of §176.704(f). The figures below the double line of the table should be used in such a contingency.

(7) Not to be carried unless screening by other cargo and bulkheads can be arranged in accordance with the other columns.

[Amdt. 176-15, 48 FR 10245, Mar. 10, 1983, as amended by Amdt. 176-37, 60 FR 50334, Sept. 28, 1995]

§176.710 Care following leakage or sifting of radioactive materials.

(a) In case of fire, collision, or breakage involving any shipment of radioactive materials, other than materials of low specific activity, the radioactive materials must be segregated from unnecessary contact with personnel. In case of obvious leakage, or if the inside container appears to be damaged, the stowage area (hold, compartment, or deck area) containing this cargo must be isolated as much as possible to prevent radioactive material from entering any person's body through contact, inhalation, or ingestion. No person may handle the material or remain in the vicinity unless supervised by a qualified person.

(b) A hold or compartment in which leakage of radioactive materials has occurred may not be used for other cargo until it is decontaminated in accordance with the requirements of §176.715.

(c) For reporting requirements, see §171.15 of this subchapter.

§176.715 Contamination control.

Each hold, compartment, or deck area used for the transportation of low specific activity or surface contaminated object Class 7 (radioactive) materials under exclusive use conditions must be surveyed with appropriate radiation detection instruments after each use. Such holds, compartments, and deck areas may not be used again until the radiation dose rate at every accessible surface is less than 5 microSieverts per hour

(0.5 mrem per hour), and the removable (non-fixed) radioactive surface contamination is not greater than the limits prescribed in §173.443 of this subchapter.

[Amdt. 176-37, 60 FR 50334, Sept. 28, 1995]

Subpart N - Detailed Requirements for Class 8 (Corrosive Materials) Materials

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.800 General stowage requirements.

(a) Each package required to have a Class 8 (corrosive) label thereon being transported on a vessel must be stowed clear of living quarters, and away from foodstuffs and cargo of an organic nature.
(b) A package of Class 8 (corrosive material) material may not be stowed over any readily combustible material.
(c) Glass carboys containing Class 8 (corrosive material) material may not be stowed on board any vessel, other than a barge, more than two tiers high unless each carboy is boxed or crated with neck protection extending to the sides of the carboy box. This protective construction must be strong enough to permit stacking one on top of the other.
(d) A Class 8 (corrosive material) material may not be stowed over a hold or compartment containing cotton unless the deck is of steel and the hatch is fitted with a tight coaming. In addition, the deck must be tight against leakage and the Class 8 (corrosive material) material may not be stowed over the square of the hatch.
(e) Each package of Class 8 (corrosive material) which also bears a FLAMMABLE LIQUID label must be stowed away from all sources of heat and ignition.

[Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, as amended by Amdt. 176-39, 61 FR 18933, Apr. 29, 1996]

§176.805 On deck stowage.

When break bulk Class 8 (corrosive materials) materials being transported on a vessel are stowed on deck:

(a) Provisions must be made for leakage from any package to drain away from other cargo into an overboard scupper or freeing port. The drainage may not enter an enclosed drainage system other than a direct overboard scupper. If this stowage is not practical, sufficient clean dry sand must be placed under and around the lower tier of packages to absorb any leakage.

(b) Dunnage must be provided on the deck and arranged so that any leakage will be apparent.

(c) Any leakage that occurs must be washed down, using liberal quantities of water.

Subpart O - Detailed Requirements for Cotton and Vegetable Fibers, Motor Vehicles, and Asbestos

Source: Amdt. 176-30, 55 FR 52708, Dec. 21, 1990, unless otherwise noted.

§176.900 Packaging and stowage of cotton and vegetable fibers; general.

(a) Cotton, Class 9, NA 1365, Cotton, wet, Division 4.2, UN 1365, and other vegetable fibers, Division 4.1, being transported on a vessel must be securely baled and bound. Each bale of cotton or vegetable fibers must be covered with bagging on at least three-fourths of its surface, including both ends. Cut cotton linters may be accepted for transportation by vessel when baled and covered with bagging on the soft sides only if the bale is compressed to a density of at least 512 kg/m^3 (32 pounds per cubic foot) and it is bound with at least six bands per bale. Any poorly compressed bale or any bale having damaged bindings may not be transported by vessel.

(b) Each bale of Cotton, wet, Division 4.2, UN 1365 must be stowed separately from any bales of dry cotton or vegetable fibers, in a 'tween deck space, and not overstowed. Any bale of cotton or vegetable fibers which is saturated with water may not be transported by vessel.

(c) Bales of cotton or vegetable fibers showing contact with oil or grease may not be accepted for transportation by vessel.

(d) Cotton or vegetable fibers must be stowed in a hold or compartment in accordance with the following requirements:

(1) All traces of oil or residue in the hold or compartment must be removed;

(2) A recently painted hold or compartment may not be used unless it is thoroughly dry;

(3) Each ventilation cowl serving the hold or compartment must be fitted with a spark screen;

(4) When a bulkhead of the hold or compartment is common with a boiler room, engine room, coal bunker, or galley and subjected to heat, a wooden bulkhead must be erected between the bulkhead and any cotton or vegetable fibers. This wooden bulkhead must be at least 15 cm (6 inches) from a boiler room bulkhead, and at least 5 cm (2 inches) from an engine room, coal bunker, or galley bulkhead;

(5) Each 'tween deck hatch must be closed with hatch covers, tarpaulins, and dunnage;

however, metal hatch covers which are sealed by other means to provide equivalent protection may be used;
(6) Each hold or compartment must be equipped with a carbon dioxide or overhead water sprinkler system or other approved fixed extinguishing system. Before loading, the extinguishing system must be examined to ensure that it is in good working condition; and
(7) Each hold or compartment must be clear of all debris and swept as clean as practicable before loading.
(e) Naked lights or any fire likely to produce sparks are not permitted on the vessel, dock area, or on any lighters alongside a vessel during loading or unloading of cotton or vegetable fibers.
(f) Upon completion of stowage, each opening must be completely closed. Where required, tarpaulins must be fitted and secured in place to provide a tight hold. During a period of temporary stoppage of loading or unloading, a hatch may be left open. However, during that period, a fire watch, designated by the master or officer-in-charge, must be stationed in the hold or compartment in which the cotton or vegetable fibers are stowed.
(g) At least one fire hose must be connected while cotton or vegetable fibers are being loaded or unloaded. Each fire pump must be operated before any loading or unloading. Pressure must be maintained on each fire main during the loading and the fire hose laid out ready for immediate use. Portable fire extinguishers must be placed to be readily available. The fire hose, fire pumps, and fire extinguishers may be the vessel's equipment or shore equipment.
(h) Smoking is not permitted on a vessel during the loading or unloading of cotton or vegetable fibers except at those times and in those places designated by the master. "NO SMOKING" signs must be conspicuously posted in appropriate places, and the responsible person in charge of the loading or unloading (see §176.57 of this part) must ensure that they are observed.
(i) Cotton or vegetable fibers may be stowed in the same hold over bulk sulfur if the sulfur has been trimmed and leveled and the hold is thoroughly cleaned of sulfur dust. A tight floor of two layers of 2.54 cm (1 inch) crossed clean dunnage boards must be laid on the sulfur before cotton or vegetable fibers are stowed. These substances may be stowed alongside each other in the same hold if they are separated by a tight dustproof wood bulkhead.
(j) Cotton or vegetable fibers may not be stowed in a 'tween deck hold over bulk sulfur in a lower hold unless the 'tween deck hold has been thoroughly cleaned of all sulfur dust and the 'tween deck hatch covers are in place and covered with tarpaulins and dunnage.

§176.901 Stowage of cotton or vegetable fibers with rosin or pitch.
(a) Unless impracticable, cotton or vegetable fibers being transported on a vessel may not be stowed in the same hold or compartment with rosin or pitch being transported on

the same vessel.
(b) When separate stowage is impracticable, the cotton or vegetable fibers may be stowed in the same hold or compartment with rosin or pitch if they are separated by clean dunnage or a cargo of a non-combustible nature. When such stowage within the same hold or compartment involves large amounts of cotton or fibers or of rosin or pitch, the rosin or pitch must be floored off with at least two layers of 2.54 cm (1 inch) dunnaging and the cotton or vegetable fibers stowed above.

§176.903 Stowage of cotton or vegetable fibers with coal.

Cotton or vegetable fibers being transported on a vessel may not be stowed in the same hold with coal. They may be stowed in adjacent holds if the holds are separated by a tight steel bulkhead and the cotton or vegetable fibers are dunnaged at least 5 cm (2 inches) off the bulkhead. Cotton or vegetable fibers may be stowed in a hold above or below one in which coal is stowed if there is a tight steel intervening deck and all hatch covers are in place and covered with tarpaulins.

§176.905 Motor vehicles or mechanical equipment powered by internal combustion engines.

(a) A motor vehicle or any mechanized equipment powered by an internal combustion engine is subject to the following requirements when carried as cargo on a vessel:
(1) Before being loaded on a vessel, each motor vehicle or mechanical equipment must be inspected for fuel leaks and identifiable faults in the electrical system that could result in short circuit or other unintended electrical source of ignition. A motor vehicle or mechanical equipment showing any signs of leakage or electrical fault may not be transported.
(2) The fuel tank of a motor vehicle or mechanical equipment powered by liquid fuel may not be more than one-fourth full.
(3) Whenever possible, each vehicle or mechanical equipment must be stowed to allow for its inspection during transit.
(4) Motor vehicles or mechanical equipment may be refueled when necessary in the hold of a vessel in accordance with §176.78.
(5) When a motor vehicle or mechanical equipment with fuel in its tanks is stowed in a closed freight container, a warning, displayed on a contrasting background and readily legible from a distance of 8 meters (26 feet), must be affixed to the access doors to read as follows:

WARNING-MAY CONTAIN EXPLOSIVE MIXTURES WITH AIR-KEEP IGNITION SOURCES AWAY WHEN OPENING

(6) A motor vehicle or mechanical equipment's ignition key may not be in the ignition while the vehicle or mechanical equipment is stowed aboard a vessel.

(b) All equipment used for handling vehicles or mechanical equipment must be designed so that the fuel tank and fuel system of the vehicle or mechanical equipment are protected from stress that might cause rupture or other damage incident to handling.

(c) Two hand-held, portable, dry chemical fire extinguishers of at least 4.5 kg (10 pounds) capacity each must be separately located in an accessible location in each hold or compartment in which any motor vehicle or mechanical equipment is stowed.

(d) "NO SMOKING" signs must be conspicuously posted at each access opening to the hold or compartment.

(e) Each portable electrical light, including a flashlight, used in the stowage area must be an approved, explosion-proof type. All electrical connections for any portable light must be made to outlets outside the space in which any vehicle or mechanical equipment is stowed.

(f) Each hold or compartment must be ventilated and fitted with an overhead water sprinkler system or fixed fire extinguishing system.

(g) Each hold or compartment must be equipped with a smoke or fire detection system capable of alerting personnel on the bridge.

(h) All electrical equipment in the hold or compartment other than fixed explosion-proof lighting must be disconnected from its power source at a location outside the hold or compartment during the handling and transportation of any vehicle or mechanical equipment. Where the disconnecting means is a switch or circuit breaker, it must be locked in the open position until all vehicles have been removed.

(i) *Exceptions. A motor vehicle or mechanical equipment is excepted from the requirements of this subchapter if the following requirements are met:*

(1) The motor vehicle or mechanical equipment has an internal combustion engine using liquid fuel that has a flashpoint less than 38 ^{o}C (100 ^{o}F), the fuel tank is empty, and the engine is run until it stalls for lack of fuel;

(2) The motor vehicle or mechanical equipment has an internal combustion engine using liquid fuel that has a flashpoint of 38 ^{o}C (100 ^{o}F) or higher, the fuel tank contains 418 liters (110 gallons) of fuel or less, and there are no fuel leaks in any portion of the fuel system;

(3) The motor vehicle or mechanical equipment is stowed in a hold or compartment designated by the administration of the country in which the vessel is registered to be specially suited for vehicles. *See 46 CFR 70.10-44 and 90.10-38 for U.S. vessels;*

(4) The motor vehicle or mechanical equipment is electrically powered by wet electric storage batteries; or

(5) The motor vehicle or mechanical equipment is equipped with liquefied petroleum gas or other compressed gas fuel tanks, the tanks are completely emptied of liquid and the positive pressure in the tank does not exceed 2 bar (29 psi), the line from the fuel tank to the regulator and the regulator itself is drained of all trace of (liquid) gas, and the fuel shut-off valve is closed.

(j) Except as provided in §173.220(f) of this subchapter, the provisions of this subchapter do not apply to items of equipment such as fire extinguishers, compressed gas accumulators, airbag inflators and the like which are installed in the motor vehicle or mechanical equipment if they are necessary for the operation of the vehicle or equipment, or for the safety of its operator or passengers.

[Amdt. 176-43, 62 FR 24742, May 6, 1997]

[CFR] PART 177 - CARRIAGE BY PUBLIC HIGHWAY

[TITLE 49] [SUBTITLE B] [PART 177]

Subpart A-General Information and Regulations

Subpart B-Loading and Unloading

Subpart C-Segregation and Separation Chart of Hazardous Materials

Subpart D-Vehicles and Shipments in Transit; Accidents

Subpart E-Regulations Applying to Hazardous Material on Motor Vehicles Carrying Passengers for Hire

177.870 Regulations for passenger carrying vehicles.

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

Subpart A - General Information and Regulations

§177.800 Purpose and scope of this part and responsibility for compliance and training.

(a) *Purpose and scope. This part prescribes requirements, in addition to those contained in parts 171, 172, 173, 178 and 180 of this subchapter, that are applicable to the acceptance and transportation of hazardous materials by private, common, or contract carriers by motor vehicle.*

(b) Responsibility for compliance. Unless this subchapter specifically provides that another person shall perform a particular duty, each carrier, including a connecting carrier, shall perform the duties specified and comply with all applicable requirements in this part and shall ensure its hazmat employees receive training in relation thereto.

(c) Responsibility for training. A carrier may not transport a hazardous material by motor vehicle unless each of its hazmat employees involved in that transportation is trained as required by this part and subpart H of part 172 of this subchapter.

(d) No unnecessary delay in movement of shipments. All shipments of hazardous materials must be transported without unnecessary delay, from and including the time of commencement of the loading of the hazardous material until its final unloading at destination.

[Amdt. 177-79, 57 FR 20954, May 15, 1992, as amended by Amdt.177-86, 61 FR 18933, Apr. 29, 1996]

§177.801 Unacceptable hazardous materials shipments.

No person may accept for transportation or transport by motor vehicle a forbidden material or hazardous material that is not prepared in accordance with the requirements of this subchapter.

[Amdt. 177-87, 61 FR 27175, May 30. 1996]

§177.802 Inspection.

Records, equipment, packagings and containers under the control of a motor carrier, insofar as they affect safety in transportation of hazardous materials by motor vehicle, must be made available for examination and inspection by a duly authorized representative of the Department.

[Amdt. 177-71, 54 FR 25015, June 12, 1989]

§177.804 Compliance with Federal Motor Carrier Safety Regulations.

Motor carriers and other persons subject to this part shall comply with 49 CFR parts 390 through 397 (excluding §§397.3 and 397.9) to the extent those regulations apply.

[Amdt. 177-81, 58 FR 50505, Sept. 27, 1993]

§177.810 Vehicular tunnels.

Except as regards Class 7 (radioactive) materials, nothing contained in parts 170-189 of this subchapter shall be so construed as to nullify or supersede regulations established and published under authority of State statute or municipal ordinance regarding the kind, character, or quantity of any hazardous material permitted by such regulations to be transported through any urban vehicular tunnel used for mass transportation.

[Amdt. 177-52, 46 FR 5316, Jan. 19, 1981, as amended by Amdt. 177-78, 55 FR 52710, Dec. 21, 1990; 62 FR 51561, Oct. 1, 1997]

§177.816 Driver training.

(a) In addition to the training requirements of §177.800, no carrier may transport, or cause to be transported, a hazardous material unless each hazmat employee who will operate a motor vehicle has been trained in the applicable requirements of 49 CFR parts 390 through 397 and the procedures necessary for the safe operation of that motor vehicle. Driver training shall include the following subjects:

(1) Pre-trip safety inspection;

(2) Use of vehicle controls and equipment, including operation of emergency equipment;

(3) Operation of vehicle, including turning, backing, braking, parking, handling, and vehicle characteristics including those that affect vehicle stability, such as effects of braking and curves, effects of speed on vehicle control, dangers associated with maneuvering through curves, dangers associated with weather or road conditions that a driver may experience (e.g., blizzards, mountainous terrain, high winds), and high center of gravity;

(4) Procedures for maneuvering tunnels, bridges, and railroad crossings;

(5) Requirements pertaining to attendance of vehicles, parking, smoking, routing, and incident reporting; and

(6) Loading and unloading of materials, including-

(i) Compatibility and segregation of cargo in a mixed load;

(ii) Package handling methods; and

(iii) Load securement.

(b) *Specialized requirements for cargo tanks and portable tanks. In addition to the training requirement of paragraph (a) of this section, each person who operates a cargo tank or a vehicle with a portable tank with a capacity of 1,000 gallons or more must receive training applicable to the requirements of this subchapter and have the appropriate State-issued commercial driver's license required by 49 CFR part 383. Specialized training shall include the following:*

(1) Operation of emergency control features of the cargo tank or portable tank;

(2) Special vehicle handling characteristics, including: high center of gravity, fluid-load subject to surge, effects of fluid-load surge on braking, characteristic differences in stability among baffled, unbaffled, and multi-compartmented tanks; and effects of partial loads on vehicle stability;

(3) Loading and unloading procedures;

(4) The properties and hazards of the material transported; and

(5) Retest and inspection requirements for cargo tanks.

(c) The training required by paragraphs (a) and (b) of this section may be satisfied by compliance with the current requirements for a Commercial Driver's License (CDL) with a tank vehicle or hazardous materials endorsement.

(d) Training required by paragraph (b) of this section must conform to the requirements of §172.704 of this subchapter with respect to frequency and recordkeeping.

[Amdt. 177-79, 57 FR 20954, May 15, 1992, as amended by Amdt. 177-79, 58 FR 5852, Jan. 22, 1993]

§177.817 Shipping papers.

(a) *General requirements. A carrier may not transport a hazardous material unless it is accompanied by a shipping paper that is prepared in accordance with §§172.200, 172.201, 172.202, and 172.203 of this subchapter.*

(b) Shipper certification. An initial carrier may not accept a hazardous material offered for transportation unless the shipping paper describing the material includes a shipper's certification which meets the requirements in §172.204 of this subchapter. Except for a hazardous waste, the certification is not required for shipments to be transported entirely by private carriage and for bulk shipments to be transported in a cargo tank supplied by the carrier.

(c) Requirements when interlining with carriers by rail. A motor carrier shall mark on the shipping paper required by this section, if it offers or delivers a freight container or transport vehicle to a rail carrier for further transportation:

(1) A description of the freight container or transport vehicle; and

(2) The kind of placard affixed to the freight container or transport vehicle.

(d) This subpart does not apply to a material that is excepted from shipping paper requirements as specified in §172.200 of this subchapter.

(e) *Shipping paper accessibility-accident or inspection. A driver of a motor vehicle containing hazardous material, and each carrier using such a vehicle, shall ensure that the shipping paper required by this section is readily available to, and recognizable by, authorities in the event of accident or inspection. Specifically, the driver and the carrier shall:*

(1) Clearly distinguish the shipping paper, if it is carried with other shipping papers or other papers of any kind, by either distinctively tabbing it or by having it appear first; and

(2) Store the shipping paper as follows:

(i) When the driver is at the vehicle's controls, the shipping paper shall be: (A) Within his immediate reach while he is restrained by the lap belt; and (B) either readily visible to a person entering the driver's compartment or in a holder which is mounted to the inside of the door on the driver's side of the vehicle.

(ii) When the driver is not at the vehicle's controls, the shipping paper shall be: (A) In a holder which is mounted to the inside of the door on the driver's side of the vehicle; or (B) on the driver's seat in the vehicle.

[Amdt. 177-35, 41 FR 16130, Apr. 15, 1976, as amended by Amdt. 177-35A, 41 FR 40691, Sept. 20, 1976; Amdt. 177-48, 45 FR 47670, Nov. 10, 1980; Amdt. 177-65, 50 FR 11055, Mar. 19, 1985; Amdt. 177-72, 53 FR 17160, May 13, 1988]

§177.823 Movement of motor vehicles in emergency situations.

(a) A carrier may not move a transport vehicle containing a hazardous material unless the vehicle is marked and placarded in accordance with part 172 or as authorized in §171.12a of this subchapter, or unless, in an emergency:

(1) The vehicle is escorted by a representative of a state or local government;

(2) The carrier has permission from the Department; or

(3) Movement of the transport vehicle is necessary to protect life or property.

(b) *Disposition of contents of cargo tank when unsafe to continue. In the event of a leak in a cargo tank of such a character as to make further transportation unsafe, the leaking vehicle should be removed from the traveled portion of the highway and every* *available means employed for the safe disposal of the leaking material by preventing, so far as practicable, its spread over a wide area, such as by digging trenches to drain to a hole or depression in the ground, diverting the liquid away from streams or sewers if possible, or catching the liquid in containers if practicable. Smoking, and any other source of ignition, in the vicinity of a leaking cargo tank is not permitted.*

(c) Movement of leaking cargo tanks. A leaking cargo tank may be transported only the minimum distance necessary to reach a place where the contents of the tank or compartment may be disposed of safely. Every available means must be utilized to prevent the leakage or spillage of the liquid upon the highway.

[Amdt. 177-35, 41 FR 16130, Apr. 15, 1976, as amended by Amdt. 177-67, 50 FR 41521, Oct. 11, 1985; Amdt. 177-86, 61 FR 18933, Apr. 29, 1996]

Subpart B - Loading and Unloading

Note: For prohibited loading and storage of hazardous materials, see §177.848.

§177.834 General requirements.

(a) *Packages secured in a vehicle. Any tank, barrel, drum, cylinder, or other packaging, not permanently attached to a motor vehicle, which contains any Class 3 (flammable liquid), Class 2 (gases), Class 8 (corrosive), Division 6.1 (poisonous), or Class 7 (radioactive) material must be secured against movement within the vehicle on which it is being transported, under conditions normally incident to transportation.*

(b) [Reserved]

(c) *No smoking while loading or unloading. Smoking on or about any motor vehicle while loading or unloading any Class 1 (explosive), Class 3 (flammable liquid), Class 4 (flammable solid), Class 5 (oxidizing), or Division 2.1 (flammable gas) materials is forbidden.*

(d) Keep fire away, loading and unloading. Extreme care shall be taken in the loading or unloading of any Class 1 (explosive), Class 3 (flammable liquid), Class 4 (flammable solid), Class 5 (oxidizing), or Division 2.1 (flammable gas) materials into or from any motor vehicle to keep fire away and to prevent persons in the vicinity from smoking, lighting matches, or carrying any flame or lighted cigar, pipe, or cigarette.

(e) Handbrake set while loading and unloading. No hazardous material shall be loaded into or on, or unloaded from, any motor vehicle unless the handbrake be securely set and all other reasonable precautions be taken to prevent motion of the motor vehicle during such loading or unloading process.

(f) Use of tools, loading and unloading. No tools which are likely to damage the effectiveness of the closure of any package or other container, or likely adversely to affect such package or container, shall be used for the loading or unloading of any

Class 1 (explosive) material or other dangerous article.
(g) Prevent relative motion between containers. Containers of Class 1 (explosive), Class 3 (flammable liquid), Class 4 (flammable solid), Class 5 (oxidizing), Class 8 (corrosive), Class 2 (gases) and Division 6.1 (poisonous) materials, must be so braced as to prevent motion thereof relative to the vehicle while in transit. Containers having valves or other fittings must be so loaded that there will be the minimum likelihood of damage thereto during transportation.
(h) Precautions concerning containers in transit; fueling road units. Reasonable care should be taken to prevent undue rise in temperature of containers and their contents during transit. There must be no tampering with such container or the contents thereof nor any discharge of the contents of any container between point of origin and point of billed destination. Discharge of contents of any container, other than a cargo tank or IM portable tank, must not be made prior to removal from the motor vehicle. Nothing contained in this paragraph shall be so construed as to prohibit the fueling of machinery or vehicles used in road construction or maintenance.
(i) Attendance requirements. (1) Loading. A cargo tank must be attended by a qualified person at all times when it is being loaded. The person who is responsible for loading the cargo tank is also responsible for ensuring that it is so attended.
(2) Unloading. A motor carrier who transports hazardous materials by a cargo tank must ensure that the cargo tank is attended by a qualified person at all times during unloading. However, the carrier's obligation to ensure attendance during unloading ceases when:
(i) The carrier's obligation for transporting the materials is fulfilled;
(ii) The cargo tank has been placed upon the consignee's premises; and
(iii) The motive power has been removed from the cargo tank and removed from the premises.
(3) Except for unloading operations subject to §§177.840 (p) or (q), a qualified person "attends" the loading or unloading of a cargo tank if, throughout the process, he is alert and is within 7.62 meters (25 feet) of the cargo tank. The qualified person attending the unloading of a cargo tank must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable during the unloading operation.
(4) A person is "qualified" if he has been made aware of the nature of the hazardous material which is to be loaded or unloaded, he has been instructed on the procedures to be followed in emergencies, he is authorized to move the cargo tank, and he has the means to do so.
(j) *Manholes and valves closed. A person may not drive a cargo tank and a motor carrier may not permit a person to drive a cargo tank motor vehicle containing a hazardous material regardless of quantity unless:*
(1) All manhole closures are closed and secured; and
(2) All valves and other closures in liquid discharge systems are closed and free of leaks.
(k) [Reserved]
(l) *Use of cargo heaters when transporting certain hazardous material. Transportation includes loading, carrying, and unloading.*

(1) When transporting Class 1 (explosive) materials. A motor vehicle equipped with a cargo heater of any type may transport Class 1 (explosive) materials only if the cargo heater is rendered inoperable by: (i) Draining or removing the cargo heater fuel tank; and (ii) disconnecting the heater's power source.
(2) When transporting certain flammable material-(i) Use of combustion cargo heaters. A motor vehicle equipped with a combustion cargo heater may be used to transport Class 3 (flammable liquid) or Division 2.1 (flammable gas) materials only if each of the following requirements are met:
(A) It is a catalytic heater.
(B) The heater's surface temperature cannot exceed 54 ^{o}C (130 ^{o}F)-either on a thermostatically controlled heater or on a heater without thermostatic control when the outside or ambient temperature is 16 ^{o}C (61 ^{o}F) or less.
(C) The heater is not ignited in a loaded vehicle.
(D) There is no flame, either on the catalyst or anywhere in the heater.
(E) The manufacturer has certified that the heater meets the requirements under paragraph (l)(2)(i) of this section by permanently marking the heater *"MEETS DOT REQUIREMENTS FOR CATALYTIC HEATERS USED WITH FLAMMABLE LIQUID AND GAS."*
(F) The heater is also marked "DO NOT LOAD INTO OR USE IN CARGO COMPARTMENTS CONTAINING FLAMMABLE LIQUID OR GAS IF FLAME IS VISIBLE ON CATALYST OR IN HEATER."
(G) Heater requirements under §393.77 of this title are complied with.
(ii) *Effective date for combustion heater requirements. The requirements under paragraph (l)(2)(i) of this section govern as follows:*
(A) Use of a heater manufactured after November 14, 1975, is governed by every requirement under (l)(2)(i) of this section;
(B) Use of a heater manufactured before November 15, 1975, is governed only by the requirements under (l)(2)(i) (A), (C), (D), (F) and (G) of this section until October 1, 1976; and
(C) Use of any heater after September 30, 1976, is governed by every requirement under paragraph (l)(2)(i) of this section.
(iii) *Restrictions on automatic cargo-space-heating temperature control devices. Restrictions on these devices have two dimensions: Restrictions upon use and restrictions which apply when the device must not be used.*
(A) Use restrictions. An automatic cargo-space-heating temperature control device may be used when transporting Class 3 (flammable liquid) or Division 2.1 (flammable gas) materials only if each of the following requirements is met:
(1) Electrical apparatus in the cargo compartment is nonsparking or explosion proof.
(2) There is no combustion apparatus in the cargo compartment.
(3) There is no connection for return of air from the cargo compartment to the combustion apparatus.
(4) The heating system will not heat any part of the cargo to more than 54 ^{o}C (129 ^{o}F).
(5) Heater requirements under §393.77 of this title are complied with.
(B) Protection against use. Class 3 (flammable liquid) or Division 2.1 (flammable gas)

materials may be transported by a vehicle, which is equipped with an automatic cargo-space-heating temperature control device that does not meet each requirement of paragraph (l)(2)(iii)(A) of this section, only if the device is first rendered inoperable, as follows:
(1) Each cargo heater fuel tank, if other than LPG, must be emptied or removed.
(2) Each LPG fuel tank for automatic temperature control equipment must have its discharge valve closed and its fuel feed line disconnected.
(m) Tanks constructed and maintained in compliance with Spec. 106A or 110A (§§179.300, 179.301 of this subchapter) that are authorized for the shipment of hazardous materials by highway in part 173 of this subchapter must be carried in accordance with the following requirements:
(1) Tanks must be securely chocked or clamped on vehicles to prevent any shifting.
(2) Equipment suitable for handling a tank must be provided at any point where a tank is to be loaded upon or removed from a vehicle.
(3) No more than two cargo carrying vehicles may be in the same combination of vehicles.
(4) Compliance with §§174.200 and 174.204 of this subchapter for combination rail freight, highway shipments and for trailer-on-flat-car service is required.
(n) Specification 56, 57, IM 101, and IM 102 portable tanks, when loaded, may not be stacked on each other nor placed under other freight during transportation by motor vehicle.
(o) *Unloading of IM portable tanks. An IM portable tank may be unloaded while remaining on a transport vehicle with the power unit attached if the tank meets the outlet requirements in §178.345-11 of this subchapter and the tank is attended by a qualified person during the unloading in accordance with the requirements in paragraph (i) of this section.*

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.834, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.835 Class 1 (explosive) materials.
(See also §177.834 (a) to (j).)
(a) *Engine stopped. No Class 1 (explosive) materials shall be loaded into or on or be unloaded from any motor vehicle with the engine running.*
(b) Care in loading, unloading, or other handling of Class 1 (explosive) materials. No bale hooks or other metal tools shall be used for the loading, unloading, or other handling of Class 1 (explosive) materials, nor shall any package or other container of Class 1 (explosive) materials, except barrels or kegs, be rolled. No packages of Class 1 (explosive) materials shall be thrown or dropped during process of loading or unloading

or handling of Class 1 (explosive) materials. Special care shall be exercised to the end that packages or other containers containing Class 1 (explosive) materials shall not catch fire from sparks or hot gases from the exhaust tailpipe.
(1) Whenever tarpaulins are used for covering Class 1 (explosive) materials, they shall be secured by means of rope, wire, or other equally efficient tie downs. Class 1 (explosive) materials placards or markings required by §177.823 shall be secured, in the appropriate locations, directly to the equipment transporting the Class 1 (explosive) materials. If the vehicle is provided with placard boards, the placards must be applied to these boards.
(2) [Reserved]
(c) *Class 1 (explosive) materials on vehicles in combination. Division 1.1 or 1.2 (Class A explosive) materials may not be loaded into or carried on any vehicle or a combination of vehicles if:*
(1) More than two cargo carrying vehicles are in the combination;
(2) Any full trailer in the combination has a wheel base of less than 184 inches;
(3) Any vehicle in the combination is a cargo tank which is required to be marked or placarded under §177.823; or
(4) The other vehicle in the combination contains any:
(i) Substances, explosive, n.o.s., Division 1.1A (explosive) material (Initiating explosive),
(ii) Packages of Class 7 (radioactive) materials bearing "Yellow III" labels,
(iii) Division 2.3 (poisonous gas) or Division 6.1 (poisonous) materials, or
(iv) Hazardous materials in a portable tank or a DOT specification 106A or 110A tank.
(d) [Reserved]
(e) *No sharp projections inside body of vehicles. No motor vehicle transporting any kind of Class 1 (explosive) material shall have on the interior of the body in which the Class 1 (explosive) materials are contained, any inwardly projecting bolts, screws, nails, or other inwardly projecting parts likely to produce damage to any package or container of Class 1 (explosive) materials during the loading or unloading process or in transit.*
(f) Class 1 (explosive) materials vehicles, floors tight and lined. Motor vehicles transporting Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) materials shall have tight floors; shall have that portion of the interior in contact with the load lined with either non-metallic material or non-ferrous metals, except that the lining is not required for truck load shipments loaded by the Departments of the Army, Navy or Air Force of the United States Government provided the Class 1 (explosive) materials are of such nature that they are not liable to leakage of dust, powder, or vapor which might become the cause of an explosion. The interior of the cargo space must be in good condition so that there will not be any likelihood of containers being damaged by exposed bolts, nuts, broken side panels or floor boards, or any similar projections.
(g) No detonator assembly or booster with detonator may be transported on the same motor vehicle with any Division 1.1, 1.2 or 1.3 (Class A or Class B explosive) material (except other detonator assemblies, boosters with detonators or detonators), explosives for blasting or detonating cord Division 1.4 (Class C explosive) material. No detonator may be transported on the same motor vehicle with any Division 1.1, 1.2 or 1.3 (Class A or Class B explosive) material (except other detonators, detonator assemblies or

boosters with detonators), explosives for blasting or detonating cord Division 1.4 (Class C explosive) material unless-
(1) It is packed in a specification MC 201 (§178.318 of this subchapter) container, or
(2) The package conforms with requirements prescribed in §173.63 of this subchapter, and its use is restricted to instances when-
(i) There is no Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) material or blasting agent loaded on the motor vehicle; and
(ii) A separation of 61 cm (24 inches) is maintained between each package of detonators and each package of detonating cord; or
(3) It is packed and loaded in accordance with a method approved by the Department. One method approved by the Department is as follows:
(i) The detonators are in packagings as prescribed in §173.63 of this subchapter which in turn are loaded into suitable containers or separate compartments. Both the detonators and the container or compartment must meet the requirements of the Institute of Makers of Explosives' Standard (IME Safety Library Publication No. 22).
(h) *Lading within body or covered tailgate closed. Except as provided in paragraphs (g), (k), and (m) of this section, dealing with the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, all of that portion of the lading of any motor vehicle which consists of Class 1 (explosive) materials shall be contained entirely within the body of the motor vehicle or within the horizontal outline thereof, without overhang or projection of any part of the load and if such motor vehicle has a tailboard or tailgate, it shall be closed and secured in place during such transportation. Every motor vehicle transporting Class 1 (explosive) materials must either have a closed body or have the body thereof covered with a tarpaulin, and in either event care must be taken to protect the load from moisture and sparks, except that subject to other provisions of these regulations, Class 1 (explosive) materials other than black powder may be transported on flat-bed vehicles if the explosive portion of the load on each vehicle is packed in fire and water resistant containers or covered with a fire and water resistant tarpaulin.*
(i) Class 1 (explosive) materials to be protected against damage by other lading. No motor vehicle transporting any Class 1 (explosive) material may transport as a part of its load any metal or other articles or materials likely to damage such Class 1 (explosive) material or any package in which it is contained, unless the different parts of such load be so segregated or secured in place in or on the motor vehicle and separated by bulkheads or other suitable means as to prevent such damage.
(j) Transfer of Class 1 (explosive) materials en route. No Division 1.1, 1.2, or 1.3 (Class A or Class B explosive) material shall be transferred from one container to another, or from one motor vehicle to another vehicle, or from another vehicle to a motor vehicle, on any public highway, street, or road, except in case of emergency. In such cases red electric lanterns, red emergency reflectors or red flags shall be set out in the manner prescribed for disabled or stopped motor vehicles. (See Motor Carrier Safety Regulations, part 392 of this title.) In any event, all practicable means, in addition to these hereinbefore prescribed, shall be taken to protect and warn other users of the highway against the hazard involved in any such transfer or against the hazard

occasioned by the emergency making such transfer necessary.

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.835, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.837 Class 3 (flammable liquid) materials.

(See also §177.834 (a) to (j).)

(a) *Engine stopped. Unless the engine of a cargo tank motor vehicle is to be used for the operation of a pump, no Class 3 material shall be loaded into, or on, or unloaded from any cargo tank motor vehicle while the engine is running.*

(b) Bonding and grounding containers other than cargo tanks prior to and during transfer of lading. For containers which are not in metallic contact with each other, either metallic bonds or ground conductors shall be provided for the neutralization of possible static charges prior to and during transfers of Class 3 (flammable liquid) materials between such containers. Such bonding shall be made by first connecting an electric conductor to the container to be filled and subsequently connecting the conductor to the container from which the liquid is to come, and not in any other order. To provide against ignition of vapors by discharge of static electricity, the latter connection shall be made at a point well removed from the opening from which the Class 3 (flammable liquid) material is to be discharged.

(c) Bonding and grounding cargo tanks before and during transfer of lading. (1) When a cargo tank is loaded through an open filling hole, one end of a bond wire shall be connected to the stationary system piping or integrally connected steel framing, and the other end to the shell of the cargo tank to provide a continuous electrical connection. (If bonding is to the framing, it is essential that piping and framing be electrically interconnected.) This connection must be made before any filling hole is opened, and must remain in place until after the last filling hole has been closed. Additional bond wires are not needed around All-Metal flexible or swivel joints, but are required for nonmetallic flexible connections in the stationary system piping. When a cargo tank is unloaded by a suction-piping system through an open filling hole of the cargo tank, electrical continuity shall be maintained from cargo tank to receiving tank.

(2) When a cargo tank is loaded or unloaded through a vapor-tight (not open hole) top or bottom connection, so that there is no release of vapor at a point where a spark could occur, bonding or grounding is not required. Contact of the closed connection must be made before flow starts and must not be broken until after the flow is completed.

(3) Bonding or grounding is not required when a cargo tank is unloaded through a nonvapor-tight connection into a stationary tank provided the metallic filling connection is maintained in contact with the filling hole.

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.837, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.838 Class 4 (flammable solid) materials, Class 5 (oxidizing) materials, and Division 4.2 (pyroforic liquid) materials.

(See also §177.834 (a) to (j).)

(a) *Lading within body or covered; tailgate closed; pick-up and delivery. All of that portion of the lading of any motor vehicle transporting Class 4 (flammable solid) or Class 5 (oxidizing) materials shall be contained entirely within the body of the motor vehicle and shall be covered by such body, by tarpaulins, or other suitable means, and if such motor vehicle has a tailboard or tailgate, it shall be closed and secured in place during such transportation: Provided, however, That the provisions of this paragraph need not apply to "pick-up and delivery" motor vehicles when such motor vehicles are used in no other transportation than in and about cities, towns, or villages. Shipment in water-tight bulk containers need not be covered by a tarpaulin or other means.*

(b) Articles to be kept dry. Special care shall be taken in the loading of any motor vehicle with Class 4 (flammable solid) or Class 5 (oxidizing) materials which are likely to become hazardous to transport when wet, to keep them from being wetted during the loading process and to keep them dry during transit. Special care shall also be taken in the loading of any motor vehicle with Class 4 (flammable solid) or Class 5 (oxidizing) materials, which are likely to become more hazardous to transport by wetting, to keep them from being wetted during the loading process and to keep them dry during transit. Examples of such dangerous materials are charcoal screenings, ground, crushed, or pulverized charcoal, and lump charcoal.

(c) Lading ventilation, precautions against spontaneous combustion. Whenever a motor carrier has knowledge concerning the hazards of spontaneous combustion or heating of any article to be loaded on a motor vehicle, such article shall be so loaded as to afford sufficient ventilation of the load to provide reasonable assurance against fire from this cause; and in such a case the motor vehicle shall be unloaded as soon as practicable after reaching its destination. Charcoal screenings, or ground, crushed, granulated, or pulverized charcoal, in bags, shall be so loaded that the bags are laid horizontally in the motor vehicle, and so piled that there will be spaces for effective air circulation, which spaces shall not be less than 10 cm (3.9 inches) wide; and air spaces shall be maintained between rows of bags. Bags shall not be piled closer than 15 cm (5.9 inches) from the top of any motor vehicle with a closed body.

(d)-(e) [Reserved]

(f) Nitrates, except ammonium nitrate having organic coating, must be loaded in closed or open type motor vehicles, which must be swept clean and be free of any projections capable of injuring bags when so packaged. When shipped in open type motor vehicles,

the lading must be suitably covered. Ammonium nitrate having organic coating must not be loaded in all-metal vehicles, other than those made of aluminum or aluminum alloys of the closed type.
(g) A motor vehicle may only contain 45.4 kg (100 pounds) or less net mass of material described as "Smokeless powder for small arms, Division 4.1".
(h) *Division 4.2 (pyrophoric liquid) materials in cylinders. Cylinders containing Division 4.2 (pyrophoric liquid) materials, unless packed in a strong box or case and secured therein to protect valves, must be loaded with all valves and safety relief devices in the vapor space. All cylinders must be secured so that no shifting occurs in transit.*

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.838, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.839 Class 8 (corrosive) materials.

(See also §177.834(a) through (j).)
(a) *Nitric acid. No packaging of nitric acid of 50 percent or greater concentration may be loaded above any packaging containing any other kind of material.*
(b) Storage batteries. All storage batteries containing any electrolyte must be so loaded, if loaded with other lading, that all such batteries will be protected against other lading falling onto or against them, and adequate means must be provided in all cases for the protection and insulation of battery terminals against short circuits.

[Amdt. 177-87, 61 FR 27175, May 30, 1996]

§177.840 Class 2 (gases) materials.

(See also §177.834 (a) to (j).)

(a) *Floors or platforms essentially flat. Cylinders containing Class 2 (gases) materials shall not be loaded onto any part of the floor or platform of any motor vehicle which is not essentially flat; cylinders containing Class 2 (gases) materials may be loaded onto any motor vehicle not having a floor or platform only if such motor vehicle be equipped with suitable racks having adequate means for securing such cylinders in place therein. Nothing contained in this section shall be so construed as to prohibit the loading of such cylinders on any motor vehicle having a floor or platform and racks as hereinbefore described.*

(1) Cylinders. To prevent their overturning, cylinders containing Class 2 (gases) materials must be securely lashed in an upright position; loaded into racks securely attached to the motor vehicle; packed in boxes or crates of such dimensions as to

prevent their overturning; or loaded in a horizontal position. Specification DOT-4L cylinders must be loaded in an upright position and securely braced.

(2) Cylinders for hydrogen, cryogenic liquid. A Specification DOT-4L cylinder containing hydrogen, cryogenic liquid may only be transported on a motor vehicle as follows:

(i) The vehicle must have an open body equipped with a suitable rack or support having a means to hold the cylinder upright when subjected to an acceleration of 2 "g" in any horizontal direction;

(ii) The combined total of the hydrogen venting rates, as marked, on the cylinders transported on one motor vehicle may not exceed 60 SCF per hour;

(iii) The vehicle may not enter a tunnel; and

(iv) Highway transportation is limited to private and contract carriage and to direct movement from point of origin to destination.

(b) Portable tank containers containing Class 2 (gases) materials shall be loaded on motor vehicles only as follows:

(1) Onto a flat floor or platform of a motor vehicle.

(2) Onto a suitable frame of a motor vehicle.

(3) In either such case, such containers shall be safely and securely blocked or held down to prevent movement relative to each other or to the supporting structure when in transit, particularly during sudden starts and stops and changes of direction of the vehicle.

(4) Requirements of paragraphs (1) and (2) of this paragraph (b) shall not be construed as prohibiting stacking of containers provided the provisions of paragraph (3) of this paragraph (b) are fully complied with.

(c) [Reserved]

(d) *Engine to be stopped in cargo tanks, except for transfer pump. No Division 2.1 (flammable gas) material shall be loaded into or on or unloaded from any cargo tank with the engine running unless the engine is used for the operation of the transfer pump of the vehicle. Unless the delivery hose is equipped with a shut-off valve at its discharge end, the engine of the motor vehicle shall be stopped at the finish of such loading or unloading operation while the filling or discharge connections are disconnected.*

(e) Chlorine cargo tanks shall be shipped only when equipped (1) with a gas mask of a type approved by the The National Institute of Occupational Safety and Health (NIOSH) Pittsburgh Research Center, U.S. Department of Health and Human Services for chlorine service; (2) with an emergency kit for controlling leaks in fittings on the dome cover plate.

(f) A cargo tank motor vehicle used for transportation of chlorine may not be moved, coupled or uncoupled, when any loading or unloading connections are attached to the vehicle, nor may it be left without the power unit attached unless the vehicle is chocked or equivalent means are provided to prevent motion. For additional requirements, see §173.315(o) of this subchapter.

(g) Each liquid discharge valve on a cargo tank, other than an engine fuel line valve, must be closed during transportation except during loading and unloading.

(h) The driver of a motor vehicle transporting a Division 2.1 (flammable gas) material that is a cryogenic liquid in a package exceeding 450 liters (119 gallons) of water capacity shall avoid unnecessary delays during transportation. If unforeseen conditions cause an excessive pressure rise, the driver shall manually vent the tank at a remote and safe location. For each shipment, the driver shall make a written record of the cargo tank pressure and ambient (outside) temperature:

(1) At the start of each trip,

(2) Immediately before and after any manual venting,

(3) At least once every five hours, and

(4) At the destination point.

(i) No person may transport a Division 2.1 (flammable gas) material that is a cryogenic liquid in a cargo tank unless the pressure of the lading is equal to or less than that used to determine the marked rated holding time (MRHT) and the one-way travel time (OWTT), marked on the tank in conformance with §173.318(g) of this subchapter, is equal to or greater than the elapsed time between the start and termination of travel. This prohibition does not apply if, prior to expiration of the OWTT, the tank is brought to full equilibration as specified in paragraph (j) of this section.

(j) Full equilibration of a cargo tank transporting a Division 2.1 (flammable gas) material that is a cryogenic liquid may only be done at a facility that loads or unloads a Division 2.1 (flammable gas) material that is a cryogenic liquid and must be performed and verified as follows:

(1) The temperature and pressure of the liquid must be reduced by a manually controlled release of vapor; and

(2) The pressure in the cargo tank must be measured at least ten minutes after the manual release is terminated.

(k) A carrier of carbon monoxide, cryogenic liquid must provide each driver with a self-contained air breathing apparatus that is approved by the National Institute of Occupational Safety and Health; for example, Mine Safety Appliance Co., Model 401, catalog number 461704.

(l) *Operating procedure. By January 1, 2000, each operator of a cargo tank motor vehicle transporting a liquefied compressed gas must carry on or within the cargo tank motor vehicle written emergency discharge control procedures for all delivery operations. The procedures must describe the cargo tank motor vehicle's emergency discharge control features and, for a passive shut-down capability, the parameters within which they are designed to function. The procedures must describe the process to be followed if using a facility-provided hose for unloading when the cargo tank motor vehicle has a specially equipped delivery hose assembly to meet the requirements of §173.315(n)(2) of this subchapter.*

(m) Cargo tank safety check. Before unloading from a cargo tank motor vehicle containing a liquefied compressed gas, the qualified person performing the function must check those components of the discharge system, including delivery hose assemblies and piping, that are readily observed during the normal course of unloading to assure that they are of sound quality, without obvious defects detectable through visual observation and audio awareness, and that connections are secure. This check must be made after the pressure in the discharge system has reached at least equilibrium with the pressure in the cargo tank. Operators need not use instruments or take extraordinary actions to check components not readily visible. No operator may unload liquefied compressed gases from a cargo tank motor vehicle with a delivery hose assembly found to have any condition identified in §180.416(g)(1) of this subchapter or with piping systems found to have any condition identified in §180.416(g)(2) of this subchapter.

(n) Emergency shut down. If there is an unintentional release of product to the environment during unloading of a liquefied compressed gas, the qualified person unloading the cargo tank motor vehicle must promptly shut the internal self-closing stop valve or other primary means of closure and shut down all motive and auxiliary power equipment.

(o) Daily test of off-truck remote shut-off activation device. For a cargo tank motor vehicle equipped with an off-truck remote means to close the internal self-closing stop valve and shut off all motive and auxiliary power equipment, an operator must successfully test the activation device within 18 hours prior to the first delivery of each day. For a wireless transmitter/receiver, the person conducting the test must be at least 45.72 meters (150 feet) from the cargo tank and may have the cargo tank in his line of sight.

(p) Unloading procedures for liquefied petroleum gas and anhydrous ammonia in metered delivery service. An operator must use the following procedures for unloading liquefied petroleum gas or anhydrous ammonia from a cargo tank motor vehicle in metered delivery service:

(1) For a cargo tank with a capacity of 13,247.5 liters (3,500 water gallons) or less, excluding delivery hose and piping, the qualified person attending the unloading operation must remain within 45.72 meters (150 feet) of the cargo tank and 7.62 meters (25 feet) of the delivery hose and must observe both the cargo tank and the receiving container at least once every five minutes when the internal self-closing stop valve is open during unloading operations that take more than five minutes to complete.

(2) For a cargo tank with a capacity greater than 13,247.5 liters (3,500 water gallons), excluding delivery hose and piping, the qualified person attending the unloading operation must remain within 45.72 meters (150 feet) of the cargo tank and 7.62 meters (25 feet) of the delivery hose when the internal self-closing stop valve is open.

(i) Except as provided in paragraph (p)(2)(ii) of this section, the qualified person attending the unloading operation must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable, except during short periods when it is necessary to activate controls or monitor the receiving container.

(ii) For deliveries where the qualified person attending the unloading operation cannot maintain an unobstructed view of the cargo tank, when the internal self-closing stop valve is open, the qualified person must observe both the cargo tank and the receiving container at least once every five minutes during unloading operations that take more than five minutes to complete. In addition, by the compliance dates specified in §§173.315(n)(5) and 180.405(m)(3) of this subchapter, the cargo tank motor vehicle must have an emergency discharge control capability that meets the requirements of §173.315(n)(2) or §173.315(n)(4) of this subchapter.

(q) *Unloading procedures for liquefied petroleum gas and anhydrous ammonia in other than metered delivery service. An operator must use the following procedures for unloading liquefied petroleum gas or anhydrous ammonia from a cargo tank motor vehicle in other than metered delivery service:*

(1) The qualified person attending the unloading operation must remain within 7.62 meters (25 feet) of the cargo tank when the internal self-closing stop valve is open.

(2) The qualified person attending the unloading operation must have an unobstructed view of the cargo tank and delivery hose to the maximum extent practicable, except during short periods when it is necessary to activate controls or monitor the receiving container.

(r) *Unloading using facility-provided hoses. A cargo tank motor vehicle equipped with a specially designed delivery hose assembly to meet the requirements of §173.315(n)(2) of this subchapter may be unloaded using a delivery hose assembly provided by the receiving facility under the following conditions:*

(1) The qualified person monitoring unloading must visually examine the facility hose assembly for obvious defects prior to its use in the unloading operation.

(2) The qualified person monitoring unloading must remain within arm's reach of the mechanical means of closure for the internal self-closing stop valve when the internal self-closing stop valve is open except for short periods when it is necessary to activate controls or monitor the receiving container. For chlorine cargo tanks, the qualified person must remain within arm's reach of a means to stop the flow of product except for short periods when it is necessary to activate controls or monitor the receiving container.

(3) If the facility hose is equipped with a passive means to shut off the flow of product that conforms to and is maintained to the performance standard in §173.315(n)(2) of this subchapter, the qualified person may attend the unloading operation in accordance with the attendance requirements prescribed for the material being unloaded in §177.834 of this section.

(s) *Off-truck remote shut-off activation device. For a cargo tank motor vehicle with an off-truck remote control shut-off capability as required by §§173.315(n)(3) or (n)(4) of this subchapter, the qualified person attending the unloading operation must be in possession of the activation device at all times during the unloading process. This requirement does not apply if the activation device is part of a system that will shut off the unloading operation without human intervention in the event of a leak or separation in the hose.*

(t) Unloading without appropriate emergency discharge control equipment. Until a cargo tank is equipped with emergency discharge control equipment in conformance with §§173.315(n)(2) and 180.405(m)(1) of this subchapter, the qualified person attending the unloading operation must remain within arm's reach of a means to close the internal self-closing stop valve when the internal self-closing stop valve is open except during short periods when the qualified person must activate controls or monitor the receiving container. For chlorine cargo tanks unloaded after December 31, 1999, the qualified person must remain within arm's reach of a means to stop the flow of product except for short periods when it is necessary to activate controls or monitor the receiving container.

(u) Unloading of chlorine cargo tanks. After July 1, 2001, unloading of chlorine from a cargo tank must be performed in compliance with Section 3 of Pamphlet 57, Emergency Shut-off Systems for Bulk Transfer of Chlorine, of the Chlorine Institute.

(Approved by the Office of Management and Budget under control number 2137-0542)

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Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.840, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.841 Division 6.1 (poisonous) and Division 2.3 (poisonous gas) materials.

(See also §177.834 (a) to (j).)

(a) *Arsenical compounds in bulk. Care shall be exercised in the loading and unloading of "arsenical dust", "arsenic trioxide", and "sodium arsenate", allowable to be loaded into sift-proof, steel hopper-type or dump-type motor-vehicle bodies equipped with water-proof, dust-proof covers well secured in place on all openings, to accomplish such loading with the minimum spread of such compounds into the atmosphere by all means that are practicable; and no such loading or unloading shall be done near or adjacent to any place where there are or are likely to be, during the loading or unloading process assemblages of persons other than those engaged in the loading or unloading process, or upon any public highway or in any public place. Before any motor vehicle may be used for transporting any other articles, all detectable traces of arsenical materials must be removed therefrom by flushing with water, or by other appropriate method, and the marking removed.*

(b) [Reserved]

(c) *Division 2.3 (poisonous gas) or Division 6.1 (poisonous) materials. The transportation of a Division 2.3 (poisonous gas) or Division 6.1 (poisonous) material is not permitted if there is any interconnection between packagings.*

(d) [Reserved]

(e) A motor carrier may not transport a package:

(1) Except as provided in paragraph (e)(3) of this section, bearing or required to bear a POISON or POISON INHALATION HAZARD label in the same motor vehicle with material that is marked as or known to be a foodstuffs, feed or edible material intended for consumption by humans or animals unless the poisonous material is packaged in accordance with this subchapter and is:

(i) Overpacked in a metal drum as specified in §173.25(c) of this subchapter; or

(ii) Loaded into a closed unit load device and the foodstuffs, feed, or other edible material are loaded into another closed unit load device;

(2) Bearing or required to bear a POISON, POISON GAS or POISON INHALATION

HAZARD label in the driver's compartment (including a sleeper berth) of a motor vehicle; or
(3) Bearing a POISON label displaying the text "PG III," or bearing a "PG III" mark adjacent to the POISON label, with materials marked as, or known to be, foodstuffs, feed or any other edible material intended for consumption by humans or animals, unless the package containing the Division 6.1, Packing Group III material is separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials with foodstuffs, feed or any other edible material would not occur.

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Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.841, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

§177.842 Class 7 (radioactive) material.
(a) The number of packages of Class 7 (radioactive) materials in any transport vehicle or in any single group in any storage location must be limited so that the total transport index number does not exceed 50. The total transport index of a group of packages and overpacks is determined by adding together the transport index number on the labels on the individual packages and overpacks in the group. This provision does not apply to exclusive use shipments described in §§173.441(b), 173.457, and 173.427 of this subchapter.
(b) Packages of Class 7 (radioactive) material bearing "RADIOACTIVE YELLOW-II" or "RADIOACTIVE YELLOW-III" labels may not be placed in a transport vehicle, storage location or in any other place closer than the distances shown in the following table to any area which may be continuously occupied by any passenger, employee, or animal, nor closer than the distances shown in the table to any package containing undeveloped film (if so marked), and must conform to the following conditions:
(1) If more than one of these packages is present, the distance must be computed from the following table on the basis of the total transport index number determined by adding together the transport index number on the labels on the individual packages and overpacks in the vehicle or storeroom.
(2) Where more than one group of packages is present in any single storage location, a single group may not have a total transport index greater than 50. Each group of packages must be handled and stowed not closer than 6 meters (20 feet) (measured edge to edge) to any other group. The following table is to be used in accordance with the provisions of paragraph (b) of this section:

Total transport index	Minimum separation distance in meters (feet) to nearest undeveloped film in various times of transit					Minimum distance in meters (feet) to area of persons, or minimum distance in meters (feet) from dividing partition of cargo compartments
-	Up to 2 hours	2-4 hours	4-8 hours	8-12 hours	Over 12 hours	-
None	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
0.1 to 1.0	0.3 (1)	0.6 (2)	0.9 (3)	1.2 (4)	1.5 (5)	0.3 (1)
1.1 to 5.0	0.9 (3)	1.2 (4)	1.8 (6)	2.4 (8)	3.4 (11)	0.6 (2)
5.1 to 10.0	1.2 (4)	1.8 (6)	2.7 (9)	3.4 (11)	4.6 (15)	0.9 (3)
10.1 to 20.0	1.5 (5)	2.4 (8)	3.7 (12)	4.9 (16)	6.7 (22)	1.2 (4)
20.1 to 30.0	2.1 (7)	3.0 (10)	4.6 (15)	6.1 (20)	8.8 (29)	1.5 (5)
30.1 to 40.0	2.4 (8)	3.4 (11)	5.2 (17)	6.7 (22)	10.1 (33)	1.8 (6)
40.1 to 50.0	2.7 (9)	3.7 (12)	5.8 (19)	7.3 (24)	11.0 (36)	2.1 (7)

Note: The distance in this table must be measured from the nearest point on the nearest packages of Class 7 (radioactive) material.

(c) Shipments of low specific activity materials and surface contaminated objects, as defined in §173.403 of this subchapter, must be loaded so as to avoid spillage and scattering of loose materials. Loading restrictions are set forth in §173.427 of this subchapter.

(d) Packages must be so blocked and braced that they cannot change position during conditions normally incident to transportation.

(e) Persons should not remain unnecessarily in a vehicle containing Class 7 (radioactive) materials.

(f) Each fissile material, controlled shipment (as defined in §173.403 of this subchapter) must be transported in accordance with one of the methods prescribed in §173.457 of this subchapter. The transport controls must be adequate to assure that no fissile material, controlled shipment is transported in the same transport vehicle with any other fissile Class 7 (radioactive) material shipment. In loading and storage areas each fissile material, controlled shipment must be segregated by a distance of at least 6 meters (20 feet) from any other package required to bear one of the "Radioactive" labels described in §172.403 of this subchapter.

(g) For shipments transported under exclusive use conditions the radiation dose rate may not exceed 0.02 mSv per hour (2 mrem per hour) in any position normally occupied in the motor vehicle. For shipments transported as exclusive use under the provisions of §173.441(b) of this subchapter for packages with external radiation levels in excess of 2 mSv (200 mrem per hour) at the package surface, the motor vehicle must meet the requirements of a closed transport vehicle (§173.403 of this subchapter). The total transport index for packages containing fissile material may not exceed 100.

[Amdt. 177-85, 60 FR 50334, Sept. 28, 1995, as amended at 63 FR 52850, Oct. 1, 1998]

§177.843 Contamination of vehicles.

(a) Each motor vehicle used for transporting Class 7 (radioactive) materials under exclusive use conditions in accordance with §173.427(b)(3) or (c) or §173.443(c) of this subchapter must be surveyed with radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at every accessible surface is 0.005 mSv per hour (0.5 mrem per hour) or less and the removable (non-fixed) radioactive surface contamination is not greater than the level prescribed in §173.443(a) of this subchapter.

(b) This section does not apply to any vehicle used solely for transporting Class 7 (radioactive) material if a survey of the interior surface shows that the radiation dose rate does not exceed 0.1 mSv per hour (10 mrem per hour) at the interior surface or 0.02 mSv per hour (2 mrem per hour) at 1 meter (3.3 feet) from any interior surface. These vehicles must be stenciled with the words "For Radioactive Materials Use Only" in lettering at least 7.6 centimeters (3 inches) high in a conspicuous place, on both sides of the exterior of the vehicle. These vehicles must be kept closed at all times other than loading and unloading.

(c) In case of fire, accident, breakage, or unusual delay involving shipments of Class 7 (radioactive) material, see §177.854.

[Amdt. 177-3, 33 FR 14933, Oct. 4, 1968, as amended by Amdt. 177-35, 41 FR 16131, Apr. 15, 1976; Amdt. 177-57, 48 FR 10247, Mar. 10, 1983; Amdt. 177-78, 55 FR 52712, Dec. 21, 1990; Amdt. 177-85, 60 FR 50335, Sept. 28, 1995; 63 FR 52850, Oct. 1, 1998]

Subpart C - Segregation and Separation Chart of Hazardous Materials

§177.848 Segregation of hazardous materials.

(a) This section applies to materials which meet one or more of the hazard classes defined in this subchapter and are:

(1) In packages which require labels in accordance with part 172 of this subchapter;

(2) In a compartment within a multi-compartmented cargo tank subject to the restrictions in §173.33 of this subchapter; or

(3) In a portable tank loaded in a transport vehicle or freight container.

(b) When a transport vehicle is to be transported by vessel, other than a ferry vessel, hazardous materials on or within that vehicle must be stowed and segregated in accordance with §176.83(b) of this subchapter.

(c) In addition to the provisions of paragraph (d) of this section, cyanides or cyanide mixtures may not be loaded or stored with acids.

(d) Hazardous materials may not be loaded, transported, or stored together, except as provided in this section, and in accordance with the following table:

Segregation Table for Hazardous Materials

Class or division		Notes	1.1 1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas zone A	2.3 gas Zone B	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG I zone A	7	8 liquids only
Explosives	1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives	1.3	-	*	*	*	*	*	X	-	X	X	X	-	X	X	X	X	X	-	X
Explosives	1.4	-	*	*	*	*	*	O	-	O	O	O	-	O	-	-	-	O	-	O
Very insensitive explosives	1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives	1.6	-	*	*	*	*	*	-	-	-	-	-	-	-	-	-	-	-	-	-
Flammable gases	2.1	-	X	X	O	X	-	-	-	X	O	-	-	-	-	-	-	O	O	-
Non-toxic, non-flammable gases	2.2	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poisonous gas Zone A	2.3	-	X	X	O	X	-	X	-	-	-	X	X	X	X	X	X	-	-	X
Poisonous gas Zone B	2.3	-	X	X	O	X	-	O	-	-	-	O	O	O	O	O	O	-	-	O
Flammable liquids	3	-	X	X	O	X	-	-	-	X	O	-	-	-	-	O	-	X	-	-
Flammable solids	4.1	-	X	-	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Spontaneously combustible materials	4.2	-	X	X	O	X	-	-	-	X	O	-	-	-	-	-	-	X	-	X
Dangerous when wet materials	4.3	-	X	X	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Oxidizers	5.1	A	X	X	-	X	-	-	-	X	O	O	-	-	-	-	-	X	-	O
Organic peroxides	5.2	-	X	X	-	X	-	-	-	X	O	-	-	-	-	-	-	X	-	O
Poisonous liquids PG I Zone A	6.1	-	X	X	O	X	-	O	-	-	-	X	X	X	X	X	X	-	-	X

Radioactive materials	7	-	X	-	-	X	-	O	-	-	-	-	-	-	-	-	-	-	-	-
Corrosive liquids	8	-	X	X	O	X	-	-	-	X	O	-	O	X	O	O	O	X	-	-

(e) Instructions for using the segregation table for hazardous materials are as follows:

(1) The absence of any hazard class or division or a blank space in the table indicates that no restrictions apply.

(2) The letter "X" in the table indicates that these materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation.

(3) The letter "O" in the table indicates that these materials may not be loaded, transported, or stored together in the same transport vehicle or storage facility during the course of transportation unless separated in a manner that, in the event of leakage from packages under conditions normally incident to transportation, commingling of hazardous materials would not occur. Notwithstanding the methods of separation employed, Class 8 (corrosive) liquids may not be loaded above or adjacent to Class 4 (flammable) or Class 5 (oxidizing) materials; except that shippers may load truckload shipments of such materials together when it is known that the mixture of contents would not cause a fire or a dangerous evolution of heat or gas.

(4) The "*" in the table indicates that segregation among different Class 1 (explosive) materials is governed by the compatibility table in paragraph (f) of this section.

(5) The note "A" in the second column of the table means that, notwithstanding the requirements of the letter "X", ammonium nitrate (UN 1942) and ammonium nitrate fertilizer may be loaded or stored with Division 1.1 (Class A explosive) or Division 1.5 (blasting agents) materials.

(6) When the §172.101 table or §172.402 of this subchapter requires a package to bear a subsidiary hazard label, segregation appropriate to the subsidiary hazard must be applied when that segregation is more restrictive than that required by the primary hazard. However, hazardous materials of the same class may be stowed together without regard to segregation required for any secondary hazard if the materials are not capable of reacting dangerously with each other and causing combustion or dangerous evolution of heat, evolution of flammable, poisonous, or asphyxiant gases, or formation of corrosive or unstable materials.

(f) Class 1 (explosive) materials shall not be loaded, transported, or stored together, except as provided in this section, and in accordance with the following table:

Compatibility Table For Class 1 (Explosive) Materials

Compatibility group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	-	X	X	X	X	X	X	X	X	X	X	X	X
B	X	-	X	X(4)	X	X	X	X	X	X	X	X	4/5
C	X	X	-	2	2	X	6	X	X	X	X	3	4/5
D	X	X(4	2	-	2	X	6	X	X	X	X	3	4/5

		)											
E	X	X	2	2	-	X	6	X	X	X	X	3	4/5
F	X	X	X	X	X	-	X	X	X	X	X	X	4/5
G	X	X	6	6	6	X	-	X	X	X	X	X	4/5
H	X	X	X	X	X	X	X	-	X	X	X	X	4/5
J	X	X	X	X	X	X	X	X	-	X	X	X	4/5
K	X	X	X	X	X	X	X	X	X	-	X	X	4/5
L	X	X	X	X	X	X	X	X	X	X	1	X	X
N	X	X	3	3	3	X	X	X	X	X	X	-	4/5
S	X	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	X	4/5	-

(g) Instructions for using the compatibility table for Class 1 (explosive) materials are as follows:

(1) A blank space in the table indicates that no restrictions apply.

(2) The letter "X" in the table indicates that explosives of different compatibility groups may not be carried on the same transport vehicle.

(3) The numbers in the table mean the following:

(i) "1" means an explosive from compatibility group L shall only be carried on the same transport vehicle with an identical explosive.

(ii) "2" means any combination of explosives from compatibility groups C, D, or E is assigned to compatibility group E.

(iii) "3" means any combination of explosives from compatibility groups C, D, or E with those in compatibility group N is assigned to compatibility group D.

(iv) "4" means §177.835(g) when transporting detonators.

(v) "5" means Division 1.4S fireworks may not be loaded on the same transport vehicle with Division 1.1 or 1.2 (Class A explosive) materials.

(vi) "6" means explosive articles in compatibility group G, other than fireworks and those requiring special stowage, may be stowed with articles of compatibility groups C, D and E, provided no explosive substances are carried in the same vehicle.

(h) Except as provided in paragraph (i) of this section, explosives of the same compatibility group but of different divisions may be transported together provided that the whole shipment is transported as though its entire contents were of the lower numerical division (i.e., Division 1.1 being lower than Division 1.2). For example, a mixed shipment of Division 1.2 (Class A explosive) materials and Division 1.4 (Class C explosive) materials, both of compatibility group D, must be transported as Division 1.2 (Class A explosive) materials.

(i) When Division 1.5 (blasting agent) materials, compatibility group D, are transported in the same freight container as Division 1.2 (Class A explosive) materials, compatibility group D, the shipment must be transported as Division 1.1 (Class A explosive) materials, compatibility group D.

[Amdt. 177-78, 55 FR 52712, Dec. 21, 1990, as amended at 56 FR 66283, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; 57 FR 47513, Oct. 16, 1992; Amdt. 177-78, 57 FR 59310, Dec. 15, 1992; Amdt. 177-82, 58 FR 50237, Sept. 24, 1993; Amdt. 177-83, 59

FR 49134, Sept. 26, 1994; Amdt. 177-87, 61 FR 27175, May 30, 1996; 63 FR 37462, July 10, 1998; 64 FR 10782, Mar. 5, 1999]

Subpart D - Vehicles and Shipments in Transit; Accidents

§177.854 Disabled vehicles and broken or leaking packages; repairs.

(a) *Care of lading, hazardous materials. Whenever for any cause other than necessary traffic stops any motor vehicle transporting any hazardous material is stopped upon the traveled portion of any highway or shoulder thereof, special care shall be taken to guard the vehicle and its load or to take such steps as may be necessary to provide against hazard. Special effort shall be made to remove the motor vehicle to a place where the hazards of the materials being transported may be provided against. See §§392.22, 392.24, and 392.25 of this title for warning devices required to be displayed on the highway.*

(b) Disposition of containers found broken or leaking in transit. When leaks occur in packages or containers during the course of transportation, subsequent to initial loading, disposition of such package or container shall be made by the safest practical means afforded under paragraphs (c), (d), and (e) of this section.

(c) Repairing or overpacking packages. (1) Packages may be repaired when safe and practicable, such repairing to be in accordance with the best and safest practice known and available.

(2) Packages of hazardous materials that are damaged or found leaking during transportation, and hazardous materials that have spilled or leaked during transportation, may be forwarded to destination or returned to the shipper in a salvage drum in accordance with the requirements of §173.3(c) of this subchapter.

(d) *Transportation of repaired packages. Any package repaired in accordance with the requirements of paragraph (c)(1) of this section, except as provided in §§177.855(c), 177.856(c), and 177.858(b), may be transported to the nearest place at which it may safely be disposed of only in compliance with the following requirements:*

(1) The package must be safe for transportation.

(2) The repair of the package must be adequate to prevent contamination of or hazardous admixture with other lading transported on the same motor vehicle therewith.

(3) If the carrier is not himself the shipper, the consignee's name and address must be plainly marked on the repaired package.

(e) *Disposition of unsafe broken packages. In the event any leaking package or container cannot be safely and adequately repaired for transportation or transported, it shall be stored pending proper disposition in the safest and most expeditious manner possible.*

(f) Stopped vehicles; other dangerous articles. Whenever any motor vehicle transporting Class 3 (flammable liquid), Class 4 (flammable solid), Class 5 (oxidizing), Class 8 (corrosive), Class 2 (gases), or Division 6.1 (poisonous) materials, is stopped for any cause other than necessary traffic stops upon the traveled portion of any highway, or a shoulder next thereto, the following requirements shall be complied with during the period of such stop:

(1) For motor vehicles other than cargo tanks used for the transportation of Class 3 (flammable liquid) or Division 2.1 (flammable gas) materials and not transporting Division 1.1, 1.2, or 1.3 (Class A or B explosive) materials, warning devices must be set out in the manner prescribed by §392.22 of this title.

(2) For cargo tanks used for the transportation of Class 3 (flammable liquid) or Division 2.1 (flammable gas) materials, whether loaded or empty, and vehicles transporting Division 1.1, 1.2, or 1.3 (explosive) materials, warning devices must be set out in the manner prescribed by §392.25 of this title.

(g) *Repair and maintenance of vehicles containing certain hazardous materials-(1) General. No person may use heat, flame or spark producing devices to repair or maintain the cargo or fuel containment system of a motor vehicle required to be placarded, other than COMBUSTIBLE, in accordance with subpart F of part 172 of this subchapter. As used in this section, "containment system" includes all vehicle components intended physically to contain cargo or fuel during loading or filling, transport, or unloading.*

(2) Repair and maintenance inside a building. No person may perform repair or maintenance on a motor vehicle subject to paragraph (g)(1) of this section inside a building unless:

(i) The motor vehicle's cargo and fuel containment systems are closed (except as necessary to maintain or repair the vehicle's motor) and do not show any indication of leakage;

(ii) A means is provided, and a person capable to operate the motor vehicle is available, to immediately remove the motor vehicle if necessary in an emergency;

(iii) The motor vehicle is removed from the enclosed area upon completion of repair or maintenance work; and

(iv) For motor vehicles loaded with Division 1.1, 1.2, or 1.3 (Class A or B explosive), Class 3 (flammable liquid), or Division 2.1 (flammable gas) materials, all sources of spark, flame or glowing heat within the area of enclosure (including any heating system drawing air therefrom) are extinguished, made inoperable or rendered explosion-proof by a suitable method. *Exception: Electrical equipment on the vehicle, necessary to accomplish the maintenance function, may remain operational.*

(h) No repair with flame unless gas-free. No repair of a cargo tank used for the transportation of any Class 3 (flammable liquid) or Division 6.1 (poisonous liquid) material, or any compartment thereof, or of any container for fuel of whatever nature, may be repaired by any method employing a flame, arc, or other means of welding, unless the tank or compartment shall first have been made gas-free.

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.854, SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

Subpart E - Regulations Applying to Hazardous Material on Motor Vehicles Carrying Passengers for Hire

§177.870 Regulations for passenger carrying vehicles.

(a) *Vehicles transporting passengers and property. In addition to the regulations in parts 170-189 of this subchapter the following requirements shall apply to vehicles transporting passengers and property.*

(b) No Class 1 (explosive) materials or other hazardous materials on passenger-carrying vehicles, exceptions. No hazardous materials except small-arms ammunition, emergency shipments of drugs, chemicals and hospital supplies, and the accompanying munitions of war of the Departments of the Army, Navy, and Air Force of the United States Government, are authorized by parts 170-189 of this subchapter to be transported on motor vehicles carrying passengers for hire where other practicable means of transportation is available.

(c) Class 1 (explosive) materials in passenger-carrying space forbidden. No Class 1 (explosive) material, except small-arms ammunition, may be carried in the passenger-carrying space of any motor vehicle transporting passengers for hire.

(d) Hazardous materials on passenger carrying vehicles; quantity. Where no other practicable means of transportation is available the following articles in the quantities as shown may be transported in motor vehicles carrying passengers for hire in a space other than that provided for passengers: Not to exceed 45 kg (99 pounds) gross weight of any or all of the kinds of Class 1 (explosive) materials permitted to be transported by passenger-carrying aircraft or rail car may be transported on a motor vehicle transporting passengers: Provided, however, That samples of Class 1 (explosive) materials for laboratory examination, not to exceed two samples, or a total of no more than 100 detonators, Division 1.4 (Class C explosive) materials at one time in a single motor vehicle, may be transported in a motor vehicle transporting passengers.

(e) Articles other than Class 1 (explosive) materials on passenger-carrying vehicles. The gross weight of any given class of hazardous material other than Class 1 (explosive) materials shall not exceed 45 kg (99 pounds), and the aggregate weight of all such other dangerous articles shall not exceed 225 kg (496 pounds). This provision does not apply to nontoxic, nonflammable refrigerants, when such refrigerant is for servicing operations of a motor carrier on whose motor vehicles the refrigerant is used. A cylinder secured against movement while in transit and not exceeding 113 kg (250 pounds) gross weight may be transported.

(f) Division 6.1 (poisonous) or Division 2.3 (poisonous gas) materials on passenger-carrying vehicles. No motor carrier may transport any extremely dangerous Division 6.1 (poisonous) or Division 2.3 (poisonous gas) material, or any paranitroaniline, in any amount, in or on any bus while engaged in the transportation of passengers; or any less dangerous Division 6.1 (poisonous) material, which is other than a liquid, in any amount exceeding an aggregate of 45 kg (99 pounds) gross weight in or on any such bus.

(g) Class 7 (radioactive) materials. In addition to the limitations prescribed in paragraphs (b) and (e) of this section, no person may transport any Class 7 (radioactive) material requiring labels under §§172.436, 172.438, and 172.440 of this subchapter in or on any motor vehicle carrying passengers for hire except where no other practicable means of transportation is available. Packages of Class 7 (radioactive) materials must be stored only in the trunk or baggage compartment of the vehicle, and must not be stored in any compartment occupied by persons. Packages of Class 7 (radioactive) materials must be handled and placed in the vehicle as prescribed in §177.842.

[29 FR 18795, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §177.870 SEE THE LIST OF CFR SECTIONS AFFECTED APPEARING IN THE FINDING AIDS SECTION OF THIS VOLUME.

Pt. 178

[CFR] PART 178 - SPECIFICATIONS FOR PACKAGINGS

TABLE OF CONTENTS

[TITLE 49] [SUBTITLE B] [PART 178]

Sec.

Subpart A [Reserved]

Subpart B-Specifications for Inside Containers, and Linings

Subpart C-Specifications for Cylinders

Subparts D-G [Reserved]

Subpart H-Specifications for Portable Tanks

Subpart I [Reserved]

Subpart J-Specifications for Containers for Motor Vehicle Transportation

Subpart K-Specifications for Packagings for Class 7 (Radioactive) Materials

Subpart L-Non-bulk Performance-Oriented Packaging Standards

Sec.

Subpart M-Testing of Non-bulk Packagings and Packages

Subpart N-Intermediate Bulk Container Performance-Oriented Standards

Subpart O-Testing of Intermediate Bulk Containers

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

[CFR] PART 178 - SPECIFICATIONS FOR PACKAGINGS

INTRODUCTORY TEXT

[TITLE 49] [SUBTITLE B] [PART 178]

§178.1 Purpose and scope.
This part prescribes the manufacturing and testing specifications for packaging and containers used for the transportation of hazardous materials in commerce.

[Amdt. 178-40, 42 FR 2689, Jan. 13, 1977. Redesignated by Amdt. 178-97, 55 FR 52715, Dec. 21, 1990]

§178.2 Applicability and responsibility.
(a) *Applicability. (1) The requirements of this part apply to packagings manufactured-*
(i) To a DOT specification, regardless of country of manufacture; or
(ii) To a UN standard, for packagings manufactured within the United States. For UN standard packagings manufactured outside the United States, see §173.24(d)(2) of this subchapter. For UN standard packagings for which standards are not prescribed in this part, see §178.3(b).
(2) A manufacturer of a packaging subject to the requirements of this part is primarily responsible for compliance with the requirements of this part. However, any person who performs a function prescribed in this part shall perform that function in accordance with this part.
(b) *Specification markings. When this part requires that a packaging be marked with a DOT specification or UN standard marking, marking of the packaging with the appropriate DOT or UN markings is the certification that-*

(1) Except as otherwise provided in this section, all requirements of the DOT specification or UN standard, including performance tests, are met; and

(2) All functions performed by, or on behalf of, the person whose name or symbol appears as part of the marking conform to requirements specified in this part.

(c) *Notification. Except as specifically provided in §§178.337-18 and 178.345-10 of this part, the manufacturer or other person certifying compliance with the requirements of this part, and each subsequent distributor of that packaging shall-*

(1) Notify in writing each person to whom that packaging is transferred-

(i) Of all requirements in this part not met at the time of transfer, and

(ii) Of the type and dimensions of any closures, including gaskets, needed to satisfy performance test requirements.

(2) Retain copies of each written notification for at least one year from date of issuance; and

(3) Make copies of all written notifications available for inspection by a representative of the Department.

(d) Except as provided in paragraph (c) of this section, a packaging not conforming to the applicable specifications or standards in this part may not be marked to indicate such conformance.

(e) *Definitions. For the purpose of this part-*

Manufacturer means the person whose name and address or symbol appears as part of the specification markings required by this part or, for a packaging marked with the symbol of an approval agency, the person on whose behalf the approval agency certifies the packaging.

Specification markings mean the packaging identification markings required by this part including, where applicable, the name and address or symbol of the packaging manufacturer or approval agency.

(f) No packaging may be manufactured or marked to a packaging specification that was in effect on September 30, 1991, and that was removed from this part 178 by a rule published in the FEDERAL REGISTER ON DECEMBER 21, 1990 AND EFFECTIVE OCTOBER 1, 1991.

[Amdt. 178-97, 55 FR 52715, Dec. 21, 1990; 56 FR 66284, Dec. 20, 1991, as amended by Amdt. No. 178-106, 59 FR 67519, Dec. 29, 1994; Amdt. 178-117, 62 FR 14338, Mar. 26, 1997]

§178.3 Marking of packagings.

(a) Each packaging represented as manufactured to a DOT specification or a UN standard must be marked with specification markings conforming to the applicable specification, and with the following:

(1) In an unobstructed area, with letters, and numerals identifying the standards or specification (e.g. UN 1A1, DOT 4B240ET, etc.).

(2) Unless otherwise specified in this part, with the name and address or symbol of

the packaging manufacturer or, where specifically authorized, the symbol of the approval agency certifying compliance with a UN standard. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety. Duplicative symbols are not authorized.

(3) The markings must be stamped, embossed, burned, printed or otherwise marked on the packaging to provide adequate accessibility, permanency, contrast, and legibility so as to be readily apparent and understood.

(4) Unless otherwise specified, letters and numerals must be at least 12.0 mm (0.47 inches) in height except that for packagings of less than or equal to 30 L (7.9 gallons) capacity for liquids or 30 kg (66 pounds) capacity for solids the height must be at least 6.0 mm (0.2 inches). For packagings having a capacity of 5 L (1 gallon) or 5 kg (11 pounds) or less, letters and numerals must be of an appropriate size.

(5) For packages with a gross mass of more than 30 kg (66 pounds), the markings or a duplicate thereof must appear on the top or on a side of the packaging.

(b) A UN standard packaging for which the UN standard is set forth in this part may be marked with the United Nations symbol and other specification markings only if it fully conforms to the requirements of this part. A UN standard packaging for which the UN standard is not set forth in this part may be marked with the United Nations symbol and other specification markings for that standard as provided in the ICAO Technical Instructions or Annex 1 of the IMDG Code subject to the following conditions:

(1) The U.S. manufacturer must establish that the packaging conforms to the applicable provisions of the ICAO Technical Instructions or Annex 1 of the IMDG Code, respectively.

(2) If an indication of the name of the manufacturer or other identification of the packaging as specified by the competent authority is required, the name and address or symbol of the manufacturer or the approval agency certifying compliance with the UN standard must be entered. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(3) The letters "USA" must be used to indicate the State authorizing the allocation of the specification marks if the packaging is manufactured in the United States.

(c) Where a packaging conforms to more than one UN standard or DOT specification, the packaging may bear more than one marking, provided the packaging meets all the requirements of each standard or specification. Where more than one marking appears on a packaging, each marking must appear in its entirety.

(d) No person may mark or otherwise certify a packaging or container as meeting the requirements of a manufacturing exemption unless that person is the holder of or a party to that exemption, an agent of the holder or party for the purpose of marking or certification, or a third party tester.

[Amdt. 178-97, 55 FR 52716, Dec. 21, 1990; 56 FR 66284, Dec. 20, 1991, as amended by Amdt. No. 178-106, 59 FR 67519, Dec. 29, 1994; Amdt. 178-113, 61 FR 21102, May 9, 1996]

[CFR] PART 178 SUBPART A - [Reserved]

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART A]

Subpart A - [Reserved]

[CFR] PART 178 SUBPART B - Specifications for Inside Containers, and Linings

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART B]

Subpart B - Specifications for Inside Containers, and Linings

Source: 29 FR 18823, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§178.33 Specification 2P; inner nonrefillable metal receptacles.

§178.33-1 Compliance.

(a) Required in all details.
(b) [Reserved]

§178.33-2 Type and size.

(a) Single-trip inside containers. Must be seamless, or with seams, welded, soldered, brazed, double seamed, or swedged.
(b) The maximum capacity of containers in this class shall not exceed one liter (61.0 cubic inches). The maximum inside diameter shall not exceed 3 inches.

[29 FR 18813, Dec. 29, 1964, as amended by Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-101, 58 FR 50237, Sept. 24, 1993]

§178.33-3 Inspection.

(a) By competent inspector.
(b) [Reserved]

§178.33-4 Duties of inspector.

(a) To inspect material and completed containers and witness tests, and to reject defective materials or containers.
(b) [Reserved]

§178.33-5 Material.

(a) Uniform quality steel plate such as black plate, electro-tin plate, hot dipped tin plate, tern plate or other commercially accepted can making plate; or nonferrous metal of uniform drawing quality.
(b) Material with seams, cracks, laminations or other injurious defects not authorized.

§178.33-6 Manufacture.

(a) By appliances and methods that will assure uniformity of completed containers; dirt and scale to be removed as necessary; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.
(b) Seams when used must be as follows:
(1) Circumferential seams: By welding, swedging, brazing, soldering, or double seaming.
(2) Side seams: By welding, brazing, or soldering.
(c) Ends: The ends shall be of pressure design.

[29 FR 18823, Dec. 29, 1964, as amended by Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33-7 Wall thickness.

(a) The minimum wall thickness for any container shall be 0.007 inch.
(b) [Reserved]

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33-8 Tests.

(a) One out of each lot of 25,000 containers or less, successively produced per day shall be pressure tested to destruction and must not burst below 240 pounds per square inch gauge pressure. The container tested shall be complete with end assembled.

(b) Each such 25,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional containers may be selected at random and subjected to the test under which failure occurred. These containers shall be complete with ends assembled. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design construction, finish, and quality.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33-9 Marking.

(a) By means of printing, lithographing, embossing, or stamping, each container must be marked to show:

(1) DOT-2P.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(b) [Reserved]

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976, as amended by Amdt. 178-97, 56 FR 66287, Dec. 20, 1991]

§178.33a Specification 2Q; inner nonrefillable metal receptacles.

§178.33a-1 Compliance.

(a) Required in all details.

(b) [Reserved]

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-2 Type and size.

(a) Single-trip inside containers. Must be seamless, or with seams welded, soldered, brazed, double seamed, or swedged.

(b) The maximum capacity of containers in this class shall not exceed one liter (61.0 cubic inches). The maximum inside diameter shall not exceed 3 inches.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-43, 42 FR 42208, Aug. 22, 1977; Amdt. 178-101, 58 FR 50237, Sept. 24, 1993]

§178.33a-3 Inspection.

(a) By competent inspector.

(b) [Reserved]

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-4 Duties of inspector.

(a) To inspect material and completed containers and witness tests, and to reject defective materials or containers.

(b) [Reserved]

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-5 Material.

(a) Uniform quality steel plate such as black plate, electrotin plate, hot dipped tinplate, ternplate or other commercially accepted can making plate; or nonferrous metal of uniform drawing quality.

(b) Material with seams, cracks, laminations or other injurious defects not authorized.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-6 Manufacture.

(a) By appliances and methods that will assure uniformity of completed containers; dirt and scale to be removed as necessary; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

(b) Seams when used must be as follows:

(1) Circumferential seams. By welding, swedging, brazing, soldering, or double seaming.

(2) Side seams. By welding, brazing or soldering.

(c) Ends. The ends shall be of pressure design.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-7 Wall thickness.

(a) The minimum wall thickness for any container shall be 0.008 inch.

(b) [Reserved]

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-8 Tests.

(a) One out of each lot of 25,000 containers or less, successively produced per day, shall be pressure tested to destruction and must not burst below 270 pounds per square inch gauge pressure. The container tested shall be complete with end assembled.

(b) Each such 25,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional containers may be selected at random and subjected to the test under which failure occurred. These containers shall be complete with ends assembled. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design, construction, finish and quality.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.33a-9 Marking.

(a) By means of printing, lithographing, embossing, or stamping, each container must be marked to show:

(1) DOT-2Q.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(b) [Reserved]

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976, as amended by Amdt. 178-97, 56 FR

66287, Dec. 20, 1991]

[CFR] PART 178 SUBPART C - Specifications for Cylinders

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART C]

Subpart C - Specifications for Cylinders

Source: Amdt. 178-114, 61 FR 25942, May 23, 1996, unless otherwise noted.

§178.35 General requirements for specification cylinders.

(a) *Compliance. Compliance with the requirements of this subpart is required in all details.*
(b) Inspections and analyses. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Administrator, in accordance with §173.300b of this subchapter. Inspections and verifications must be performed by-
(1) An independent inspection agency approved in writing by the Associate Administrator, in accordance with §173.300a of this subchapter; or
(2) For DOT Specifications 3B, 3BN, 3E, 4B, 4BA, 4D (water capacity less than 1,100 cubic inches), 4B240ET, 4AA480, 4L, 8, 8AL, 4BW, 39 (marked service pressure 900 p.s.i.g. or lower) and 4E manufactured in the United States, a competent inspector of the manufacturer.
(c) *Duties of inspector. The inspector shall determine that each cylinder made is in conformance with the applicable specification. Except as otherwise specified in the applicable specification, the inspector shall perform the following:*
(1) Inspect all material and reject any not meeting applicable requirements. For cylinders made by the billet-piercing process, billets must be inspected and shown to be free from pipe, cracks, excessive segregation and other injurious defects after parting or, when applicable, after nick and cold break.
(2) Verify the material of construction meets the requirements of the applicable specification by-
(i) Making a chemical analysis of each heat of material;
(ii) Obtaining a certified chemical analysis from the material manufacturer for each heat of material (a ladle analysis is acceptable); or
(iii) If an analysis is not provided for each heat of material by the material manufacturer, by making a check analysis of a sample from each coil, sheet, or tube.
(3) Verify compliance of cylinders with the applicable specification by-

(i) Verifying identification of material is proper;
(ii) Inspecting the inside of the cylinder before closing in ends;
(iii) Verifying that the heat treatment is proper;
(iv) Obtaining samples for all tests and check chemical analyses;
(v) Witnessing all tests;
(vi) Verify threads by gauge;
(vii) Reporting volumetric capacity and tare weight (see report form) and minimum thickness of wall noted; and
(viii) Verifying that each cylinder is marked in accordance with the applicable specification.
(4) Furnish complete test reports required by this subpart to the maker of the cylinder and, upon request, to the purchaser. The test report must be retained by the inspector for fifteen years from the original test date of the cylinder.
(d) *Defects. A cylinder may not be constructed of material with seams, cracks, laminations, or other injurious defects.*
(e) Safety devices. Safety devices and protection for valves, safety devices, and other connections, if applied, must be as required or authorized by the appropriate specification, and as required in §§173.34 and 173.301 of this subchapter.
(f) Markings. Markings on a DOT Specification cylinder must conform to applicable requirements.
(1) Each cylinder must be marked with the following information:
(i) The DOT specification marking must appear first, followed immediately by the service pressure. For example, DOT-3A1800.
(ii) The serial number must be placed just below or immediately following the DOT specification marking.
(iii) A symbol (letters) must be placed just below, immediately before or following the serial number. Other variations in sequence of markings are authorized only when necessitated by a lack of space. The symbol and numbers must be those of the manufacturer. The symbol must be registered with the Associate Administrator; duplications are not authorized.
(iv) The inspector's official mark and date of test (such as 5-95 for May 1995) must be placed near the serial number. This information must be placed so that dates of subsequent tests can be easily added. An example of the markings prescribed in this paragraph (f)(1) is as follows:

DOT-3A1800
1234
XY
AB 5-95

Or;

DOT-3A1800-1234-XY
AB 5-95

Where:

DOT-3A = specification number
1800 = service pressure
1234 = serial number
xy = symbol of manufacturer
AB = inspector's mark
5-95 = date of test

(2) Additional required marking must be applied to the cylinder as follows:

(i) The word "spun" or "plug" must be placed near the DOT specification marking when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

(ii) As prescribed in specification 3HT (§178.44) or 3T (§178.45), if applicable.

(3) Marking exceptions.

(i) A DOT 3E cylinder is not required to be marked with the inspector mark.

(ii) An identifying lot number may be marked on the cylinder in place of a serial number for cylinders not over 2 inches outside diameter or for cylinders with a volumetric capacity not exceeding 60 cubic inches. Each lot shall not have over 500 cylinders.

(4) Unless otherwise specified in the applicable specification, the markings on each cylinder must be stamped plainly and permanently on the shoulder, top head, or neck.

(5) The size of each marking must be at least 0.25 inch or as space permits.

(6) Other markings are authorized provided they are made in low stress areas other than the side wall and are not of a size and depth that will create harmful stress concentrations. Such marks may not conflict with any DOT required markings.

(g) *Inspector's report. Each inspector shall prepare a report containing, at a minimum, the applicable information listed in CGA Pamphlet C-11 or, until October 1, 1997, in accordance with the applicable test report requirements of this subchapter in effect on September 30, 1996. Any additional information or markings that are required by the applicable specification must be shown on the test report. The signature of the inspector on the reports certifies that the processes of manufacture and heat treatment of cylinders were observed and found satisfactory.*

(h) Report retention. The manufacturer of the cylinders shall retain the reports required by this subpart for 15 years from the original test date of the cylinder.

§178.36 Specification 3A and 3AX seamless steel cylinders.

(a) Type size and service pressure. In addition to the requirements of §178.35, cylinders must conform to the following:

(1) A DOT-3A cylinder is a seamless steel cylinder with a water capacity (nominal) not over 1,000 pounds and a service pressure of at least 150 pounds per square inch.

(2) A DOT-3AX is a seamless stainless steel cylinder with a water capacity not less than 1,000 pounds and a service pressure of at least 500 pounds per square inch, conforming to the following requirements:
(i) Assuming the cylinder is to be supported horizontally at its two ends only and to be uniformly loaded over its entire length consisting of the weight per unit of length of the straight cylindrical portion filled with water and compressed to the specified test pressure; the sum of two times the maximum tensile stress in the bottom fibers due to bending, plus that in the same fibers (longitudinal stress), due to hydrostatic test may not exceed 80 percent of the minimum yield strength of the steel at such maximum stress. Wall thickness must be increased when necessary to meet the requirement.
(ii) To calculate the maximum longitudinal tensile stress due to bending, the following formula must be used:

$$S=Mc/I$$

(iii) To calculate the maximum longitudinal tensile stress due to hydrostatic test pressure, the following formula must be used:

$$S = A_1 P/A_2$$

where:

S = tensile stress-p.s.i.;
M = bending moment-inch pounds-$(wl^2)/8$;
w = weight per inch of cylinder filled with water;
l = length of cylinder-inches;
c = radius (D)/(2) of cylinder-inches;
I = moment of inertia-0.04909 (D^4-d^4) inches fourth;
D = outside diameter-inches;
d = inside diameter-inches;
A_1 = internal area in cross section of cylinder-square inches;
A_2 = area of metal in cross section of cylinder-square inches;
P=hydrostatic test pressure-p.s.i.

(b) *Steel. Open-hearth or electric steel of uniform quality must be used. Content percent may not exceed the following: Carbon, 0.55; phosphorous, 0.045; sulphur, 0.050.*
(c) Identification of material. Material must be identified by any suitable method, except that plates and billets for hot-drawn cylinders must be marked with the heat number.
(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No fissure or other defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. If not

originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses must be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

(e) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, the carbon content of which may not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedures.

(2) As permitted in paragraph (d) of this section.

(3) Cylinders used solely in anhydrous ammonia service may have a $^{1/2}$ inch diameter bar welded within their concave bottoms.

(f) *Wall thickness. For cylinders with service pressure less than 900 pounds, the wall stress may not exceed 24,000 pounds per square inch. A minimum wall thickness of 0.100 inch is required for any cylinder over 5 inches outside diameter. Wall stress calculation must be made by using the following formula:*

$S = [P(1.3D^2+0.4d^2)]/(D^2-d^2)$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. The completed cylinder must be uniformly and properly heat-treated prior to tests.*

(h) Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads are required on openings.

(1) Threads must be clean cut, even, without checks, and to gauge.

(2) Taper threads, when used, must be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 6 engaged threads are authorized. Straight threads must have a tight fit and calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test, as follows:*

(1) The test must be by water-jacket, or other suitable methods, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus the test pressure cannot be maintained the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent, volumetric expansion may not exceed 10 percent of the total volumetric expansion at test pressure.

(4) Each cylinder must be tested to at least $^{5/3}$ times service pressure.

(j) *Flattening test. A flattening test must be performed on one cylinder taken at random out or each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^{o} included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material as follows:

(1) The test is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(2) Specimens must conform to the following:

(i) Gauge length of 8 inches with a width of not over $1^{1/2}$ inches, a gauge length of 2 inches with a width of not over $1^{1/2}$ inches, or a gauge length of at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2-percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading must be set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed 1/8 inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. Either of the following is an acceptable result:*

(1) An elongation at least 40 percent for a 2-inch gauge length or at least 20 percent in other cases and yield strength not over 73 percent of tensile strength. In this instance, the flattening test is not required.

(2) An elongation at least 20 percent for a 2-inch gauge length or 10 percent in other cases and a yield strength not over 73 percent of tensile strength. In this instance, the flattening test is required, without cracking, to 6 times the wall thickness.

(m) *Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture subject to the following conditions and limitations:*

(1) Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Except as provided in paragraph (n) of this section, a cylinder that is leaking must be rejected.

(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(4) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, the manufacturer should design the test apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(n) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. Spun cylinders rejected under the provisions of paragraph (m) of this section may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.*

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended at 62 FR 51561, Oct. 1, 1997]

§178.37 Specification 3AA and 3AAX seamless steel cylinders.

(a) *Type, size and service pressure. In addition to the requirements of §178.35, cylinders must conform to the following:*

(1) A DOT-3AA cylinder is a seamless steel cylinder with a water capacity (nominal) of not over 1,000 pounds and a service pressure of at least 150 pounds per square inch.

(2) A DOT-3AAX cylinder is a seamless steel cylinder with a water capacity of not less than 1,000 pounds and a service pressure of at least 500 pounds per square inch, conforming to the following requirements:

(i) Assuming the cylinder is to be supported horizontally at its two ends only and to be uniformly loaded over its entire length consisting of the weight per unit of length of the straight cylindrical portion filled with water and compressed to the specified test pressure; the sum of two times the maximum tensile stress in the bottom fibers due to bending, plus that in the same fibers (longitudinal stress), due to hydrostatic test pressure may not exceed 80 percent of the minimum yield strength of the steel at such maximum stress. Wall thickness must be increased when necessary to meet the requirement.

(ii) To calculate the maximum tensile stress due to bending, the following formula must be used:

$$S = Mc/I$$

(iii) To calculate the maximum longitudinal tensile stress due to hydrostatic test pressure, the following formula must be used:

$$S = A^1P/A^2$$

Where:

S = tensile stress-p.s.i.;
M = bending moment-inch pounds $(wl^2)/8$;
w = weight per inch of cylinder filled with water;
l = length of cylinder-inches;
c = radius (D)/(2) of cylinder-inches;
I = moment of inertia-0.04909 $(D^4\text{-}d^4)$ inches fourth;
D = outside diameter-inches;
d = inside diameter-inches;
A^1 = internal area in cross section of cylinder-square inches;
A^2 = area of metal in cross section of cylinder-square inches;
P = hydrostatic test pressure-p.s.i.

(b) *Authorized steel. Open-hearth, basic oxygen, or electric steel of uniform quality* *must be used. A heat of steel made under the specifications in table 1 of this paragraph (b), check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in table 2 of this paragraph (b) are not exceeded. When a carbon-boron steel is used, a hardenability test must be performed on the first and last ingot of each heat of steel. The results of this test must be recorded on the Record of Chemical Analysis of Material for Cylinders required by §178.35. This hardness test must be made $^{5/16}$-inch from the quenched end of the Jominy quench bar and the hardness must be at least Rc 33 and no more than Rc 53. The following chemical analyses are authorized:*

Table 1-Authorized Materials

Designation	4130X (percent) (see Note 1)	NE-8630 (percent) (see Note 1)	9115 (percent) (see Note 1)	9125 (percent) (see Note 1)	Carbon-boron (percent)	Inter- mediate manganese (percent)
Carbon	0.25/0.35	0.28/0.33	0.10/0.20	0.20/0.30	0.27-0.37	0.40 max.
Manganese	0.40/0.90	0.70/0.90	0.50/0.75	0.50/0.75	0.80-1.40	1.35/1.65.
Phosphorus	0.04 max	0.04 max	0.04 max	0.04 max	0.035 max	0.04 max.
Sulfur	0.05 max	0.04 max	0.04 max	0.04 max	0.045 max	0.05 max.
Silicon	0.15/0.35	0.20/0.35	0.60/0.90	0.60/0.90	0.3 max.	0.10/0.30.
Chromium	0.80/1.10	0.40/0.60	0.50/0.65	0.50/0.65.	-	-
Molybdenum	0.15/0.25	0.15/0.25	-	-	-	-
Zirconium	-	-	0.05/0.15	0.05/0.15	-	-
Nickel	-	0.40/0.70	-	-	-	-
Boron	-	-	-	-	0.0005/0.003.	-

NOTE 1: This designation may not be restrictive and the commercial steel is limited in analysis as shown in this table.

Table 2-Check Analysis Tolerances

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
-	-	Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.02	0.03
-	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
-	Over 0.60 to 1.15 incl	0.04	0.04
-	Over 1.15 to 2.50 incl	0.05	0.05
Phosphorus[1]	All ranges	-	.01
Sulphur	All ranges	-	.01
Silicon	To 0.30 incl	.02	.03
-	Over 0.30 to 1.00 incl	.05	.05

Nickel	To 1.00 incl	.03	.03
Chromium	To 0.90 incl	.03	.03
-	0.90 to 2.90 incl	.05	.05
Molybdenum	To 0.20 incl	.01	.01
-	Over 0.20 to 0.40	.02	.02
Zirconium	All ranges	.01	.05

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material. Material must be identified by any suitable method except that plates and billets for hot-drawn cylinders must be marked with the heat number.*

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No fissure or other defects is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses must be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

(e) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, the carbon content of which may not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in paragraph (d) of this section.

(f) *Wall thickness. The thickness of each cylinder must conform to the following:*

(1) For cylinders with a service pressure of less than 900 pounds, the wall stress may not exceed 24,000 pounds per square inch. A minimum wall thickness of 0.100 inch is required for any cylinder with an outside diameter of over 5 inches.

(2) For cylinders with service pressure of 900 p.s.i. or more the minimum wall must be such that the wall stress at the minimum specified test pressure may not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical tests required in paragraphs (k) and (l) of this section and must be not over 70,000 p.s.i.

(3) Calculation must be made by the formula:

$$S = [P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. The completed cylinders must be uniformly and properly heat treated prior to tests. Heat treatment of cylinders of the authorized analyses must be as follows:*

(1) All cylinders must be quenched by oil, or other suitable medium except as provided in paragraph (g)(5) of this section.

(2) The steel temperature on quenching must be that recommended for the steel analysis, but may not exceed 1750 ^{o}F.

(3) All steels must be tempered at a temperature most suitable for that steel.

(4) The minimum tempering temperature may not be less than 1000 ^{o}F except as noted in paragraph (1)(vi) of this section.

(5) Steel 4130X may be normalized at a temperature of 1650 ^{o}F instead of being quenched and cylinders so normalized need not be tempered.

(6) Intermediate manganese steels may be tempered at temperatures not less than 1150 ^{o}F., and after heat treating each cylinder must be submitted to a magnetic test to detect the presence of quenching cracks. Cracked cylinders must be rejected and destroyed.

(7) Except as otherwise provided in paragraph (g)(6) of this section, all cylinders, if water quenched or quenched with a liquid producing a cooling rate in excess of 80 percent of the cooling rate of water, must be inspected by the magnetic particle, dye penetrant or ultrasonic method to detect the presence of quenching cracks. Any cylinder designed to the requirements for specification 3AA and found to have a quenching crack must be rejected and may not be requalified. Cylinders designed to the requirements for specification 3AAX and found to have cracks must have cracks removed to sound metal by mechanical means. Such specification 3AAX cylinders will be acceptable if the repaired area is subsequently examined to assure no defect, and it is determined that design thickness requirements are met.

(h) *Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads are required on openings.*

(1) Threads must be clean cut, even, without checks, and to gauge.

(2) Taper threads, when used, must be of a length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 6 engaged threads are authorized. Straight threads must have a tight fit and a calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1

percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Each cylinder must be tested to at least $^{5/3}$ times the service pressure.

(j) *Flattening test. A flattening test must be performed on one cylinder taken at random out of each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^{o} included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material as follows:

(1) The test is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat treatment as the finished cylinder.

(2) Specimens must conform to the following:

(i) Gauge length of 8 inches with a width of not over 1$^{1/2}$ inches, a gauge length of 2 inches with a width of not over 1$^{1/2}$ inches, or a gauge length of at least 24 times the thickness with width not over 6 times thickness when the thickness of the cylinder wall is not over $^{3/16}$ inch.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length.

Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. An acceptable result for physical and flattening tests is elongation at least 20 percent for 2 inches of gauge length or at least 10 percent in other cases. Flattening is required, without cracking, to 6 times the wall thickness of the cylinder.*

(m) Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than the service pressure, must be applied to one side of the finished bottom over an area of at least $^{1/16}$ of the total area of the bottom but not less than $^{3/4}$ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Except as provided in paragraph (n) of this section, a cylinder must be rejected if there is any leaking.

(1) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(2) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(3) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, the manufacturer should design the test apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(n) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. Spun cylinders rejected under the provision of paragraph (m) of this section may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.*

§178.38 Specification 3B seamless steel cylinders.

(a) Type, size, and service pressure. A DOT 3B cylinder is seamless steel cylinder with a water capacity (nominal) of not over 1,000 pounds and a service pressure of at least 150 to not over 500 pounds per square inch.

(b) Steel. Open-hearth or electric steel of uniform quality must be used. Content percent may not exceed the following: carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

(c) Identification of material. Material must be identified by any suitable method except

that plates and billets for hot-drawn cylinders must be marked with the heat number.
(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No fissure or other defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.
(e) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited except as follows:
(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which may not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.
(2) As permitted in paragraph (d) of this section.
(f) *Wall thickness. The wall stress may not exceed 24,000 pounds per square inch. The minimum wall thickness is 0.090 inch for any cylinder with an outside diameter of 6 inches. Calculation must be made by the following formula:*

$$S = [P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

Where:

S = wall stress in pounds per square inch;
P = at least two times service pressure or 450 pounds per square inch, whichever is the greater;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. The completed cylinders must be uniformly and properly heat-treated prior to tests.*

(h) Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads, conforming to the following, are required on all openings:

(1) Threads must be clean cut, even, without checks, and to gauge.

(2) Taper threads when used, must be of a length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 4 engaged threads are authorized. Straight threads must have a tight fit, and calculated shear strength at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Cylinders must successfully withstand a hydrostatic test, as* *follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) Each cylinder; to at least 2 times service pressure; or

(ii) 1 cylinder out of each lot of 200 or less; to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect.

(j) *Flattening test. A flattening test must be performed on one cylinder taken at random out or each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^o included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:

(1) The test is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(2) Specimens must conform to the following:

(i) Gauge length of 8 inches with a width of not over 1$^{1/2}$ inches; or a gauge length of 2 inches with a width of not over 1$^{1/2}$ inches; or a gauge length at least 24 times the thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent

strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. Either of the following is an acceptable result:*

(1) An elongation of at least 40 percent for a 2-inch gauge length or at least 20 percent in other cases and yield strength not over 73 percent of tensile strength. In this instance, the flattening test is not required.

(2) An elongation of at least 20 percent for a 2-inch gauge length or 10 percent in other cases and yield strength not over 73 percent of tensile strength. Flattening is required, without cracking, to 6 times the wall thickness.

(m) *Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture, subject to the following conditions and limitations:*

(1) Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least $^{1/16}$ of the total area of the bottom but not less than $^{3/4}$ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Except as provided in paragraph (n) of this section, a cylinder must be rejected if there is any leaking.

(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(4) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(n) *Rejected cylinders. Reheat treatment of rejected cylinders is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. Spun cylinders rejected under the provisions of paragraph (m) of this section may be removed from the spun cylinder category by* *drilling to remove defective material, tapping and plugging.*

(o) Marking. Markings may be stamped into the sidewalls of cylinders having a service pressure of 150 psi if all of the following conditions are met:

(1) Wall stress at test pressure may not exceed 24,000 psi.

(2) Minimum wall thickness must be not less than 0.090 inch.

(3) Depth of stamping must be no greater than 15 percent of the minimum wall thickness, but may not exceed 0.015 inch.

(4) Maximum outside diameter of cylinder may not exceed 5 inches.

(5) Carbon content of cylinder may not exceed 0.25 percent. If the carbon content exceeds 0.25 percent, the complete cylinder must be normalized after stamping.

(6) Stamping must be adjacent to the top head.

§178.39 Specification 3BN seamless nickel cylinders.

(a) *Type, size and service pressure. A DOT 3BN cylinder is a seamless nickel cylinder with a water capacity (nominal) not over 125 pounds water capacity (nominal) and a service pressure at least 150 to not over 500 pounds per square inch.*

(b) Nickel. The percentage of nickel plus cobalt must be at least 99.0 percent.

(c) Identification of material. The material must be identified by any suitable method except that plates and billets for hot-drawn cylinders must be marked with the heat number.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Cylinders closed in by spinning process are not authorized.

(e) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited except that welding is authorized for the attachment of neckrings and footrings which are nonpressure parts, and only to the tops and bottoms of cylinders. Neckrings and footrings must be of weldable material, the carbon content of which may not exceed 0.25 percent. Nickel welding rod must be used.

(f) Wall thickness. The wall stress may not exceed 15,000 pounds per square inch. A minimum wall thickness of 0.100 inch is required for any cylinder over 5 inches in outside diameter. Wall stress calculation must be made by using the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;

P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;

D = outside diameter in inches;

d = inside diameter in inches.

(g) *Heat treatment. The completed cylinders must be uniformly and properly heat-treated prior to tests.*

(h) Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads conforming to the following are required on openings:

(1) Threads must be clean cut, even, without checks, and to gauge.

(2) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 6 engaged threads are authorized. Straight threads must have a tight fit and a calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test, as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Each cylinder must be tested to at least 2 times service pressure.

(j) *Flattening test. A flattening test must be performed on one cylinder taken at random out or each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^{o} included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:

(1) The test is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width of not over 1$^{1/2}$ inches, a gauge length of 2 inches with a width of not over 1$^{1/2}$ inches, or a gauge length of at least 24 times the thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, and the strain indicator reading must be set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. Either of the following is an acceptable result:*

(1) An elongation of at least 40 percent for a 2 inch gauge length or at least 20 percent in other cases and yield point not over 50 percent of tensile strength. In this instance, the flattening test is not required.

(2) An elongation of at least 20 percent for a 2 inch gauge length or 10 percent in other cases and a yield point not over 50 percent of tensile strength. Flattening is required, without cracking, to 6 times the wall thickness.

(m) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding is not authorized.*

§178.42 Specification 3E seamless steel cylinders.

(a) Type, size, and service pressure. A DOT 3E cylinder is a seamless steel cylinder with an outside diameter not greater than 2 inches nominal, a length less than 2 feet and a service pressure of 1,800 pounds per square inch.

(b) Steel. Open-hearth or electric steel of uniform quality must be used. Content percent may not exceed the following: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

(c) Identification of steel. Materials must be identified by any suitable method.
(d) Manufacture. Cylinders must be manufactured by best appliances and methods. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. The thickness of the spun bottom is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness must be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.
(e) Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads conforming to the following are required on openings.
(1) Threads must be clean cut, even, without checks, and to gauge.
(2) Taper threads, when used, must be of length not less than as specified for American Standard taper pipe threads.
(3) Straight threads having at least 4 engaged threads are authorized. Straight threads must have a tight fit and a calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.
(f) *Hydrostatic test. Cylinders must be tested as follows:*
(1) One cylinder out of each lot of 500 or less must be subjected to a hydrostatic pressure of 6,000 pounds per square inch or higher.
(2) The cylinder referred to in paragraph (f)(1) of this section must burst at a pressure higher than 6,000 pounds per square inch without fragmenting or otherwise showing lack of ductility, or must hold a pressure of 12,000 pounds per square inch for 30 seconds without bursting. In which case, it must be subjected to a flattening test without cracking to six times wall thickness between knife edges, wedge shaped 60 degree angle, rounded out to a $^{1/2}$ inch radius. The inspector's report must be suitably changed to show results of latter alternate and flattening test.
(3) Other cylinders must be examined under pressure of at least 3,000 pounds per square inch and not to exceed 4,500 pounds per square inch and show no defect. Cylinders tested at a pressure in excess of 3,600 pounds per square inch must burst at a pressure higher than 7,500 pounds per square inch when tested as specified in paragraph (f)(2) of this section. The pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete examination.
(g) *Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture subject to the following conditions and limitations:*
(1) A pressure, approximately the same as but not less than the service pressure, must be applied to one side of the finished bottom over an area of at least $^{1/16}$ of the total area of the bottom but not less than $^{3/4}$ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Accept as provided in paragraph (h) of this section, a cylinder must be rejected if there is any leakage.
(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.
(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished

cylinder has been effected by a plug.
(4) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, the manufacturer shall design the test apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.
(h) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. Spun cylinders rejected under the provisions of paragraph (g) of this section may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.*
(i) Marking. Markings required by §178.35 must be stamped plainly and permanently on the shoulder, top head, neck or sidewall of each cylinder.

§178.44 Specification 3HT seamless steel cylinders for aircraft use.

(a) Type, size and service pressure. A DOT 3HT cylinder is a seamless steel cylinder with a water capacity (nominal) of not over 150 pounds and a service pressure of at least 900 pounds per square inch.
(b) Authorized steel. Open hearth or electric furnace steel of uniform quality must be used. A heat of steel made under the specifications listed in table 1 in this paragraph (b), check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in table 2 in this paragraph (b) are not exceeded. Grain size 6 or finer according to ASTM E 112. Steel of the following chemical analysis is authorized:

Table 1-Authorized Materials

Designation	AISI 4130 (percent)
Carbon	0.28/0.33
Manganese	0.40/0.60
Phosphorus	0.040 maximum
Sulfur	0.040 maximum
Silicon	0.15/0.35
Chromium	0.80/1.10
Molybdenum	0.15/.025

Table 2-Check Analysis Tolerances

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the

-	-	minimum limit	
		Under minimum limit	Over maximum limit
Carbon	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
Phosphorus[1]	All ranges	-	.01
Sulphur	All ranges	-	.01
Silicon	To 0.30 incl	.02	.03
-	Over 0.30 to 1.00 incl	.05	.05
Chromium	To 0.90 incl	.03	.03
-	Over 0.90 to 2.10 incl	.05	.05
Molybdenum	To 0.20 incl	.01	.01
-	Over 0.20 to 0.40 incl	.02	.02

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material. Material must be identified by any suitable method. Steel stamping of heat identifications may not be made in any area which will eventually become the side wall of the cylinder. Depth of stamping may not encroach upon the minimum prescribed wall thickness of the cylinder.*

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No fissure or other defect is permitted that is likely to weaken the finished container appreciably. The general surface finish may not exceed a roughness of 250 RMS. Individual irregularities such as draw marks, scratches, pits, etc., should be held to a minimum consistent with good high stress pressure vessel manufacturing practices. If the cylinder is not originally free of such defects or does not meet the finish requirements, the surface may be machined or otherwise treated to eliminate these defects. The point of closure of cylinders closed by spinning may not be less than two times the prescribed wall thickness of the cylindrical shell. The cylinder end contour must be hemispherical or ellipsoidal with a ratio of major-to-minor axis not exceeding two to one and with the concave side to pressure.

(e) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited, except that welding by spinning is permitted to close the bottom of spun cylinders. Machining or grinding to produce proper surface finish at point of closure is required.

(f) Wall thickness. (1) Minimum wall thickness for any cylinder must be 0.050 inch. The minimum wall thickness must be such that the wall stress at the minimum specified test pressure may not exceed 75 percent of the minimum tensile strength of the steel as determined from the physical tests required in paragraph (m) of this section and may not be over 105,000 psi.

(2) Calculations must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress in pounds per square inch;
P = Minimum test pressure prescribed for water jacket test;
D = Outside diameter in inches;
d = Inside diameter in inches.

(3) Wall thickness of hemispherical bottoms only permitted to 90 percent of minimum wall thickness of cylinder sidewall but may not be less than 0.050 inch. In all other cases, thickness to be no less than prescribed minimum wall.

(g) *Heat treatment. The completed cylinders must be uniformly and properly heated prior to tests. Heat treatment of the cylinders of the authorized analysis must be as follows:*

(1) All cylinders must be quenched by oil, or other suitable medium.

(2) The steel temperature on quenching must be that recommended for the steel analysis, but may not exceed 1750^{o}F.

(3) The steel must be tempered at a temperature most suitable for the particular steel analysis but not less than 850^{o}F.

(4) All cylinders must be inspected by the magnetic particle or dye penetrant method to detect the presence of quenching cracks. Any cylinder found to have a quenching crack must be rejected and may not be requalified.

(h) *Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings. Threads conforming to the following are required on openings:*

(1) Threads must be clean cut, even, without cracks, and to gauge.

(2) Taper threads, when used, must be of length not less than as specified for National Gas Tapered Thread (NGT) as required by American Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections.

(3) Straight threads having at least 6 engaged threads are authorized. Straight threads must have a tight fit and a calculated shear stress of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Each cylinder must withstand a hydrostatic test, as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy either of 1 percent of 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, which ever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Each cylinder must be tested to at least $^{5/3}$ times service pressure.

(j) *Cycling tests. Prior to the initial shipment of any specific cylinder design, cyclic* *pressurization tests must have been performed on at least three representative samples without failure as follows:*

(1) Pressurization must be performed hydrostatically between approximately zero psig and the service pressure at a rate not in excess of 10 cycles per minute. Adequate recording instrumentation must be provided if equipment is to be left unattended for periods of time.

(2) Tests prescribed in paragraph (j)(1) of this section must be repeated on one random sample out of each lot of cylinders. The cylinder may then be subjected to a burst test.

(3) A lot is defined as a group of cylinders fabricated from the same heat of steel, manufactured by the same process and heat treated in the same equipment under the same conditions of time, temperature, and atmosphere, and may not exceed a quantity of 200 cylinders.

(4) All cylinders used in cycling tests must be destroyed.

(k) *Burst test. One cylinder taken at random out of each lot of cylinders must be hydrostatically tested to destruction.*

(l) Flattening test. A flattening test must be performed on one cylinder taken at random out or each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^o included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(m) Physical tests. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:

(1) Test is required on 2 specimens cut from 1 cylinder taken at random out of each lot of cylinders.

(2) Specimens must conform to the following:

(i) A gauge length of at least 24 times the thickness with a width not over six times the thickness. The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with the record of physical tests detailed information in regard to such specimens.

(ii) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length.

Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(n) *Magnetic particle inspection. Inspection must be performed on the inside of each container before closing and externally on each finished container after heat treatment. Evidence of discontinuities, which in the opinion of a qualified inspector may appreciably weaken or decrease the durability of the cylinder, must be cause for rejection.*

(o) Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by dry gas or dry air pressure after the bottom has been cleaned and is free from all moisture, subject to the following conditions and limitations:

(1) Pressure, approximately the same as but not less than service pressure, must be applied to one side of the finished bottom over an area of at least $^{1/16}$ of the total area of the bottom but not less than $^{3/4}$ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Except as provided in paragraph (q) of this section, a cylinder must be rejected if there is leakage.

(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(4) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, the manufacturer should design the test apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(p) *Acceptable results of tests. Results of the flattening test, physical tests, burst test, and cycling test must conform to the following:*

(1) Flattening required without cracking to ten times the wall thickness of the cylinder.

(2) Physical tests:

(i) An elongation of at least 6 percent for a gauge length of 24 times the wall thickness.

(ii) The tensile strength may not exceed 165,000 p.s.i.

(3) The burst pressure must be at least $^{4/3}$ times the test pressure.

(4) Cycling-at least 10,000 pressurizations.

(q) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding or spinning is not authorized. For each cylinder subjected to reheat treatment during original manufacture, sidewall measurements must be made to verify that the minimum sidewall thickness meets specification requirements after the final heat treatment.*

(r) Marking. (1) Cylinders must be marked by low stress type steel stamping in an area and to a depth which will insure that the wall thickness measured from the root of the stamping to the interior surface is equal to or greater than the minimum prescribed wall thickness. Stamping must be permanent and legible. Stamping on side wall not authorized.

(2) The rejection elastic expansion (REE), in cubic centimeters (cc), must be marked on the cylinder near the date of test. The REE for a cylinder is 1.05 times its original elastic expansion.

(3) Name plates are authorized, provided that they can be permanently and securely attached to the cylinder. Attachment by either brazing or welding is not permitted. Attachment by soldering is permitted provided steel temperature does not exceed 500 ^{o}F.

(s) *Inspector's report. In addition to the requirements of §178.35, the inspector's report must indicate the rejection elastic expansion (REE), in cubic centimeters (cc).*

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended at 62 FR 51561, Oct. 1, 1997]

§178.45 Specification 3T seamless steel cylinder.

(a) *Type, size, and service pressure. A DOT 3T cylinder is a seamless steel cylinder with a minimum water capacity of 1,000 pounds and a minimum service pressure of 1,800 p.s.i. Each cylinder must have integrally formed heads concave to pressure at both ends. The inside head shape must be hemispherical, ellipsoidal in which the major axis is two times the minor axis, or a dished shape falling within these two limits. Permanent closures formed by spinning are prohibited.*

(b) Material, steel. Only open hearth, basic oxygen, or electric furnace process steel of uniform quality is authorized. The steel analysis must conform to the following:

Analysis Tolerances

Element	Ladle analysis	Check Analysis	
-	-	Under	Over
Carbon	0.35 to 0.50	0.03	0.04
Manganese	0.75 to 1.05	0.04	0.04
Phosphorus (max)	0.035	-	0.01
Sulphur (max)	0.04	-	0.01
Silicon	0.15 to 0.35	0.02	0.03
Chromium	0.80 to 1.15	0.05	0.05
Molybdenum	0.15 to 0.25	0.02	0.02

(1) A heat of steel made under the specifications in the table in this paragraph (b),

the ladle analysis of which is slightly out of the specified range, is acceptable if satisfactory in all other aspects. However, the check analysis tolerances shown in the table in this paragraph (b) may not be exceeded except as approved by the Department.

(2) Material with seams, cracks, laminations, or other injurious defects is not permitted.

(3) Material used must be identified by any suitable method.

(c) *Manufacture. General manufacturing requirements are as follows:*

(1) Surface finish must be uniform and reasonably smooth.

(2) Inside surfaces must be clean, dry, and free of loose particles.

(3) No defect of any kind is permitted if it is likely to weaken a finished cylinder.

(4) If the cylinder surface is not originally free from the defects, the surface may be machined or otherwise treated to eliminate these defects provided the minimum wall thickness is maintained.

(5) Welding or brazing on a cylinder is not permitted.

(d) *Wall thickness. The minimum wall thickness must be such that the wall stress at the minimum specified test pressure does not exceed 67 percent of the minimum tensile strength of the steel as determined by the physical tests required in paragraphs (j) and (k) of this section. A wall stress of more than 90,500 p.s.i. is not permitted. The minimum wall thickness for any cylinder may not be less than 0.225 inch.*

(1) Calculation of the stress for cylinders must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress in pounds per square inch;
P = Minimum test pressure, at least $^{5/3}$ service pressure;
D = Outside diameter in inches;
d = Inside diameter in inches.

(2) Each cylinder must meet the following additional requirement which assumes a cylinder horizontally supported at its two ends and uniformly loaded over its entire length. This load consists of the weight per inch of length of the straight cylindrical portion filled with water compressed to the specified test pressure. The wall thickness must be increased when necessary to meet this additional requirement:

(i) The sum of two times the maximum tensile stress in the bottom fibers due to bending (see paragraph (d)(2)(ii) of this section), plus the maximum tensile stress in the same fibers due to hydrostatic testing (see paragraph (d)(2)(iii) of this section) may not exceed 80 percent of the minimum yield strength of the steel at this maximum stress.

(ii) The following formula must be used to calculate the maximum tensile stress due to bending:

$$S = Mc / I$$

Where:

S = Tensile stress in pounds per square inch;
M = Bending moment in inch-pounds ($wl^2/8$);
I = Moment of inertia-0.04909 (D^4-d^4) in inches fourth;
c = Radius ($D/2$) of cylinder in inches;
w = Weight per inch of cylinder filled with water;
l = Length of cylinder in inches;
D = Outside diameter in inches;
d = Inside diameter in inches.

(iii) The following formula must be used to calculate the maximum longitudinal tensile stress due to hydrostatic test pressure:

$$S = A_1 P / A_2$$

Where:

S = Tensile stress in pounds per square inch;
A_1 = Internal area in cross section of cylinder in square inches;
P = Hydrostatic test pressure in pounds per square, inch;
A_2 = Area of metal in cross section of cylinder in square inches.

(e) *Heat treatment. Each completed cylinder must be uniformly and properly heat treated prior to testing, as follows:*
(1) Each cylinder must be heated and held at the proper temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder and then quenched in a suitable liquid medium having a cooling rate not in excess of 80 percent of water. The steel temperature on quenching must be that recommended for the steel analysis, but it must never exceed 1750 ^{o}F.
(2) After quenching, each cylinder must be reheated to a temperature below the transformation range but not less than 1050 ^{o}F., and must be held at this temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder. Each cylinder must then be cooled under conditions recommended for the steel.
(f) *Openings. Openings in cylinders must comply with the following:*
(1) Openings are permitted on heads only.
(2) The size of any centered opening in a head may not exceed one half the outside diameter of the cylinder.
(3) Openings in a head must have ligaments between openings of at least three times the average of their hole diameter. No off-center opening may exceed 2.625 inches in diameter.
(4) All openings must be circular.

(5) All openings must be threaded. Threads must be in compliance with the following:

(i) Each thread must be clean cut, even, without any checks, and to gauge.

(ii) Taper threads, when used, must be the American Standard Pipe thread (NPT) type and must be in compliance with the requirements of NBS Handbook H-28, Part II, Section VII.

(iii) Taper threads conforming to National Gas Taper thread (NGT) standards must be in compliance with the requirements of NBS Handbook H-28, Part II, Sections VII and IX.

(iv) Straight threads conforming with National Gas Straight thread (NGS) standards are authorized. These threads must be in compliance with the requirements of NBS Handbook H-28, Part II, Sections VII and IX.

(g) *Hydrostatic test. Each cylinder must be tested at an internal pressure by the water jacket method or other suitable method, conforming to the following requirements:*

(1) The testing apparatus must be operated in a manner that will obtain accurate data. Any pressure gauge used must permit reading to an accuracy of one percent. Any expansion gauge used must permit reading of the total expansion to an accuracy of one percent.

(2) Any internal pressure applied to the cylinder after heat treatment and before the official test may not exceed 90 percent of the test pressure.

(3) The pressure must be maintained sufficiently long to assure complete expansion of the cylinder. In no case may the pressure be held less than 30 seconds.

(4) If, due to failure of the test apparatus, the required test pressure cannot be maintained, the test must be repeated at a pressure increased by 10 percent or 100 p.s.i., whichever is lower or, the cylinder must be reheat treated.

(5) Permanent volumetric expansion of the cylinder may not exceed 10 percent of its total volumetric expansion at the required test pressure.

(6) Each cylinder must be tested to at least $^{5/3}$ times its service pressure.

(h) *Ultrasonic examination. After the hydrostatic test, the cylindrical section of each vessel must be examined in accordance with ASTM Standard A-388-67 using the angle beam technique. The equipment used must be calibrated to detect a notch equal to five percent of the design minimum wall thickness. Any discontinuity indication greater than that produced by the five percent notch must be cause for rejection of the cylinder unless the discontinuity is repaired within the requirements of this specification.*

(i) Basic requirements for tension and Charpy impact tests. Cylinders must be subjected to a tension and Charpy impact as follows:

(1) When the cylinders are heat treated in a batch furnace, two tension specimens and three Charpy impact specimens must be tested from one of the cylinders or a test ring from each batch. The lot size represented by these tests may not exceed 200 cylinders.

(2) When the cylinders are heat treated in a continuous furnace, two tension specimens and three Charpy impact specimens must be tested from one of the cylinders or a test ring from each four hours or less of production. However, in no case may a test lot based on this production period exceed 200 cylinders.

(3) Each specimen for the tension and Charpy impact tests must be taken from the

side wall of a cylinder or from a ring which has been heat treated with the finished cylinders of which the specimens must be representative. The axis of the specimens must be parallel to the axis of the cylinder. Each cylinder or ring specimen for test must be of the same diameter, thickness, and metal as the finished cylinders they represent. A test ring must be at least 24 inches long with ends covered during the heat treatment process so as to simulate the heat treatment process of the finished cylinders it represents.

(4) A test cylinder or test ring need represent only one of the heats in a furnace batch provided the other heats in the batch have previously been tested and have passed the tests and that such tests do not represent more than 200 cylinders from any one heat.

(5) The test results must conform to the requirements specified in paragraphs (j) and (k) of this section.

(6) When the test results do not conform to the requirements specified, the cylinders represented by the tests may be reheat treated and the tests repeated. Paragraph (i)(5) of this section applies to any retesting.

(j) *Basic conditions for acceptable physical testing. The following criteria must be followed to obtain acceptable physical test results:*

(1) Each tension specimen must have a gauge length of two inches with a width not exceeding one and one-half inches. Except for the grip ends, the specimen may not be flattened. The grip ends may be flattened to within one inch of each end of the reduced section.

(2) A specimen may not be heated after heat treatment specified in paragraph (d) of this section.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gage length.

(i) This yield strength must be determined by the "offset" method or the "extension under load" method described in ASTM Standard E8.

(ii) For the "extension under load" method, the total strain (or extension under load) corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gage length under appropriate load and adding thereto 0.2 percent of the gage length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. However, when the degree of accuracy of this method is questionable the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set with the specimen under a stress of 12,000 p.s.i. and the strain indicator reading set at the calculated corresponding strain.

(iv) The cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during the determination of yield strength.

(4) Each impact specimen must be Charpy V-notch type size 10 mm &times 10 mm taken in accordance with paragraph 11 of ASTM Standard A-333-67. When a reduced size specimen is used, it must be the largest size obtainable.

(k) *Acceptable physical test results. Results of physical tests must conform to the following:*

(1) The tensile strength may not exceed 155,000 p.s.i.
(2) The elongation must be at least 16 percent for a two-inch gage length.
(3) The Charpy V-notch impact properties for the three impact specimens which must be tested at 0 ^{o}F may not be less than the values shown as follows:

Size of specimen (mm)	Average value for acceptance (3 specimens)	Minimum value (1 specimen only of the 3)
10.0x10.0	25.0 ft. lbs.	20.0 ft. lbs.
10.0x7.5	21.0 ft. lbs.	17.0 ft. lbs.
10.0x5.0	17.0 ft. lbs.	14.0 ft. lbs.

(4) After the final heat treatment, each vessel must be hardness tested on the cylindrical section. The tensile strength equivalent of the hardness number obtained may not be more than 165,000 p.s.i. (Rc 36). When the result of a hardness test exceeds the maximum permitted, two or more retests may be made; however, the hardness number obtained in each retest may not exceed the maximum permitted.

(l) *Rejected cylinders. Reheat treatment is authorized for rejected cylinders. However, each reheat treated cylinder must subsequently pass all the prescribed tests. Repair by welding is not authorized.*

(m) Markings. Marking must be done by stamping into the metal of the cylinder. All markings must be legible and located on a shoulder.

(n) Inspector's report. In addition to the requirements of §178.35, the inspector's report for the physical test report, must indicate the average value for three specimens and the minimum value for one specimen for each lot number.

§178.46 Specification 3AL seamless aluminum cylinders.

(a) Size and service pressure. A DOT 3AL cylinder is a seamless aluminum cylinder with a maximum water capacity of 1000 pounds and minimum service pressure of 150 psig.

(b) Authorized material and identification of material. The material of construction must meet the following conditions:

(1) Starting stock must be cast stock or traceable to cast stock.

(2) Material with seams, cracks, laminations, or other defects likely to weaken the finished cylinder may not be used.

(3) Material must be identified by a suitable method that will identify the alloy, the aluminum producer's cast number, the solution heat treat batch number and the lot number.

(4) The material must be of uniform quality. Only the following heat treatable aluminum alloys in table 1 and 2 are permitted as follows:

Table 1-Chemical Composition Limits
[Chemical composition (in weight percent)]

Aluminum Assoc. alloy designation No.	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Pb	Bi	Other		A1
-	-	-	-	-	-	-	-	-	-	-	Each	Total	-
6351	0.7-1.3	0.50	0.10	0.40-0.80	0.40-0.80	-	0.20	0.20	0.01	0.01	0.05	0.15	Remainder.
6061	0.40-0.80	0.70	0.15-0.40	0.15	0.80-1.20	0.04-0.35	0.25	0.15	0.01	0.01	0.05	0.15	Remainder.

[1]Analysis is regularly made only for the elements for which specific limits are shown, except for unalloyed aluminum. If, however, the presence of other elements is suspected to be, or in the course of routine analysis is indicated to be in excess of specified limits, further analysis is made to determine that these other elements are not in excess of the amounts specified. (Aluminum Association Standards and Data.)

Table 2-Mechanical Property Limits

Alloy and temper	Tensile strength-PSI		Elongation-percent minimum for 2" or 4D size specimen
-	Ultimate-minimum	Yield-minimum	-
6351-T6	42,000	37,000	[2]14
6061-T6	38,000	35,000	[2]14

[1]"D" represents specimen diameters. When the cylinder wall is greater than 3/16 inch thick, a retest without reheat treatment using the 4D size specimen is authorized if the test using the 2 inch size specimen fails to meet elongation requirements.

[2]When cylinder wall is not over 3/16-inch thick, 10 percent elongation is authorized when using a 24tx6t size test specimen.

(5) All starting stock must be 100 percent ultrasonically inspected, along the length at right angles to the central axis from two positions at 90^{o} to one another. The equipment and continuous scanning procedure must be capable of detecting and rejecting internal defects such as cracks which have an ultrasonic response greater than that of a calibration block with a 5/64-inch diameter flat bottomed hole.

(6) Cast stock must have uniform equiaxed grain structure not to exceed 500 microns maximum.

(7) Any starting stock not complying with the provisions of paragraphs (b)(1) through (b)(6) of this section must be rejected.

(c) *Manufacture. Cylinders must be manufactured in accordance with the following* *requirements:*

(1) Cylinder shells must be manufactured by the backward extrusion method and have a cleanliness level adequate to ensure proper inspection. No fissure or other defect is acceptable that is likely to weaken the finished cylinder below the design strength requirements. A reasonably smooth and uniform surface finish is required. If not originally free from such defects, the surface may be machined or otherwise conditioned to eliminate these defects.

(2) Thickness of the cylinder base may not be less than the prescribed minimum wall thickness of the cylindrical shell. The cylinder base must have a basic torispherical, hemispherical, or ellipsoidal interior base configuration where the dish radius is no greater than 1.2 times the inside diameter of the shell. The knuckle radius may not be less than 12 percent of the inside diameter of the shell. The interior base contour may deviate from the true torispherical, hemispherical or ellipsoidal configuration provided that-

(i) Any areas of deviation are accompanied by an increase in base thickness;

(ii) All radii of merging surfaces are equal to or greater than the knuckle radius;

(iii) Each design has been qualified by successfully passing the cycling tests in this paragraph (c); and

(iv) Detailed specifications of the base design are available to the inspector.

(3) For free standing cylinders, the base thickness must be at least two times the minimum wall thickness along the line of contact between the cylinder base and the floor when the cylinders are in the vertical position.

(4) Welding or brazing is prohibited.

(5) Each new design and any significant change to any acceptable design must be qualified for production by testing prototype samples as follows:

(i) Three samples must be subjected to 100,000 pressure reversal cycles between zero and service pressure or 10,000 pressure reversal cycles between zero and test pressure, at a rate not in excess of 10 cycles per minute without failure.

(ii) Three samples must be pressurized to destruction and failure may not occur at less than 2.5 times the marked cylinder service pressure. Each cylinder must remain in one piece. Failure must initiate in the cylinder sidewall in a longitudinal direction. Rate of pressurization may not exceed 200 psi per second.

(6) In this specification "significant change" means a 10 percent or greater change in cylinder wall thickness, service pressure, or diameter; a 30 percent or greater change in water capacity or base thickness; any change in material; over 100 percent increase in size of openings; or any change in the number of openings.

(d) *Wall thickness. The minimum wall thickness must be such that the wall stress at the minimum specified test pressure will not exceed 80 percent of the minimum yield strength nor exceed 67 percent of the minimum ultimate tensile strength as verified by physical tests in paragraph (i) of this section. The minimum wall thickness for any cylinder with an outside diameter greater than 5 inches must be 0.125 inch. Calculations must be made by the following formula:*

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress in pounds per square inch;
P = Prescribed minimum test pressure in pounds per square inch (see paragraph (g) of this section);
D = Outside diameter in inches; and
d = Inside diameter in inches.

(e) *Openings. Openings must comply with the following requirements:*
(1) Openings are permitted in heads only.
(2) The size of any centered opening in a head may not exceed one-half the outside diameter of the cylinder.
(3) Other openings are permitted in the head of a cylinder if:
(i) Each opening does not exceed 2.625 inches in diameter, or one-half the outside diameter of the cylinder; whichever is less;
(ii) Each opening is separated from each other by a ligament; and
(iii) Each ligament which separates two openings must be at least three times the average of the diameters of the two openings.
(4) All openings must be circular.
(5) All openings must be threaded. Threads must comply with the following:
(i) Each thread must be clean cut, even, without checks, and to gauge.
(ii) Taper threads, when used, must conform to one of the following:
(A) American Standard Pipe Thread (NPT) type, conforming to the requirements of Federal Standard H-28, Section 7;
(B) National Gas Taper Thread (NGT) type, conforming to the requirements of Federal Standard H-28, Sections 7 and 9; or
(C) Other taper threads conforming to other standards may be used provided the length is not less than that specified for NPT threads.
(iii) Straight threads, when used, must conform to one of the following:
(A) National Gas Straight Thread (NGS) type, conforming to the requirements of Federal Standard H-28, Sections 7 and 9;
(B) Unified Thread (UN) type, conforming to the requirements of Federal Standard H-28, Section 2;
(C) Controlled Radius Root Thread (UN) type, conforming to the requirements of Federal Standard H-28, Section 4; or
(D) Other straight threads conforming to other recognized standards may be used provided that the requirements in paragraph (e)(5)(iv) of this section are met.
(iv) All straight threads must have at least 6 engaged threads, a tight fit, and a factor of safety in shear of at least 10 at the test pressure of the cylinder. Shear stress must be calculated by using the appropriate thread shear area in accordance with Federal Standard H-28, Appendix A5, Section 3.
(f) *Heat treatment. Prior to any test, all cylinders must be subjected to a solution heat treatment and aging treatment appropriate for the aluminum alloy used.*

(g) Hydrostatic test. Each cylinder must be subjected to an internal test pressure using the water jacket equipment and method or other suitable equipment and method and comply with the following requirements:

(1) The testing apparatus must be operated in a manner so as to obtain accurate data. The pressure gauge used must permit reading to an accuracy of one percent. The expansion gauge must permit reading the total expansion to an accuracy of either one percent or 0.1 cubic centimeter.

(2) The test pressure must be maintained for a sufficient period of time to assure complete expansion of the cylinder. In no case may the pressure be held less than 30 seconds. If, due to failure of the test apparatus, the required test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 psi, whichever is lower. If the test apparatus again fails to maintain the test pressure, the cylinder being tested must be rejected. Any internal pressure applied to the cylinder before any official test may not exceed 90 percent of the test pressure.

(3) The minimum test pressure is the greatest of the following:

(i) 450 psi regardless of service pressure;

(ii) Two times the service pressure for cylinders having service pressure less than 500 psi; or

(iii) Five-thirds times the service pressure for cylinders having a service pressure of at least 500 psi.

(4) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(h) *Flattening test. One cylinder taken at random out of each lot must be subjected to a flattening test as follows:*

(1) The test must be between knife edges, wedge shaped, having a 60^{o} included angle, and rounded in accordance with the following table. The longitudinal axis of the cylinder must be at an angle 90^{o} to the knife edges during the test. The flattening test table is as follows:

Table 3-Flattening Test Table

Cylinder wall thickness in inches	Radius in inches
Under .150	.500
.150 to .249	.875
.250 to .349	1.500
.350 to .449	2.125
.450 to .549	2.750
.550 to .649	3.500
.650 to .749	4.125

(2) An alternate bend test in accordance with ASTM E 290 using a mandrel diameter not more than 6 times the wall thickness is authorized to qualify lots that fail the

flattening test of this section without reheat treatment. If used, this test must be performed on two samples from one cylinder taken at random out of each lot of 200 cylinders or less.

(3) Each test cylinder must withstand flattening to nine times the wall thickness without cracking. When the alternate bend test is used, the test specimens must remain uncracked when bent inward around a mandrel in the direction of curvature of the cylinder wall until the interior edges are at a distance apart not greater than the diameter of the mandrel.

(i) *Mechanical properties test. Two test specimens cut from one cylinder representing each lot of 200 cylinders or less must be subjected to the mechanical properties test, as follows:*

(1) The results of the test must conform to at least the minimum acceptable mechanical property limits for aluminum alloys as specified in paragraph (b) of this section.

(2) Specimens must be 4D bar or gauge length 2 inches with width not over $1^{1/2}$ inch taken in the direction of extrusion approximately 180^{o} from each other; provided that gauge length at least 24 times thickness with width not over 6 times thickness is authorized, when cylinder wall is not over $^{3/16}$ inch thick. The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When the size of the cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows. When such specimens are used, the inspector's report must show that the specimens were so taken and prepared. Heating of specimens for any purpose is forbidden.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard B-557.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 10,000,000 psi. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 6,000 psi, the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(j) *Rejected cylinder. Reheat treatment of rejected cylinders is authorized one time. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable.*

(k) Duties of inspector. In addition to the requirements of §178.35, the inspector shall:

(1) Verify compliance with the provisions of paragraph (b) of this section by:

(i) Performing or witnessing the performance of the chemical analyses on each melt or cast lot or other unit of starting material; or

(ii) Obtaining a certified chemical analysis from the material or cylinder manufacturer for each melt, or cast of material; or

(iii) Obtaining a certified check analysis on one cylinder out of each lot of 200 cylinders or less, if a certificate containing data to indicate compliance with the material specification is obtained.

(2) The inspector shall verify ultrasonic inspection of all material by inspection or by obtaining the material producer's certificate of ultrasonic inspection. Ultrasonic inspection must be performed or verified as having been performed in accordance with paragraph (c) of this section.

(3) The inspector must also determine that each cylinder complies with this specification by:

(i) Selecting the samples for check analyses performed by other than the material producer;

(ii) Verifying that the prescribed minimum thickness was met by measuring or witnessing the measurement of the wall thickness; and

(iii) Verifying that the identification of material is proper.

(4) Prior to initial production of any design or design change, verify that the design qualification tests prescribed in paragraph (c)(6) of this section have been performed with acceptable results.

(l) *Definitions. (1) In this specification, a "lot" means a group of cylinders successively produced having the same:*

(i) Size and configuration;

(ii) Specified material of construction;

(iii) Process of manufacture and heat treatment;

(iv) Equipment of manufacture and heat treatment; and

(v) Conditions of time, temperature and atmosphere during heat treatment.

(2) In no case may the lot size exceed 200 cylinders, but any cylinder processed for use in the required destructive physical testing need not be counted as being one of the 200.

(m) *Inspector's report. In addition to the information required by §178.35, the record of chemical analyses must also include the alloy designation, and applicable information on iron, titanium, zinc, magnesium and any other applicable element used in the construction of the cylinder.*

§178.47 Specification 4DS welded stainless steel cylinders for aircraft use.

(a) Type, size, and service pressure. A DOT 4DS cylinder is either a welded stainless steel sphere (two seamless hemispheres) or circumferreentially welded cylinder both with a water capacity of not over 100 pounds and a service pressure of at least 500 but not over 900 pounds per square inch.

(b) Steel. Types 304, 321 and 347 stainless steel are authorized with proper welding procedure. A heat of steel made under the specifications in table 1 in this paragraph (b), check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in table 2 in this paragraph (b) are not exceeded, except as approved by Associate Administrator. The following chemical analyses are authorized:

Table 1-Authorized Materials

-	Stainless steels		
	304 (percent)	321 (percent)	347 (percent)
Carbon (max)	0.08	0.08	0.08
Manganese (max)	2.00	2.00	2.00
Phosphorus (max)	.030	.030	.030
Sulphur (max)	.030	.030	.030
Silicon (max)	.75	.75	.75
Nickel	8.0/11.0	9.0/13.0	9.0/13.0
Chromium	18.0/20.0	17.0/20.0	17.0/20.0
Molybdenum	-	-	-
Titanium	-	([1])	-
Columbium	-	-	([2])

[1]Titanium may not be more than 5C and not more than 0.60%.
[2]Columbium may not be less than 10C and not more than 1.0%.

Table 2-Check Analysis Tolerances

Element -	Limit or maximum specified (percent) -	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.01	0.01
Manganese	Over 1.15 to 2.50 incl	0.05	0.05
Phosphorus[1]	All ranges	-	.01
Sulphur	All ranges	-	.01
Silicon	Over 0.30 to 1.00 incl	.05	.05
Nickel	Over 5.30 to 10.00 incl	.10	.10
-	Over 10.00 to 14.00 incl	.15	.15
Chromium	Over 15.00 to 20.00 incl	.20	.20
Titanium	All ranges	.05	.05
Columbium	All ranges	.05	.05

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material. Materials must be identified by any suitable method.*

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably, a reasonably smooth and uniform surface finish is required. No abrupt change in wall thickness is permitted. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3. All seams of the sphere or cylinder must be fusion welded. Seams must be of the butt type and means must be provided for accomplishing complete penetration of the joint.

(e) Attachments. Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable stainless steel in accordance with paragraph (b) of this section.

(f) Wall thickness. The minimum wall thickness must be such that the wall stress at the minimum specified test pressure may not be over 60,000 psi. A minimum wall thickness of 0.040 inch is required for any diameter container. Calculations must be made by the following formulas:

(1) Calculation for sphere must be made by the formula:

$$S = PD / 4tE$$

Where:

S = Wall stress in pounds per square inch;
P = Test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D = Outside diameter in inches;
t = Minimum wall thickness in inches;
E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat zones which zone must extend a distance of 6 times wall thickness from center of weld);
E = 1.0 (for all other areas).

(2) Calculation for a cylinder must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress in pounds per square inch;
P = Test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D = Outside diameter in inches;
d = Inside diameter in inches.

(g) *Heat treatment. The seamless hemispheres and cylinders may be stress relieved or annealed for forming. Welded container must be stress relieved at a temperature of 775 ^{o}F + 25^{o} after process treatment and before hydrostatic test.*

(h) Openings in container. Openings must comply with the following:

(1) Each opening in the container must be provided with a fitting, boss or pad of weldable stainless steel securely attached to the container by fusion welding.

(2) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

(i) Threads must be clean cut, even, without checks, and tapped to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

(i) *Process treatment. Each container must be hydraulically pressurized in a water jacket to at least 100 percent, but not more than 110 percent, of the test pressure and maintained at this pressure for a minimum of 3 minutes. Total and permanent expansion must be recorded and included in the inspector's report.*

(j) Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:

(1) The test must be by water-jacket, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Each container must be tested to at least 2 times service pressure.

(5) Container must then be inspected. Any wall thickness lower than that required by paragraph (f) of this section must be cause for rejection. Bulges and cracks must be cause for rejection. Welded joint defects exceeding requirements of paragraph (k) of this section must be cause for rejection.

(k) *Radiographic inspection. Radiographic inspection is required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the container diameter need not be subjected to radiographic inspection. Evidence of any defects likely to seriously weaken the container is cause for rejection. Radiographic inspection must be performed subsequent to the hydrostatic test.*

(l) Burst test. One container taken at random out of 200 or less must be hydrostatically tested to destruction. Rupture pressure must be included as part of the inspector's report.

(m) Flattening test. A flattening test must be performed as follows:

(1) For spheres the test must be at the weld between parallel steel plates on a press with welded seam at right angles to the plates. Test one sphere taken at random out of each lot of 200 or less after the hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(2) For cylinders the test must be between knife edges, wedge shaped, 60^{o} angle, rounded to $^{1/2}$-inch radius. Test one cylinder taken at random out of each lot of 200 or less, after the hydrostatic test.

(n) *Acceptable results for flattening and burst tests. Acceptable results for flattening and burst tests are as follows:*

(1) Flattening required to 50 percent of the original outside diameter without cracking.

(2) Burst pressure must be at least 3 times the service pressure.

(o) *Rejected containers. Repair of welded seams by welding prior to process treatment is authorized. Subsequent thereto, containers must be heat treated and pass all prescribed tests.*

(p) Duties of inspector. In addition to the requirements of §178.35, the inspector must verify that all tests are conducted at temperatures between 60 ^{o}F and 90 ^{o}F.

(q) Marking. Markings must be stamped plainly and permanently on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder.

§178.50 Specification 4B welded or brazed steel cylinders.

(a) Type, size, and service pressure. A DOT 4B is a welded or brazed steel cylinder with longitudinal seams that are forged lap-welded or brazed and with water capacity (nominal) not over 1,000 pounds and a service pressure of at least 150 but not over 500 pounds per square inch. Cylinders closed in by spinning process are not authorized.

(b) Steel. Open-hearth, electric or basic oxygen process steel of uniform quality must be used. Content percent may not exceed the following: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

(c) Identification of material. Material must be identified by any suitable method except that plates and billets for hotdrawn cylinders must be marked with the heat number.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Exposed bottom welds on cylinders over 18 inch long must be protected by footrings. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3. Seams must be made as follows:

(1) Welded or brazed circumferential seams. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing

material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.
(2) Longitudinal seams in shells. Longitudinal seams must be forged lap welded, by copper brazing, by copper alloy brazing, or by silver alloy brazing. Copper alloy composition must be: Copper, 95 percent minimum; Silicon, 1.5 percent to 3.85 percent; Manganese, 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1000 °F. When brazed, the plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or electric spot-welding; brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side.
(e) Welding or brazing. Only the attachment of neckrings, footrings, handles, bosses, pads, and valve protection rings to the tops and bottoms of cylinders by welding or brazing is authorized. Such attachments and the portion of the container to which they are attached must be made of weldable steel, the carbon content of which may not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.
(f) Wall thickness. The wall thickness of the cylinder must comply with the following requirements:
(1) For cylinders with outside diameters over 6 inches the minimum wall thickness must be 0.090 inch. In any case, the minimum wall thickness must be such that calculated wall stress at minimum test pressure (paragraph (i)(4) of this section) may not exceed the following values:
(i) 24,000 pounds per square inch for cylinders without longitudinal seam.
(ii) 22,800 pounds per square inch for cylinders having copper brazed or silver alloy brazed longitudinal seam.
(iii) 18,000 pounds per square inch for cylinders having forged lapped welded longitudinal seam.
(2) Calculation must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. Cylinder body and heads, formed by drawing or pressing, must be uniformly and properly heat treated prior to tests.*

(h) Opening in cylinders. Openings in cylinders must conform to the following:

(1) Each opening in cylinders, except those for safety devices, must be provided with

a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis except that if attachment is by welding, carbon content may not exceed 0.25 percent. If threads are used, they must comply with the following:

(i) Threads must be clean cut, even without checks, and tapped to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(iv) A brass fitting may be brazed to the steel boss or flange on cylinders used as component parts of hand fire extinguishers.

(2) The closure of a fitting, boss, or pad must be adequate to prevent leakage.

(i) *Hydrostatic test. Cylinders must withstand a hydrostatic test as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) At least one cylinder selected at random out of each lot of 200 or less must be tested as outlined in paragraphs (i)(1), (i)(2), and (i)(3) of this section to at least two times service pressure.

(ii) All cylinders not tested as outlined in paragraph (i)(4)(i) of this section must be examined under pressure of at least two times service pressure and show no defect.

(j) *Flattening test. After the hydrostatic test, a flattening test must be performed on one cylinder taken at random out or each lot of 200 or less, by placing the cylinder between wedge shaped knife edges having a 60^{o} included angle, rounded to $^{1/2}$-inch radius. The longitudinal axis of the cylinder must be at a 90-degree angle to knife edges during the test. For lots of 30 or less, flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material as follows:

(1) The test is required on 2 specimens cut from 1 cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less. For lots of 30 or less,

physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width of not over $1^{1/2}$ inches, a gauge length of 2 inches with a width of not over $1^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times the thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, and strain indicator reading must be set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. Either of the following is an acceptable result:*

(1) An elongation of at least 40 percent for a 2-inch gauge length or at least 20 percent in other cases and yield strength not over 73 percent of tensile strength. In this instance, a flattening test is not required.

(2) When cylinders are constructed of lap welded pipe, flattening test is required, without cracking, to 6 times the wall thickness. In such case, the rings (crop ends) cut from each end of pipe, must be tested with the weld 45^{o} or less from the point of greatest stress. If a ring fails, another from the same end of pipe may be tested.

(m) *Rejected cylinders. Reheat treatment is authorized for rejected cylinder. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair of brazed seams by brazing and welded seams by welding is authorized.*

(n) Markings. Markings must be stamped plainly and permanently in any of the

following locations on the cylinder:
(1) On shoulders and top heads when they are not less than 0.087-inch thick.
(2) On side wall adjacent to top head for side walls which are not less than 0.090 inch thick.
(3) On a cylindrical portion of the shell which extends beyond the recessed bottom of the cylinder, constituting an integral and non-pressure part of the cylinder.
(4) On a metal plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least $^{1/16}$-inch thick and must be attached by welding, or by brazing. The brazing rod must melt at a temperature of 1100 ^{o}F. Welding or brazing must be along all the edges of the plate.
(5) On the neck, neckring, valve boss, valve protection sleeve, or similar part permanently attached to the top of the cylinder.
(6) On the footring permanently attached to the cylinder, provided the water capacity of the cylinder does not exceed 25 pounds.

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended at 62 FR 51561, Oct. 1, 1997]

§178.51 Specification 4BA welded or brazed steel cylinders.
(a) *Type, size, and service pressure. A DOT 4BA cylinder is a cylinder, either spherical or cylindrical in shape, with a water capacity of 1,000 pounds or less and a service pressure of at least 225 and not over 500 pounds per square inch. Closures made by the spinning process are not authorized.*
(1) Spherical type cylinders must be made from two seamless hemispheres joined by the welding of one circumferential seam.
(2) Cylindrical type cylinders must be of circumferentially welded or brazed construction.
(b) *Steel. The steel used in the construction of the cylinder must be as specified in table 1 of appendix A to this part.*
(c) Identification of material. Material must be identified by any suitable method except that plates and billets for hotdrawn cylinders must be marked with the heat number.
(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings.
(1) Seams must be made as follows:
(i) Minimum thickness of heads and bottoms must be not less than 90 percent of the required thickness of the side wall.
(ii) Circumferential seams must be made by welding or by brazing. Heads must be

attached by brazing and must have a driving fit with the shell, unless the shell is crimped, swedged or curled over the skirt or flange of the head and must be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of the shell must be at least four times the thickness of shell metal.

(iii) Longitudinal seams in shells must be made by copper brazing, copper alloy brazing, or by silver alloy brazing. Copper alloy composition must be: Copper 95 percent minimum, Silicon 1.5 percent to 3.85 percent, Manganese 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1,000 ^{o}F. The plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or by electric spot-welding. Brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side. Strength of longitudinal seam: Copper brazed longitudinal seam must have strength at least $^{3/2}$ times the strength of the steel wall.

(2) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(e) *Welding and brazing. Only the welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings to the tops and bottoms of cylinders is authorized. Provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which may not exceed 0.25 percent except in the case of 4130x steel which may be used with proper welding procedure.*

(f) Wall thickness. The minimum wall thickness of the cylinder must meet the following conditions:

(1) For any cylinder with an outside diameter of greater than 6 inches, the minimum wall thickness is 0.078 inch. In any case the minimum wall thickness must be such that the calculated wall stress at the minimum test pressure may not exceed the lesser value of any of the following:

(i) The value shown in table I of appendix A to this part, for the particular material under consideration;

(ii) One-half of the minimum tensile strength of the material determined as required in paragraph (j) of this section;

(iii) 35,000 pounds per square inch; or

(iv) Further provided that wall stress for cylinders having copper brazed longitudinal seams may not exceed 95 percent of any of the above values. Measured wall thickness may not include galvanizing or other protective coating.

(2) Cylinders that are cylindrical in shape must have the wall stress calculated by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
d = inside diameter in inches.

(3) Cylinders that are spherical in shape must have the wall stress calculated by the formula:

$$S = PD / 4tE$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
t = minimum wall thickness in inches;
E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone must extend a distance of 6 times wall thickness from center line of weld);
E = 1.0 (for all other areas).

(4) For a cylinder with a wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter may not exceed 4.1.

(g) *Heat treatment. Cylinders must be heat treated in accordance with the following requirements:*

(1) Each cylinder must be uniformly and properly heat treated prior to test by the applicable method shown in table I of appendix A to this part. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations, but may be done before, during or after the brazing operations.

(2) Heat treatment is not required after the welding or brazing of weldable low carbon parts to attachments of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400 ^{o}F in any part of the top or bottom material.

(h) *Openings in cylinders. Openings in cylinders must comply with the following requirements:*

(1) Any opening must be placed on other than a cylindrical surface.

(2) Each opening in a spherical type cylinder must be provided with a fitting, boss, or pad of weldable steel securely attached to the container by fusion welding.

(3) Each opening in a cylindrical type cylinder must be provided with a fitting, boss, or pad, securely attached to container by brazing or by welding.

(4) If threads are used, they must comply with the following:

(i) Threads must be clean-cut, even, without checks and tapped to gauge.

(ii) Taper threads must be of a length not less than that specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, must have a tight fit and a calculated shear strength of at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test, as follows:*

(1) The test must be by water jacket, or other suitable method, operated so as to obtain accurate data. A pressure gauge must permit reading to an accuracy of 1 percent. An expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat treatment and previous to the official test may not exceed 90 percent of the test pressure.

(3) Permanent volumetric expansion may not exceed 10 percent of the total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) At least one cylinder selected at random out of each lot of 200 or less must be tested as outlined in paragraphs (i)(1), (i)(2), and (i)(3) of this section to at least two times service pressure.

(ii) All cylinders not tested as outlined in paragraph (i)(4)(i) of this section must be examined under pressure of at least two times service pressure and show no defect.

(j) *Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:*

(1) The test is required on 2 specimens cut from one cylinder or part thereof having passed the hydrostatic test and heat-treated as required, taken at random out of each lot of 200 or less. Physical tests for spheres are required on 2 specimens cut from flat representative sample plates of the same heat taken at random from the steel used to produce the spheres. This flat steel from which 2 specimens are to be cut must receive the same heat treatment as the spheres themselves. Sample plates must be taken from each lot of 200 or less spheres.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, or a gauge length of 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times the thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of the cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain reference must be set while the specimen is under a stress of 12,000 pounds per square inch, and the strain indicator reading must be set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Elongation. Physical test specimens must show at least a 40 percent elongation for a 2-inch gauge length or at least 20 percent in other cases. Except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens, and by 1 in other cases, for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.*

(l) Tests of welds. Except for brazed seams, welds must be tested as follows:

(1) Tensile test. A specimen must be cut from one cylinder of each lot of 200 or less, or welded test plate. The welded test plate must be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case must it be of a lesser thickness than that required for a quarter size Charpy impact specimen. The weld must be made by the same procedures and subjected to the same heat treatment as the major weld on the cylinder. The specimen must be taken from across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented must be rejected.

(2) Guided bend test. A root bend test specimen must be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (l)(1) of this section. Specimens must be taken from across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) Alternate guided-bend test. This test may be used and must be as required by CGA Pamphlet C-3. The specimen must be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines a to b, must be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in paragraph (k) of this section.

(m) Rejected cylinders. Reheat treatment is authorized for rejected cylinders. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair of brazed seams by brazing and welded seams by welding is authorized.

(n) Markings. Markings must be stamped plainly and permanently in one of the following locations on the cylinder:

(1) On shoulders and top heads not less than 0.087 inch thick.

(2) On side wall adjacent to top head for side walls not less than 0.090 inch thick.

(3) On a cylindrical portion of the shell which extends beyond the recessed bottom of the cylinder constituting an integral and non-pressure part of the cylinder.

(4) On a plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least $^{1/16}$ inch thick and must be attached by welding, or by brazing at a temperature of at least 1100 ^{o}F., throughout all edges of the plate.

(5) On the neck, neckring, valve boss, valve protection sleeve, or similar part permanently attached to the top of the cylinder.

(6) On the footring permanently attached to the cylinder, provided the water capacity of the cylinder does not exceed 25 pounds.

§178.53 Specification 4D welded steel cylinders for aircraft use.

(a) *Type, size, and service pressure. A DOT 4D cylinder is a welded steel sphere (two seamless hemispheres) or circumferentially welded cylinder (two seamless drawn shells) with a water capacity not over 100 pounds and a service pressure of at least 300 but not over 500 pounds per square inch. Cylinders closed in by spinning process are not authorized.*

(b) Steel. Open-hearth or electric steel of uniform and weldable quality must be used. Content may not exceed the following: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050, except that the following steels commercially known as 4130X and Type 304, 316, 321, and 347 stainless steels may be used with proper welding procedure. A heat of steel made under table 1 in this paragraph (b), check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in table 2 in this paragraph (b) are not exceeded, except as approved by the Associate Administrator. The following chemical analyses are authorized:

Table 1-4130X Steel

4130X	Percent
Carbon	0.25/0.35.
Manganese	0.40/0.60.
Phosphorus	0.04 max.
Sulphur	0.05 max
Silicon	0.15/0.35.

Chromium	0.80/1.10.
Molybdenum	0.15/0.25.
Zirconium	None.
Nickel	None.

Table 2-Authorized Stainless Steels

-	Stainless steels			
	304 (percent)	316 (percent)	321 (percent)	347 (percent)
Carbon (max)	0.08	0.08	0.08	0.08
Manganese (max)	2.00	2.00	2.00	2.00
Phosphorus (max)	.030	.045	.030	.030
Sulphur (max)	.030	.030	.030	.030
Silicon (max)	.75	1.00	.75	.75
Nickel	8.0/11.0	10.0/14.0	9.0/13.0	9.0/13.0
Chromium	18.0/20.0	16.0/18.0	17.0/20.0	17.0/20.0
Molybdenum	-	2.0/3.0	-	-
Titanium	-	-	([1])	-
Columbium	-	-	-	([2])

[1]Titanium may not be less than 5C and not more than 0.60%.
[2]Columbium may not be less than 10C and not more than 1.0%.

Table 3-Check Analysis Tolerances

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
-	-	Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.01	0.01
-	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
-	Over 1.15 to 2.50 incl	.05	.05
Phosphorus[1]	All ranges	-	.01
Sulphur	All ranges	-	.01
Silicon	To 0.30 incl	.02	.03
-	Over 0.30 to 1.00 incl	.05	.05
Nickel	Over 5.30 to 10.00 incl	.10	.10
-	Over 10.00 to 14.00 incl	.15	.15
Chromium	To 0.90 incl	.03	.03
-	Over 0.90 to 2.10 incl	.05	.05
-	Over 15.00 to 20.00 incl	.20	.20

Molybdenum	To 0.20 incl	.01	.01
-	Over 0.20 to 0.40 incl	.02	.02
-	Over 1.75 to 3.0 incl	.10	.10
Titanium	All ranges	.05	.05
Columbium	All ranges	.05	.05

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material. Material must be identified by any suitable method except that plates and billets for hotdrawn cylinders must be marked with the heat number.*

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished container appreciably. A reasonably smooth and uniform surface finish is required. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(e) Wall thickness. The wall stress at the minimum test pressure may not exceed 24,000 pounds per square inch, except where steels commercially known as 4130X, types 304, 316, 321, and 347 stainless steels are used, stress at the test pressures may not exceed 37,000 pounds per square inch. The minimum wall thickness for any container having a capacity of 1,100 cubic inches or less is 0.04 inch. The minimum wall thickness for any container having a capacity in excess of 1,100 cubic inches is 0.095 inch. Calculations must be done by the following:

(1) Calculation for a "sphere" must be made by the formula:

$$S = PD / 4tE$$

Where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D = outside diameter in inches;
t = minimum wall thickness in inches;
E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone must extend a distance of 6 times wall thickness from center line of weld);
E = 1.0 (for all other areas).

(2) Calculation for a cylinder must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^T12)$$

Where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(f) *Heat treatment. The completed cylinders must be uniformly and properly heat-treated prior to tests.*

(g) Openings in container. Openings in cylinders must comply with the following:

(1) Each opening in the container, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to the container by brazing or by welding or by threads. If threads are used, they must comply with the following:

(i) Threads must be clean cut, even, without checks, and tapped to gauge.

(ii) Taper threads must be of a length not less than that specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, must have a tight fit and calculated shear strength of at least 10 times the test pressure of the container. Gaskets, adequate to prevent leakage, are required.

(2) Closure of a fitting, boss, or pad must be adequate to prevent leakage.

(h) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test, as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. A pressure gauge must permit a reading to an accuracy of 1 percent. An expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of the total volumetric expansion at test pressure.

(4) Containers must be tested as follows:

(i) Each container to at least 2 times service pressure; or

(ii) One container out of each lot of 200 or less to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defects.

(i) *Flattening test for spheres and cylinders. Spheres and cylinders must be subjected to a flattening test as follows:*

(1) One sphere taken at random out of each lot of 200 or less must be subjected to a flattening test as follows:

(i) The test must be performed after the hydrostatic test.

(ii) The test must be between parallel steel plates on a press with a welded seam at right angles to the plates. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(2) One cylinder taken at random out of each lot of 200 or less must be subjected to a flattening test, as follows:

(i) The test must be performed after the hydrostatic test.

(ii) The test must be between knife edges, wedge shaped, 60^{o} angle, rounded to $^{1/2}$ inch radius. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat treatment as the finished cylinder.

(j) *Physical test and specimens for spheres and cylinders. Spheres and cylinders must be subjected to a physical test as follows:*

(1) Physical test for spheres are required on 2 specimens cut from a flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates must be taken for each lot of 200 or less spheres.

(2) Specimens for spheres must have a gauge length 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times the thickness is authorized when a wall is not over $^{3/16}$ inch thick.

(3) Physical test for cylinders is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less. For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat treatment as the finished cylinder.

(4) Specimens for cylinders must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, or a gauge length of 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times the thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. Heating of the specimen for any purpose is not authorized.

(5) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Acceptable results for physical and flattening tests. Either of the following is an acceptable result:*

(1) An elongation of at least 40 percent for a 2 inch gauge length or at least 20 percent in other cases and yield strength not over 73 percent of tensile strength. In this instance, the flattening test is not required.

(2) An elongation of at least 20 percent for a 2 inch gauge length or 10 percent in other cases. Flattening is required to 50 percent of the original outside diameter without cracking.

(l) *Rejected cylinders. Reheat-treatment is authorized for rejected cylinders. Subsequent thereto, containers must pass all prescribed tests to be acceptable. Repair of welded seams by welding prior to reheat-treatment is authorized.*

(m) Marking. Marking on each container by stamping plainly and permanently are only authorized where the metal is at least 0.09 inch thick, or on a metal nameplate permanently secured to the container by means other than soft solder, or by means that would not reduce the wall thickness.

§178.55 Specification 4B240ET welded or brazed cylinders.

(a) Type, spinning process, size and service pressure. A DOT 4B240ET cylinder is a brazed type cylinder made from electric resistance welded tubing. The maximum water capacity of this cylinder is 12 pounds or 333 cubic inches and the service must be 240 pounds per square inch. The maximum outside diameter of the shell must be five inches and maximum length of the shell is 21 inches. Cylinders closed in by a spinning process are authorized.

(b) Steel. Open-hearth, basic oxygen, or electric steel of uniform quality must be used. Plain carbon steel content may not exceed the following: Carbon, 0.25; phosphorus, 0.045; sulfur, 0.050. The addition of other elements for alloying effect is prohibited.

(c) Identification of material. Material must be identified by any suitable method.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Heads may be attached to shells by lap brazing or may be formed integrally. The thickness of the bottom of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell. Such bottom thicknesses must be measured within an area bounded by a line representing the points of contact between the cylinder and the floor when the cylinder is in a vertical position. Seams must conform to the following:

(1) Circumferential seams must be by brazing only. Heads must be attached to shells by

the lap brazing method and must overlap not less than four times the wall thickness. Brazing material must have a melting point of not less than 1000 °F. Heads must have a driving fit with the shell unless the shell is crimped, swedged, or curled over the skirt or flange of the head and be thoroughly brazed until complete penetration of the joint by the brazing material is secured. Brazed joints may be repaired by brazing.
(2) Longitudinal seams in shell must be by electric resistance welded joints only. No repairs to longitudinal joints is permitted.
(3) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.
(e) *Welding or brazing. Only the attachment, by welding or brazing, to the tops and bottoms of cylinders of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized. Provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which may not exceed 0.25 percent.*
(f) Wall thickness. The wall stress must be at least two times the service pressure and may not exceed 18,000 pounds per square inch. The minimum wall thickness is 0.044 inch. Calculation must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = 2 times service pressure;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. Heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests. Cylinders with integral formed heads or bases must be subjected to a normalizing operation. Normalizing and brazing operations may be combined, provided the operation is carried out at a temperature in excess of the upper critical temperature of the steel.*

(h) Openings in cylinders. Openings in cylinders must comply with the following:

(1) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to the cylinder by brazing or by welding or by threads. A fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content may not exceed 0.25 percent. If threads are used, they must comply with the following:

(i) Threads must be clean cut, even without checks, and tapped to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(2) Closure of a fitting, boss, or pad must be adequate to prevent leakage.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) At least one cylinder selected at random out of each lot of 200 or less must be tested as outlined in paragraphs (i)(1), (i)(2), and (i)(3) of this section to at least two times service pressure.

(ii) All cylinders not tested as outlined in paragraph (i)(4)(i) of this section must be examined under pressure of at least two times service pressure and show no defect.

(5) Each 1000 cylinders or less successively produced each day must constitute a lot. One cylinder must be selected from each lot and hydrostatically tested to destruction. If this cylinder bursts below five times the service pressure, then two additional cylinders must be selected and subjected to this test. If either of these cylinders fails by bursting below five times the service pressure then the entire lot must be rejected. All cylinders constituting a lot must be of identical size, construction heat-treatment, finish, and quality.

(j) *Flattening test. Following the hydrostatic test, one cylinder taken at random out of each lot of 200 or less, must be subjected to a flattening test that is between knife edges, wedge shaped, 60^{o} angle, rounded to $^{1/2}$ inch radius.*

(k) Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:

(1) The test is required on 2 specimens cut from 1 cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less in the case of cylinders of capacity greater than 86 cubic inches and out of each lot of 500 or less for cylinders having a capacity of 86 cubic inches or less.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width not over 1$^{1/2}$ inches, a gauge length of 2 inches with a width not over 1$^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times the thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(l) *Acceptable results for physical and flattening tests. Acceptable results for the physical and flattening tests are an elongation of at least 40 percent for a 2 inch gauge length or at least 20 percent in other cases and a yield strength not over 73 percent of tensile strength. In this instance the flattening test is required, without cracking, to six times the wall thickness with a weld 90^{o} from the direction of the applied load. Two rings cut from the ends of length of pipe used in production of a lot may be used for the flattening test provided the rings accompany the lot which they represent in all thermal processing operations. At least one of the rings must pass the flattening test.*

(m) Leakage test. All spun cylinders and plugged cylinders must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture, subject to the following conditions:

(1) Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least $^{1/16}$ of the total area of the bottom but not less than $^{3/4}$ inch in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Except as provided in paragraph (n) of this section, cylinders which are leaking must be rejected.

(2) A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

(3) A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

(4) As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

(n) *Rejected cylinders. Repairs of rejected cylinders is authorized. Cylinders that are leaking must be rejected, except that:*

(1) Spun cylinders rejected under the provisions of paragraph (m) of this section may be removed from the spun cylinder category by drilling to remove defective material, tapping, and plugging.

(2) Brazed joints may be rebrazed.

(3) Subsequent to the operations noted in paragraphs (n)(1) and (n)(2) of this section, acceptable cylinders must pass all prescribed tests.

(o) *Marking. Markings on each cylinder must be by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which is permanently attached to the cylinders and forming an integral part thereof, provided that cylinders not less than 0.090 inch thick may be stamped on the side wall adjacent to top head.*

§178.56 Specification 4AA480 welded steel cylinders.

(a) Type, size, and service pressure. A DOT 4AA480 cylinder is a welded steel cylinder having a water capacity (nominal) not over 1,000 pounds water capacity and a service pressure of 480 pounds per square inch. Closures welded by spinning process not permitted.

(b) Steel. The limiting chemical composition of steel authorized by this specification must be as shown in table I of appendix A to this part.

(c) Identification of material. Material must be identified by any suitable method except that plates and billets for hotdrawn cylinders must be marked with the heat number.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Minimum thickness of heads and bottoms may not be less than 90 percent of the required thickness of the side wall. Seams must be made as follows:

(1) Circumferential seams must be welded. Brazing is not authorized.

(2) Longitudinal seams are not permitted.

(3) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(e) *Welding. Only the welding of neckrings, footrings, bosses, pads, and valve protection rings to the tops and bottoms of cylinders is authorized. Provided that such attachments are made of weldable steel, the carbon content of which does not exceed 0.25 percent.*

(f) Wall thickness. The wall thickness of the cylinder must conform to the following:

(1) For cylinders with an outside diameter over 5 inches, the minimum wall thickness is 0.078 inch. In any case, the minimum wall thickness must be such that the calculated wall stress at the minimum test pressure (in paragraph (i) of this section) may not exceed the lesser value of either of the following:
(i) One-half of the minimum tensile strength of the material determined as required in paragraph (j) of this section; or
(ii) 35,000 pounds per square inch.
(2) Calculation must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
d = inside diameter in inches.

(3) The ratio of tangential length to outside diameter may not exceed 4.0 for cylinders with a wall thickness less than 0.100 inch.

(g) *Heat treatment. Each cylinder must be uniformly and properly heat treated prior to tests. Any suitable heat treatment in excess of 1100 ^{o}F is authorized except that liquid quenching is not permitted. Heat treatment must be accomplished after all forming and welding operations. Heat treatment is not required after welding weldable low carbon parts to attachments of similar material which have been previously welded to the top or bottom of cylinders and properly heat treated, provided such subsequent welding does not produce a temperature in excess of 400 ^{o}F., in any part of the top or bottom material.*

(h) Openings in cylinders. Openings in cylinders must conform to the following:

(1) All openings must be in the heads or bases.

(2) Each opening in the cylinder, except those for safety devices, must be provided with a fitting boss, or pad, securely attached to the cylinder by welding or by threads. If threads are used they must comply with the following:

(i) Threads must be clean-cut, even without checks and cut to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads having at least 6 engaged threads, must have a tight fit and a calculated shear strength at least 10 times the test pressure of the cylinder. Gaskets, adequate to prevent leakage, are required.

(3) Closure of a fitting, boss or pad must be adequate to prevent leakage.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:*

(1) The test must be by water jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1

percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds or sufficiently longer to assure complete expansion. Any internal pressure applied after heat-treatment and before the official test may not exceed 90 percent of the test pressure. If, due to failure of test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is lower.

(3) Permanent volumetric expansion may not exceed 10 percent of the total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) At least one cylinder selected at random out of each lot of 200 or less must be tested as described in paragraphs (i)(1), (i)(2), and (i)(3) of this section, to at least two times service pressure. If a selected cylinder fails, then two additional specimens must be selected at random from the same lot and subjected to the prescribed test. If either of these fails the test, then each cylinder in that lot must be so tested; and

(ii) Each cylinder not tested as prescribed in paragraph (i)(4)(i) of this section must be examined under pressure of at least two times service pressure and must show no defect. A cylinder showing a defect must be rejected unless it may be requalified under paragraph (m) of this section.

(j) *Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material, as follows:*

(1) The test is required on 2 specimens cut from one cylinder having passed the hydrostatic test, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times the thickness with a width not over 6 times thickness is authorized when the cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain reference must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Elongation. Physical test specimens must show at least a 40 percent elongation for 2-inch gauge lengths or at least a 20 percent elongation in other cases. Except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens and by 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.*

(l) Tests of welds. Welds must be tested as follows:

(1) Tensile test. A specimen must be cut from one cylinder of each lot of 200 or less, or a welded test plate. The welded test plate must be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that it may not be of a lesser thickness than that required for a quarter size Charpy impact specimen. The weld must be made by the same procedures and subjected to the same heat treatment as the major weld on the cylinder. The specimens must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented must be rejected.

(2) Guided bend test. A root bend test specimen must be cut from the cylinder or a welded test plate, used for the tensile test specified in paragraph (l)(1) of this section. Specimens must be taken from across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) Alternate guided-bend test. This test may be used and must be as required by CGA Pamphlet C-3. The specimen must be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines-a to b, is at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in paragraph (k) of this section.

(m) Rejected cylinders. Reheat treatment of rejected cylinders is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair of welded seams by welding is authorized.

(n) Markings. Markings must be stamped plainly and permanently in one of the following locations on the cylinder:

(1) On shoulders and top heads not less than 0.087 inch thick.

(2) On neck, valve boss, valve protection sleeve, or similar part permanently attached

to top end of cylinder.

(3) On a plate attached to the top of the cylinder or permanent part thereof: sufficient space must be left on the plate to provide for stamping at least six retest dates: the plate must be at least $^{1/16}$ inch thick and must be attached by welding or by brazing at a temperature of at least 1100 °F, throughout all edges of the plate.

(4) Variations in location of markings authorized only when necessitated by lack of space.

§178.57 Specification 4L welded insulated cylinders.

(a) *Type, size, service pressure, and design service temperature. A DOT 4L cylinder is a fusion welded insulated cylinder with a water capacity (nominal) not over 1,000 pounds water capacity and a service pressure of at least 40 but not greater than 500 pounds per square inch conforming to the following requirements:*

(1) For liquefied hydrogen service, the cylinders must be designed to stand on end, with the axis of the cylindrical portion vertical.

(2) The design service temperature is the coldest temperature for which a cylinder is suitable. The required design service temperatures for each cryogenic liquid is as follows:

Cryogenic liquid	Design service temperature
Argon	Minus 320 °F or colder.
Helium	Minus 452 °F or colder.
Hydrogen	Minus 42 3 °F or colder.
Neon	Minus 411 °F or colder.
Nitrogen	Minus 320 °F or colder.
Oxygen	Minus 320 °F or colder.

(b) *Material. Material use in the construction of this specification must conform to the following:*

(1) Inner containment vessel (cylinder). Designations and limiting chemical compositions of steel authorized by this specification must be as shown in table 1 in paragraph (o) of this section.

(2) Outer jacket. Steel or aluminum may be used subject to the requirements of paragraph (o)(2) of this section.

(c) Identification of material. Material must be identified by any suitable method.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart and to the following requirements:

(1) No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. The shell portion must be a

reasonably true cylinder.

(2) The heads must be seamless, concave side to the pressure, hemispherical or ellipsoidal in shape with the major diameter not more than twice the minor diameter. Minimum thickness of heads may not be less than 90 percent of the required thickness of the sidewall. The heads must be reasonably true to shape, have no abrupt shape changes, and the skirts must be reasonably true to round.

(3) The surface of the cylinder must be insulated. The insulating material must be fire resistant. The insulation on non-evacuated jackets must be covered with a steel jacket not less than 0.060-inch thick or an aluminum jacket not less than 0.070 inch thick, so constructed that moisture cannot come in contact with the insulating material. If a vacuum is maintained in the insulation space, the evacuated jacket must be designed for a minimum collapsing pressure of 30 psi differential whether made of steel or aluminum. The construction must be such that the total heat transfer, from the atmosphere at ambient temperature to the contents of the cylinder, will not exceed 0.0005 Btu per hour, per Fahrenheit degree differential in temperature, per pound of water capacity of the cylinder. For hydrogen, cryogenic liquid service, the total heat transfer, with a temperature differential of 520 Fahrenheit degrees, may not exceed that required to vent 30 SCF of hydrogen gas per hour.

(4) For a cylinder having a design service temperature colder than minus 320 ^{o}F, a calculation of the maximum weight of contents must be made and that weight must be marked on the cylinder as prescribed in §178.35.

(5) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3. In addition, an impact test of the weld must be performed in accordance with paragraph (l) of this section as part of the qualification of each welding procedure and operator.

(e) *Welding. Welding of the cylinder must be as follows:*

(1) All seams of the cylinder must be fusion welded. A means must be provided for accomplishing complete penetration of the joint. Only butt or joggle butt joints for the cylinder seams are authorized. All joints in the cylinder must have reasonably true alignment.

(2) All attachments to the sidewalls and heads of the cylinder must be by fusion welding and must be of a weldable material complying with the impact requirements of paragraph (l) of this section.

(3) For welding the cylinder, each procedure and operator must be qualified in accordance with the sections of CGA Pamphlet C-3 that apply. In addition, impact tests of the weld must be performed in accordance with paragraph (l) of this section as part of the qualification of each welding procedure and operator.

(4) Brazing, soldering and threading are permitted only for joints not made directly to the cylinder body. Threads must comply with the requirements of paragraph (h) of this section.

(f) *Wall thickness. The minimum wall thickness of the cylinder must be such that the calculated wall stress at the minimum required test pressure may not exceed the least value of the following:*

(1) 45,000 pounds per square inch.

(2) One-half of the minimum tensile strength across the welded seam determined in paragraph (l) of this section.
(3) One-half of the minimum tensile strength of the base metal determined as required in paragraph (j) of this section.
(4) The yield strength of the base metal determined as required in paragraph (l) of this section.
(5) Further provided that wall stress for cylinders having longitudinal seams may not exceed 85 percent of the above value, whichever applies.
(6) Calculation must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for pressure test in pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. Heat treatment is not permitted.*
(h) Openings in cylinder. Openings in cylinders must conform to the following:
(1) Openings are permitted in heads only. They must be circular and may not exceed 3 inches in diameter or one third of the cylinder diameter, whichever is less. Each opening in the cylinder must be provided with a fitting, boss or pad, either integral with, or securely attached to, the cylinder body by fusion welding. Attachments to a fitting, boss or pad may be made by welding, brazing, mechanical attachment, or threading.
(2) Threads must comply with the following:
(i) Threads must be clean-cut, even, without checks and cut to gauge.
(ii) Taper threads to be of a length not less than that specified for NPT.
(iii) Straight threads must have at least 4 engaged threads, tight fit and calculated shear strength at least 10 times the test pressure of the cylinder. Gaskets, which prevent leakage and are inert to the hazardous material, are required.
(i) *Pressure test. Each cylinder, before insulating and jacketing, must be examined under a pressure of at least 2 times the service pressure maintained for at least 30 seconds without evidence of leakage, visible distortion or other defect. The pressure gauge must permit reading to an accuracy of 1 percent.*
(j) Physical test. A physical test must be conducted to determine yield strength, tensile strength, and elongation as follows:
(1) The test is required on 2 specimens selected from material of each heat and in the same condition as that in the completed cylinder.
(2) Specimens must conform to the following:
(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with width not over $1^{1/2}$ inches, or a gauge length at least 24 times thickness with a width not over 6 times thickness (authorized when cylinder wall is not over $^{1/16}$ inch

thick).

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section.

(iii) When size of the cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows. When specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic expansion of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on the elastic modulus of the material used. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain reference must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Acceptable results for physical tests. Physical properties must meet the limits specified in paragraph (o)(1), table 1, of this section, for the particular steel in the annealed condition. The specimens must show at least a 20 percent elongation for a 2-inch gage length. Except that the percentage may be reduced numerically by 2 for each 7,500 pounds per square inch increment of tensile strength above 100,000 pounds per square inch to a maximum of 5 such increments. Yield strength and tensile strength must meet the requirements of paragraph (o)(1), table 1, of this section.*

(l) Tests of welds. Welds must be tested as follows:

(1) Tensile test. A specimen must be cut from one cylinder of each lot of 200 or less, or welded test plate. The welded test plate must be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that it may not be of a lesser thickness than that required for a quarter size Charpy impact specimen. The weld must be made by the same procedures and subjected to the same heat treatment as the major weld on the cylinder. The specimen must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fails to meet the requirements, the entire lot represented must be rejected.

(2) Guided bend test. A "root" bend test specimen must be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (l)(1) of this section and from any other seam or equivalent welded test plate if the seam is welded by a procedure different from that used for the major seam. Specimens must be taken across the particular seam being tested and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) Alternate guided-bend test. This test may be used and must be as specified in CGA Pamphlet C-3. The specimen must be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines a to b, is at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 100,000 pounds per square inch, as provided in paragraph (c) of this section.

(4) Impact tests. One set of three impact test specimens (for each test) must be prepared and tested for determining the impact properties of the deposited weld metal-

(i) As part of the qualification of the welding procedure.

(ii) As part of the qualification of the operators.

(iii) For each "heat" of welding rodor wire used.

(iv) For each 1,000 feet of weld made with the same heat of welding rod or wire.

(v) All impact test specimens must be of the Charpy type, keyhole or milled U-notch, and must conform in all respects to Figure 3 of ASTM E-23-60. Each set of impact specimens must be taken across the weld and have the notch located in the weld metal. When the cylinder material thickness is 2.5 mm or thicker, impact specimens must be cut from a cylinder or welded test plate used for the tensile or bend test specimens. The dimension along the axis of the notch must be reduced to the largest possible of 10 mm, 7.5 mm, 5 mm or 2.5 mm, depending upon cylinder thickness. When the material in the cylinder or welded test plate is not of sufficient thickness to prepare 2.5 mm impact test specimens, 2.5 mm specimens must be prepared from a welded test plate made from $^{1/8}$ inch thick material meeting the requirements specified in paragraph (o)(1), table 1, of this section and having a carbon analysis of .05 minimum, but not necessarily from one of the heats used in the lot of cylinders. The test piece must be welded by the same welding procedure as used on the particular cylinder seam being qualified and must be subjected to the same heat treatment.

(vi) Impact test specimens must be cooled to the design service temperature. The apparatus for testing the specimens must conform to the requirements of ASTM Standard E-23-60. The test piece, as well as the handling tongs, must be cooled for a length of time sufficient to reach the service temperature. The temperature of the cooling device must be maintained within a range of plus or minus 3 ^{o}F. The specimen must be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time lapse of not more than six seconds.

(vii) The impact properties of each set of impact specimens may not be less than the values in the following table:

Size of specimen	Minimum impact value required for avg. of each set of three specimens (ft.-lb.)	Minimum impact value permitted on one only of a set of three (ft.-lb.)
10 mmx10 mm	15	10
10 mmx7.5 mm	12.5	8.5
10 mmx5 mm	10	7.0
10 mmx2.5 mm	5	3.5

(viii) When the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen and the value for more than one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens must be made. The value of each of these retest specimens must equal or exceed the required average value. When an erratic result is caused by a defective specimen, or there is uncertainty in test procedure, a retest is authorized.

(m) *Radiographic examination. Cylinders must be subject to a radiographic examination as follows:*

(1) The techniques and acceptability of radiographic inspection must conform to the standards set forth in CGA Pamphlet C-3.

(2) One finished longitudinal seam must be selected at random from each lot of 100 or less successively produced and be radiographed throughout its entire length. Should the radiographic examination fail to meet the requirements of paragraph (m)(1) of this section, two additional seams of the same lot must be examined, and if either of these fail to meet the requirements of (m)(1) of this section, only those passing are acceptable.

(n) *Rejected cylinders. Reheat treatment of rejected cylinders is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Welds may be repaired by suitable methods of fusion welding.*

(o) Authorized materials of construction. Authorized materials of construction are as follows:

(1) Inner containment vessel (cylinder). Electric furnace steel of uniform quality must be used. Chemical analysis must conform to ASTM A240, Type 304 Stainless Steel. A heat of steel made under table 1 and table 2 in this paragraph (o)(1) is acceptable, even though its check chemical analysis is slightly out of the specified range, if it is satisfactory in all other respects, provided the tolerances shown in table 3 in this paragraph (o)(1) are not exceeded. The following chemical analyses and physical properties are authorized:

Table 1-Authorized Materials

Designation	Chemical analysis, limits in percent
Carbon[1]	0.08 max.
Manganese	2.00 max.
Phosphorus	0.045 max.
Sulphur	0.030 max.
Silicon	1.00 max.
Nickel	8.00-10.50.
Chromium	18.00-20.00.
Molybdenum	None.
Titanium	None.
Columbium	None.

[1]The carbon analysis must be reported to the nearest hundredth of one percent.

Table 2-Physical Properties

	Physical properties (annealed)
Tensile strength, p.s.i. (minimum)	75,000
Yield strength, p.s.i. (minimum)	30,000
Elongation in 2 inches (minimum) percent	30.0
Elongation other permissible gauge lengths (minimum) percent	15.0

Table 3-Check Analysis Tolerances

Elements	Limit or specified range (percent)	Tolerance over the maximum limit or under the minimum limit
Carbon	To 0.030, incl	0.005
-	Over 0.30 to 0.20, incl	0.01
Manganese	To 1.00 incl	.03
-	Over 1.00 to 3.00, incl	0.04
Phosphorus[1]	To 0.040, incl	0.005
-	Over 0.040 to 0.020 incl	0.010
Sulphur	To .40 incl	0.005
Silicon	To 1.00, incl	0.05
Nickel	Over 5.00 to 10.00, incl	0.10
-	Over 10.00 to 20.00, incl	0.15
Chromium	Over 15.00 to 20.00, incl	0.20

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(2) *Outer jacket. (i) Nonflammable cryogenic liquids. Cylinders intended for use in the transportation of nonflammable cryogenic liquid must have an outer jacket made of steel or aluminum.*

(ii) Flammable cryogenic liquids. Cylinders intended for use in the transportation of flammable cryogenic liquid must have an outer jacket made of steel.

(p) *Markings. (1) Markings must be stamped plainly and permanently on shoulder or top head of jacket or on a permanently attached plate or head protective ring.*

(2) The letters "ST", followed by the design service temperature (for example, ST-423F), must be marked on cylinders having a design service temperature of colder than minus 320 °F only. Location to be just below the DOT mark.

(3) The maximum weight of contents, in pounds (for example, "Max. Content 51 #"), must be marked on cylinders having a design service temperature colder than minus 320 °F only. Location to be near symbol.

(4) Special orientation instructions must be marked on the cylinder (for example, THIS END UP), if the cylinder is used in an orientation other than vertical with openings at the top of the cylinder.

(5) If the jacket of the cylinder is constructed of aluminum, the letters "AL" must be marked after the service pressure marking. Example: DOT-4L150 AL.

(6) Except for serial number and jacket material designation, each marking prescribed in this paragraph (p) must be duplicated on each cylinder by any suitable means.

(q) *Inspector's report. In addition to the information required by §178.35, the inspector's reports must contain information on:*

(1) The jacket material and insulation type;

(2) The design service temperature

(°F); and

(3) The impact test results, on a lot basis.

§178.58 Specification 4DA welded steel cylinders for aircraft use.

(a) *Type, size, and service pressure. A DOT 4DA is a welded steel sphere (two seamless hemispheres) or a circumferentially welded cylinder (two seamless drawn shells) with a water capacity not over 100 pounds and a service pressure of at least 500 but not over 900 pounds per square inch.*

(b) Steel. Open-hearth or electric steel of uniform quality must be used. A heat of steel made under table 1 in this paragraph (b), check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in table 2 in this paragraph (b) are not exceeded except as approved by the Associate Administrator. The following chemical analyses are authorized:

Table 1-Authorized Materials

4130	Percent
Carbon	0.28/0.33.
Manganese	0.40/0.60.
Phosphorus	0.040 max.
Sulfur	0.040 max.
Silicon	0.15/0.35.
Chromium	0.80/1.10.
Molybdenum	0.15/0.25.

Table 2-Check Analysis Tolerances

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
-	-	Under minimum limit	Over maximum limit
Carbon	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
Phosphorus[1]	All ranges	-	.01
Sulphur	All ranges	-	.01
Silicon	To 0.30 incl	.02	.03
-	Over 0.30 to 1.00 incl	.05	.05
Chromium	To 0.90 incl	.03	.03
-	Over 0.90 to 2.10 incl	.05	.05
Molybdenum	To 0.20 incl	.01	.01
-	Over 0.20 to 0.40, incl	.02	.02

[1]Rephosphorized steels not subject to check analysis for phosphorus.

(c) *Identification of material. Materials must be identified by any suitable method except that plates and billets for hot-drawn containers must be marked with the heat number.*

(d) Manufacture. Cylinders must be manufactured in accordance with the following requirements:

(1) By best appliances and methods. No defect is acceptable that is likely to weaken the finished container appreciably. A reasonably smooth and uniform surface finish is required. No abrupt change in wall thickness is permitted. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(2) All seams of the sphere or cylinders must be fusion welded. Seams must be of

the butt or joggle butt type and means must be provided for accomplishing complete penetration of the joint.

(e) *Welding. Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable steel, the carbon content of which may not exceed 0.25 percent except in the case of 4130 steel.*

(f) Wall thickness. The minimum wall thickness must be such that the wall stress at the minimum specified test pressure may not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical and burst tests required and may not be over 70,000 p.s.i. For any diameter container, the minimum wall thickness is 0.040 inch. Calculations must be made by the formulas in (f)(1) or (f)(2) of this section:

(1) Calculation for a sphere must be made by the following formula:

$$S = PD / 4tE$$

Where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i.e., at least 2 times service pressure, in pounds per square inch;
D = outside diameter in inches;
t = minimum wall thickness in inches;
E = 0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone must extend a distance of 6 times wall thickness from center line of weld);
E = 1.0 (for all other areas).

(2) Calculation for a cylinder must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = test pressure prescribed for water jacket test, i.e., at least 2 times service pressure, in pounds per square inch;
D = outside diameter in inches;
d = inside diameter in inches.

(g) *Heat treatment. The completed containers must be uniformly and properly heat-treated prior to tests. Heat-treatment of containers of the authorized analysis must be as follows:*

(1) All containers must be quenched by oil, or other suitable medium except as provided in paragraph (g)(4) of this section.

(2) The steel temperature on quenching must be that recommended for the steel

analysis, but may not exceed 1,750 ^oF.

(3) The steel must be tempered at the temperature most suitable for the analysis except that in no case shall the tempering temperature be less than 1,000 ^oF.

(4) The steel may be normalized at a temperature of 1,650 ^oF instead of being quenched, and containers so normalized need not be tempered.

(5) All cylinders, if water quenched or quenched with a liquid producing a cooling rate in excess of 80 percent of the cooling rate of water, must be inspected by the magnetic particle or dye penetrant method to detect the presence of quenching cracks. Any cylinder found to have a quench crack must be rejected and may not be requalified.

(h) *Openings in container. Openings in the container must comply with the following requirements:*

(1) Each opening in the container must be provided with a fitting, boss, or pad of weldable steel securely attached to the container by fusion welding.

(2) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

(i) Threads must be clean cut, even, without checks, and tapped to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

(i) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) Each container must be tested to at least 2 times service pressure.

(j) *Burst test. One container taken at random out of 200 or less must be hydrostatically tested to destruction. The rupture pressure must be included as part of the inspector's report.*

(k) Flattening test. Spheres and cylinders must be subjected to a flattening test as follows:

(1) Flattening test for spheres. One sphere taken at random out of each lot of 200 or less must be subjected to a flattening test as follows:

(i) The test must be performed after the hydrostatic test.

(ii) The test must be at the weld between the parallel steel plates on a press with a welded seam, at right angles to the plates. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(2) *Flattening test for cylinders. One cylinder taken at random out of each lot of 200 or less, must be subjected to a flattening test as follows:*

(i) The test must be performed after the hydrostatic test.

(ii) The test must between knife edges, wedge shaped, 60^{o} angle, rounded to $^{1/2}$ inch radius; test

(l) *Radiographic inspection. Radiographic examinations is required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the sphere diameter need not be subjected to radiographic inspection. Evidence of any defects likely to seriously weaken the container must be cause for rejection.*

(m) Physical test and specimens for spheres and cylinders. Spheres and cylinders must be subjected to a physical test as follows:

(1) A physical test for a sphere is required on 2 specimens cut from a flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates to be taken for each lot of 200 or less spheres.

(2) Specimens for spheres have a gauge length of 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times thickness with a width not over 6 times thickness is authorized when wall of sphere is not over $^{3/16}$ inch thick.

(3) A physical test for cylinders is required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less.

(4) Specimens for cylinder must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with a width not over $1^{1/2}$ inches, a gauge length at least 24 times thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section.

(iii) Heating of a specimen for any purpose is not authorized.

(5) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(n) *Acceptable results for physical, flattening, and burst tests. The following are acceptable results of the physical, flattening and burst test:*

(1) Elongation must be at least 20 percent for a 2-inch gauge length or 10 percent in other cases.

(2) Flattening is required to 50 percent of the original outside diameter without cracking.

(3) Burst pressure must be at least 3 times service pressure.

(o) *Rejected containers. Reheat-treatment of rejected cylinders is authorized. Subsequent thereto, containers must pass all prescribed tests to be acceptable. Repair of welded seams by welding prior to reheat-treatment is authorized.*

(p) Marking. Markings on each container must be stamped plainly and permanently on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder.

§178.59 Specification 8 steel cylinders with porous fillings for acetylene.

(a) Type and service pressure. A DOT 8 cylinder is a seamless cylinder with a service pressure of 250 pounds per square inch. The following steel is authorized:

(1) A longitudinal seam if forge lap welded;

(2) Attachment of heads by welding or by brazing by dipping process; or

(3) A welded circumferential body seam if the cylinder has no longitudinal seam.

(b) *Steel. Open-hearth, electric or basic oxygen process steel of uniform quality must be used. Content percent may not exceed the following: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.*

(c) Identification of steel. Materials must be identified by any suitable method except that plates and billets for hot-drawn cylinders must be marked with the heat number.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is acceptable that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(e) Exposed bottom welds. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings.

(f) Heat treatment. Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

(g) Openings. Openings in the cylinders must comply with the following:

(1) Standard taper pipe threads are required;

(2) Length may not be less than as specified for American Standard pipe threads;

tapped to gauge; clean cut, even, and without checks.
(h) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:*
(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.
(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure.
(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.
(4) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If hydrostatically tested cylinder fails, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.
(i) *Leakage test. Cylinders with bottoms closed in by spinning must be subjected to a leakage test by setting the interior air or gas pressure to not less than the service pressure. Cylinders which leak must be rejected.*
(j) Physical test. A physical test must be conducted as follows:
(1) The test is required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.
(2) Specimens must conform to a gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with width not over $1^{1/2}$, or a gauge length at least 24 times thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.
(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:
(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8.
(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 offset.
(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.
(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per-minute during yield strength determination.
(4) Yield strength may not exceed 73 percent of tensile strength. Elongation must be at

least 40 percent in 2 inch or 20 percent in other cases.
(k) *Rejected cylinders. Reheat treatment of rejected cylinder is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding is authorized.*
(l) Porous filling. (1) Cylinders must be filled with a porous material in accordance with the following:
(i) The porous material may not disintegrate or sag when wet with solvent or when subjected to normal service;
(ii) The porous filling material must be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized if the well is filled with a material of such type that the functions of the filling material are not impaired;
(iii) Overall shrinkage of the filling material is authorized if the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed $^{1/2}$ of 1 percent of the respective diameter or length, but not to exceed $^{1/8}$ inch, measured diametrically and longitudinally;
(iv) The clearance may not impair the functions of the filling material;
(v) The installed filling material must meet the requirements of CGA Pamphlet C-12; and
(vi) Porosity of filling material may not exceed 80 percent except that filling material with a porosity of up to 92 percent may be used when tested with satisfactory results in accordance with CGA Pamphlet C-12.
(2) When the porosity of each cylinder is not known, a cylinder taken at random from a lot of 200 or less must be tested for porosity. If the test cylinder fails, each cylinder in the lot may be tested individually and those cylinders that pass the test are acceptable.
(3) For filling that is molded and dried before insertion in cylinders, porosity test may be made on a sample block taken at random from material to be used.
(4) The porosity of the filling material must be determined. The amount of solvent at 70 ^{o}F for a cylinder:
(i) Having shell volumetric capacity above 20 pounds water capacity (nominal) may not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	43.4
87 to 90	42.0
83 to 87	40.0
80 to 83	38.6
75 to 80	36.2
70 to 75	33.8
65 to 70	31.4

(ii) Having volumetric capacity of 20 pounds or less water capacity (nominal), may not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	41.8
83 to 90	38.5
80 to 83	37.1
75 to 80	34.8
70 to 75	32.5
65 to 70	30.2

(m) *Tare weight. The tare weight is the combined weight of the cylinder proper, porous filling, valve, and solvent, without removable cap.*

(n) Duties of inspector. In addition to the requirements of §178.35, the inspector is required to-

(1) Certify chemical analyses of steel used, signed by manufacturer thereof; also verify by, check analyses of samples taken from each heat or from 1 out of each lot of 200 or less, plates, shells, or tubes used.

(2) Verify compliance of cylinder shells with all shell requirements; inspect inside before closing in both ends; verify heat treatment as proper; obtain all samples for all tests and for check analyses; witness all tests; verify threads by gauge; report volumetric capacity and minimum thickness of wall noted.

(3) Prepare report on manufacture of steel shells in form prescribed in §178.35. Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(4) Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports; and furnish complete reports required by this specification to the person who has completed the manufacture of the cylinders and, upon request, to the purchaser. The test reports must be retained by the inspector for fifteen years from the original test date of the cylinder.

(o) *Marking. (1) Marking on each cylinder must be stamped plainly and permanently on or near the shoulder, top head, neck or valve protection collar which is permanently attached to the cylinder and forming integral part thereof.*

(2) Tare weight of cylinder, in pounds and ounces, must be marked on the cylinder.

(3) Cylinders, not completed, when delivered must each be marked for identification of each lot of 200 or less.

§178.60 Specification 8AL steel cylinders with porous fillings for acetylene.

(a) *Type and service pressure. A DOT 8AL cylinder is a seamless steel cylinder with a service pressure of 250 pounds per square inch. However, the attachment of heads by* *welding or by brazing by dipping process and a welded circumferential body seam is authorized. Longitudinal seams are not authorized.*

(b) Authorized steel. The authorized steel is as specified in table I of appendix A to this part.

(c) Identification of steel. Material must be identified by any suitable method except that plates and billets for hot-drawn cylinders must be marked with heat number.

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(e) Footrings. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings.

(f) Welding or brazing. Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) The attachment to the tops or bottoms of cylinders of neckrings, footrings, handlers, bosses, pads, and valve protecting rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which may not exceed 0.25 percent.

(2) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments, specified in paragraph (f)(1) of this section, of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400 ^{o}F in any part of the top or bottom material.

(g) *Wall thickness; wall stress. The wall thickness/wall stress of the cylinder must conform to the following:*

(1) The calculated wall stress at 750 pounds per square inch may not exceed 35,000 pounds per square inch, or one-half of the minimum ultimate strength of the steel as determined in paragraph (l) of this section, whichever value is the smaller. The measured wall thickness may not include galvanizing or other protective coating.

(i) Calculation of wall stress must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = 750 pounds per square inch (minimum test pressure);
D = outside diameter in inches;
d = inside diameter in inches.

(ii) Either D or d must be calculated from the relation D = d + 2t, where t = minimum wall thickness.

(2) Cylinders with a wall thickness less than 0.100 inch, the ratio of straight side wall

length to outside diameter may not exceed 3.5.

(3) For cylinders having outside diameter over 5 inches, the minimum wall thickness must be 0.087 inch.

(h) *Heat treatment. Each cylinder must be uniformly and properly heat treated, prior to tests, by any suitable method in excess of 1100 ^{o}F. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations but may be done before, during, or after the brazing operations. Liquid quenching is not authorized.*

(i) Openings. Standard taper pipe threads required in all openings. The length of the opening may not be less than as specified for American Standard pipe threads; tapped to gauge; clean cut, even, and without checks.

(j) Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test as follows:

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit reading of total expansion to an accuracy of either 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test may not exceed 90 percent of the test pressure.

(3) Permanent volumetric expansion may not exceed 10 percent of total volumetric expansion at test pressure.

(4) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If a hydrostatically tested cylinder fails, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.

(k) *Leakage test. Cylinders with bottoms closed in by spinning must be leakage tested by setting the interior air or gas pressure at not less than the service pressure. Any cylinder that leaks must be rejected.*

(l) Physical test. A physical test must be conducted as follows;

(1) The test is required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.

(2) Specimens must conform to a gauge length of 8 inches with a width not over 1$^{1/2}$ inches, a gauge length 2 inches with a width not over 1 $^{1/2}$ inches, or a gauge length at least 24 times thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E 8.

(ii) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 offset.

(iii) For the purpose of strain measurement, the initial strain must be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(m) *Elongation. Physical test specimens must show at least a 40 percent elongation for a 2 inch gauge length or at least a 20 percent elongation in other cases. Except that these elongation percentages may be reduced numerically by 2 for 2 inch specimens and 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.*

(n) Weld tests. Specimens taken across the circumferentially welded seam must be cut from one cylinder taken at random from each lot of 200 or less cylinders after heat treatment and must pass satisfactorily the following tests:

(1) Tensile test. A specimen must be cut from one cylinder of each lot of 200 or less, or welded test plate. The specimen must be taken from across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented must be rejected.

(2) Guided bend test. A root bend test specimen must be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (n)(1) of this section. Specimens must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) Alternate guided-bend test. This test may be used and must be as required by CGA Pamphlet C-3. The specimen must be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines-a to b, must be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in paragraph (m) of this section.

(o) Rejected cylinders. Reheat treatment of rejected cylinders is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair by welding is authorized.

(p) Porous filling. (1) Cylinders must be filled with a porous material in accordance with the following:

(i) The porous material may not disintegrate or sag when wet with solvent or when subjected to normal service;

(ii) The filling material must be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized if the well is filled with a material of such type that the functions of the filling material are not impaired;

(iii) Overall shrinkage of the filling material is authorized if the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed $^{1/2}$ of 1 percent of the respective diameter or length but not to exceed $^{1/8}$ inch, measured diametrically and longitudinally;

(iv) The clearance may not impair the functions of the filling material;

(v) The installed filling material must meet the requirements of CGA Pamphlet C-12; and

(vi) Porosity of filling material may not exceed 80 percent except that filling material with a porosity of up to 92 percent may be used when tested with satisfactory results in accordance with CGA Pamphlet C-12.

(2) When the porosity of each cylinder is not known, a cylinder taken at random from a lot of 200 or less must be tested for porosity. If the test cylinder fails, each cylinder in the lot may be tested individually and those cylinders that pass the test are acceptable.

(3) For filling that is molded and dried before insertion in cylinders, porosity test may be made on sample block taken at random from material to be used.

(4) The porosity of the filling material must be determined; the amount of solvent at 70 ^{o}F for a cylinder:

(i) Having shell volumetric capacity above 20 pounds water capacity (nominal) may not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	43.4
87 to 90	42.0
83 to 87	40.0
80 to 83	38.6
75 to 80	36.2
70 to 75	33.8
65 to 70	31.4

(ii) Having volumetric capacity of 20 pounds or less water capacity (nominal), may not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	41.8
83 to 90	38.5
80 to 83	37.1
75 to 80	34.8
70 to 75	32.5

65 to 70	30.2

(q) *Tare weight. The tare weight is the combined weight of the cylinder proper, porous filling, valve, and solvent, but without removable cap.*

(r) Duties of inspector. In addition to the requirements of §178.35, the inspector shall-

(1) Certify chemical analyses of steel used, signed by manufacturer thereof; also verify by check analyses, of samples taken from each heat or from 1 out of each lot of 200 or less plates, shells, or tubes used.

(2) Verify compliance of cylinder shells with all shell requirements, inspect inside before closing in both ends, verify heat treatment as proper; obtain all samples for all tests and for check analyses, witness all tests; verify threads by gauge, report volumetric capacity and minimum thickness of wall noted.

(3) Report percentage of each specified alloying element in the steel. Prepare report on manufacture of steel shells in form prescribed in §178.35. Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(4) Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports prescribed in paragraph (b) of this section; and furnish complete test reports required by this specification to the person who has completed the manufacturer of the cylinders and, upon request, to the purchaser. The test reports must be retained by the inspector for fifteen years from the original test date of the cylinder.

(s) *Marking. (1) Tare weight of cylinder, in pounds and ounces, must be marked on the cylinder.*

(2) Cylinders, not completed, when delivered must each be marked for identification of each lot of 200 or less.

(3) Markings must be stamped plainly and permanently in locations in accordance with the following:

(i) On shoulders and top heads not less than 0.087 inch thick; or

(ii) On neck, valve boss, valve protection sleeve, or similar part permanently attached to the top end of cylinder; or

(iii) On a plate of ferrous material attached to the top of the cylinder or permanent part thereof; the plate must be at least $^{1/16}$ inch thick, and must be attached by welding, or by brazing at a temperature of at least 1,100 ^{o}F throughout all edges of the plate. Sufficient space must be left on the plate to provide for stamping at least four (4) retest dates.

§178.61 Specification 4BW welded steel cylinders with electric-arc welded longitudinal seam.

(a) *Type, size and service pressure. A DOT 4BW cylinder is a welded type steel cylinder with a longitudinal electric-arc welded seam, a water capacity (nominal) not over 1,000 pounds and a service pressure at least 225 and not over 500 pounds per square inch*

gauge. Cylinders closed in by spinning process are not authorized.
(b) Authorized steel. Steel used in the construction of the cylinder must conform to the following:
(1) The body of the cylinder must be constructed of steel conforming to the limits specified in table I of appendix A to this part.
(2) Material for heads must meet the requirements of paragraph (a) of this section or be open hearth, electric or basic oxygen carbon steel of uniform quality. Content percent may not exceed the following: Carbon 0.25, Manganese 0.60, Phosphorus 0.045, Sulfur 0.050. Heads must be hemispherical or ellipsoidal in shape with a maximum ratio of 2.1. If low carbon steel is used, the thickness of such heads must be determined by using a maximum wall stress of 24,000 p.s.i. in the formula described in paragraph (f)(1) of this section.
(c) *Identification of material. Material must be identified by any suitable method.*
(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart and the following:
(1) No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface is required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Minimum thickness of heads may not be less than 90 percent of the required thickness of the sidewall. Heads must be concave to pressure.
(2) Circumferential seams must be by electric-arc welding. Joints must be butt with one member offset (joggle butt) or lap with minimum overlap of at least four times nominal sheet thickness.
(3) Longitudinal seams in shells must conform to the following:
(i) Longitudinal electric-arc welded seams must be of the butt welded type. Welds must be made by a machine process including automatic feed and welding guidance mechanisms. Longitudinal seams must have complete joint penetration, and must be free from undercuts, overlaps or abrupt ridges or valleys. Misalignment of mating butt edges may not exceed $^{1/6}$ of nominal sheet thickness or $^{1/32}$ inch whichever is less. All joints with nominal sheet thickness up to and including $^{1/8}$ inch must be tightly butted. When nominal sheet thickness is greater than $^{1/8}$ inch, the joint must be gapped with maximum distance equal to one-half the nominal sheet thickness or $^{1/32}$ inch whichever is less. Joint design, preparation and fit-up must be such that requirements of this paragraph (d) are satisfied.
(ii) Maximum joint efficiency must be 1.0 when each seam is radiographed completely. Maximum joint efficiency must be 0.90 when one cylinder from each lot of 50 consecutively welded cylinders is spot radiographed. In addition, one out of the first five cylinders welded following a shut down of welding operations exceeding four hours must be spot radiographed. Spot radiographs, when required, must be made of a finished welded cylinder and must include the girth weld for 2 inches in both directions from the intersection of the longitudinal and girth welds and include at least 6 inches of the longitudinal weld. Maximum joint efficacy of 0.75 must be permissible without radiography.

(4) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.
(e) *Welding of attachments. The attachment to the tops and bottoms only of cylinders by welding of neckrings, footrings, handles, bosses, pads and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which may not exceed 0.25 percent.*
(f) Wall thickness. For outside diameters over 6 inches the minimum wall thickness must be 0.078 inch. For a cylinder with a wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter may not exceed 4 to1 (4:1). In any case the minimum wall thickness must be such that the wall stress calculated by the formula listed in paragraph (f)(4) of this section may not exceed the lesser value of any of the following:
(1) The value referenced in paragraph (b) of this section for the particular material under consideration.
(2) One-half of the minimum tensile strength of the material determined as required in paragraph (j) of this section.
(3) 35,000 pounds per square inch.
(4) Stress must be calculated by the following formula:

$$S = [2P(1.3D^2 + 0.4d^2)] / [E(D^2 - d^2)]$$

where:

S = wall stress, p.s.i.;
P = service pressure, p.s.i.;
D = outside diameter, inches;
d = inside diameter, inches;
E = joint efficiency of the longitudinal seam (from paragraph (d) of this section).

(g) *Heat treatment. Each cylinder must be uniformly and properly heat treated prior to test by the applicable method referenced in paragraph (b) of this section. Heat treatment must be accomplished after all forming and elding operations. Heat treatment is not required after welding or brazing of weldable low carbon parts to attachments of similar material which have been previously welded to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400 ^{o}F in any part of the top or bottom material.*
(h) Openings in cylinders. Openings in the cylinder must conform to the following:
(1) All openings must be in the heads or bases.
(2) Openings in cylinders must be provided with adequate fittings, bosses, or pads, integral with or securely attached to the cylinder by welding.
(3) Threads must comply with the following:
(i) Threads must be clean cut and to gauge.
(ii) Taper threads must be of length not less than as specified for American Standard

Taper Pipe threads.

(iii) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(4) Closure of fittings, boss or pads must be adequate to prevent leakage.

(i) *Hydrostatic test. Cylinders must withstand a hydrostatic test, as follows:*

(1) The test must be by water-jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit readings to an accuracy of 1 percent. The expansion gauge must permit readings of total volumetric expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure must be maintained for at least 30 seconds and sufficiently longer to ensure complete expansion. Any internal pressure applied after heat treatment and previous to the official test may not exceed 90 percent of the test pressure.

(3) Permanent volumetric expansion may not exceed 10 percent of the total volumetric expansion at test pressure.

(4) Cylinders must be tested as follows:

(i) At least 1 cylinder selected at random out of each lot of 200 or less must be tested as outlined in paragraphs (i)(1), (i)(2), and (i)(3) of this section to at least two times service pressure.

(ii) All cylinders not tested as outlined in paragraph (i)(4)(i) of this section must be examined under pressure of at least two times service pressure and show no defect.

(5) One finished cylinder selected at random out of each lot of 500 or less successively produced must be hydrostatically tested to 4 times service pressure without bursting.

(j) *Physical tests. Cylinders must be subjected to a physical test as follows:*

(1) Specimens must be taken from one cylinder after heat treatment and chosen at random from each lot of 200 or less, as follows:

(i) Body specimen. One specimen must be taken longitudinally from the body section at least 90 degrees away from the weld.

(ii) Head specimen. One specimen must be taken from either head on a cylinder when both heads are made of the same material. However, if the two heads are made of differing materials, a specimen must be taken from each head.

(iii) If due to welded attachments on the top head there is insufficient surface from which to take a specimen, it may be taken from a representative head of the same heat treatment as the test cylinder.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with a width not over $1^{1/2}$ inches, or a gauge length at least 24 times thickness with a width not over 6 times thickness is authorized when a cylinder wall is not over $^{3/16}$ inch thick.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section.

(iii) When size of the cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by either the "off-set" method or the "extension under load" method as prescribed in ASTM Standard E8.

(ii) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2-percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2-percent offset.

(iii) For the purpose of strain measurement, the initial strain reference must be set while the specimen is under a stress of 12,000 pounds per square inch and the strain indicator reading being set at the calculated corresponding strain.

(iv) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Elongation. Physical test specimens must show at least a 40 percent elongation for a 2-inch gauge length or at least a 20 percent elongation in other cases. Except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens and by 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four increments.*

(l) Tests of welds. Welds must be subjected to the following tests:

(1) Tensile test. A specimen must be cut from one cylinder of each lot of 200 or less. The specimen must be taken from across the longitudinal seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(2) Guided bend test. A root test specimen must be cut from the cylinder used for the tensile test specified in paragraph (l)(1) of this section. Specimens must be taken from across the longitudinal seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) Alternate guided bend test. This test may be used and must be as required by CGA Pamphlet C-3. The specimen must be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gauge lines a to b, must be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in paragraph (k) of this section.

(m) Radiographic examination. Welds of the cylinders must be subjected to a radiographic examination as follows:

(1) Radiographic inspection must conform to the techniques and acceptability criteria set forth in CGA Pamphlet C-3. When fluoroscopic inspection is used, permanent film records need not be retained.

(2) Should spot radiographic examination fail to meet the requirements of paragraph (m)(1) of this section, two additional welds from the same lot of 50 cylinders or less must be examined, and if either of these fail to meet the requirements, each cylinder must be examined as previously outlined; only those passing are acceptable.

(n) *Rejected cylinders. (1) Unless otherwise stated, if a sample cylinder or specimen taken from a lot of cylinders fails the prescribed test, then two additional specimens must be selected from the same lot and subjected to the prescribed test. If either of these fails the test, then the entire lot must be rejected.*

(2) Reheat treatment of rejected cylinders is authorized. Subsequent thereto, cylinders must pass all prescribed tests to be acceptable. Repair of welded seams by welding is authorized provided that all defective metal is cut away and the joint is rewelded as prescribed for original welded joints.

(o) *Markings. Markings must be stamped plainly and permanently in any of the following locations on the cylinder:*

(1) On shoulders and top heads when they are not less than 0.087-inch thick.

(2) On a metal plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least $^{1/16}$-inch thick and must be attached by welding, or by brazing. The brazing rod is to melt at a temperature of 1100 ^{o}F Welding or brazing must be along all the edges of the plate.

(3) On the neck, valve boss, valve protection sleeve, or similar part permanently attached to the top of the cylinder.

(4) On the footring permanently attached to the cylinder, provided the water capacity of the cylinder does not exceed 25 pounds.

(p) *Inspector's report. In addition to the information required by §178.35, the inspector's report must indicate the type and amount of radiography.*

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended at 64 FR 51919, Sept. 27, 1999]

§178.65 Specification 39 non-reusable (non-refillable) cylinders.

(a) *Type, size, service pressure, and test pressure. A DOT 39 cylinder is a seamless, welded, or brazed cylinder with a service pressure not to exceed 80 percent of the test pressure. Spherical pressure vessels are authorized and covered by references to cylinders in this specification.*

(1) Size limitation. Maximum water capacity may not exceed: (i) 55 pounds (1,526 cubic inches) for a service pressure of 500 p.s.i.g. or less, and (ii) 10 pounds (277 cubic inches) for a service pressure in excess of 500 p.s.i.g.

(2) Test pressure. The minimum test pressure is the maximum pressure of contents at 130 ^{o}F or 180 p.s.i.g. whichever is greater.

(3) Pressure of contents. The term "pressure of contents" as used in this specification means the total pressure of all the materials to be shipped in the cylinder.

(b) Material; steel or aluminum. The cylinder must be constructed of either steel or aluminum conforming to the following requirements:

(1) Steel. (i) The steel analysis must conform to the following:

	Ladle analysis	Check analysis
Carbon, maximum percent	0.12	0.15
Phosphorus, maximum percent	.04	.05
Sulfur, maximum percent	.05	.06

(ii) For a cylinder made of seamless steel tubing with integrally formed ends, hot drawn, and finished, content percent for the following may not exceed: Carbon, 0.55; phosphorous, 0.045; sulfur, 0.050.

(iii) For non-heat treated welded steel cylinders, adequately killed deep drawing quality steel is required.

(iv) Longitudinal or helical welded cylinders are not authorized for service pressures in excess of 500 p.s.i.g.

(2) *Aluminum. Aluminum is not authorized for service pressures in excess of 500 p.s.i.g. The analysis of the aluminum must conform to the Aluminum Association standard for alloys 1060, 1100, 1170, 3003, 5052, 5086, 5154, 6061, and 6063 as specified in its publication entitled "Aluminum Standards and Data".*

(3) Material with seams, cracks, laminations, or other injurious defects not permitted.

(4) Material used must be identified by any suitable method.

(c) *Manufacture. (1) General manufacturing requirements are as follows:*

(i) The surface finish must be uniform and reasonably smooth.

(ii) Inside surfaces must be clean, dry, and free of loose particles.

(iii) No defect of any kind is permitted if it is likely to weaken a finished cylinder.

(2) Requirements for seams:

(i) Brazing is not authorized on aluminum cylinders.

(ii) Brazing material must have a melting point of not lower than 1,000 ^{o}F.

(iii) Brazed seams must be assembled with proper fit to ensure complete penetration of the brazing material throughout the brazed joint.

(iv) Minimum width of brazed joints must be at least four times the thickness of the shell wall.

(v) Brazed seams must have design strength equal to or greater than 1.5 times the minimum strength of the shell wall.

(vi) Welded seams must be properly aligned and welded by a method that provides clean, uniform joints with adequate penetration.

(vii) Welded joints must have a strength equal to or greater than the minimum strength of the shell material in the finished cylinder.

(3) Attachments to the cylinder are permitted by any means which will not be detrimental to the integrity of the cylinder. Welding or brazing of attachments to the

cylinder must be completed prior to all pressure tests.

(4) Welding procedures and operators must be qualified in accordance with CGA Pamphlet C-3.

(d) *Wall thickness. The minimum wall thickness must be such that the wall stress at test pressure does not exceed the yield strength of the material of the finished cylinder wall. Calculations must be made by the following formulas:*

(1) Calculation of the stress for cylinders must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress, in p.s.i.;
P = Test pressure;
D = Outside diameter, in inches;
d = Inside diameter, in inches.

(2) Calculation of the stress for spheres must be made by the following formula:

$$S = PD / 4t$$

Where:

S = Wall stress, in p.s.i.;
P = Test pressure;
D = Outside diameter, in inches;
t = Minimum wall thickness, in inches.

(e) *Openings and attachments. Openings and attachments must conform to the following:*

(1) Openings and attachments are permitted on heads only.

(2) All openings and their reinforcements must be within an imaginary circle, concentric to the axis of the cylinder. The diameter of the circle may not exceed 80 percent of the outside diameter of the cylinder. The plane of the circle must be parallel to the plane of a circumferential weld and normal to the long axis of the cylinder.

(3) Unless a head has adequate thickness, each opening must be reinforced by a securely attached fitting, boss, pad, collar, or other suitable means.

(4) Material used for welded openings and attachments must be of weldable quality and compatible with the material of the cylinder.

(f) *Pressure tests. (1) Each cylinder must be tested at an internal pressure of at least the test pressure and must be held at that pressure for at least 30 seconds.*

(i) The leakage test must be conducted by submersion under water or by some other method that will be equally sensitive.

(ii) If the cylinder leaks, evidences visible distortion, or any other defect, while under test, it must be rejected (see paragraph (h) of this section).

(2) One cylinder taken from the beginning of each lot, and one from each 1,000 or less successively produced within the lot thereafter, must be hydrostatically tested to destruction. The entire lot must be rejected (see paragraph (h) of this section) if:

(i) A failure occurs at a gage pressure less than 2.0 times the test pressure;

(ii) A failure initiates in a braze or a weld or the heat affected zone thereof;

(iii) A failure is other than in the sidewall of a cylinder longitudinal with its long axis; or

(iv) In a sphere, a failure occurs in any opening, reinforcement, or at a point of attachment.

(3) A "lot" is defined as the quantity of cylinders successively produced per production shift (not exceeding 10 hours) having identical size, design, construction, material, heat treatment, finish, and quality.

(g) *Flattening test. One cylinder must be taken from the beginning of production of each lot (as defined in paragraph (f)(3) of this section) and subjected to a flattening test as follows:*

(1) The flattening test must be made on a cylinder that has been tested at test pressure.

(2) A ring taken from a cylinder may be flattened as an alternative to a test on a complete cylinder. The test ring may not include the heat affected zone or any weld. However, for a sphere, the test ring may include the circumferential weld if it is located at a 45 degree angle to the ring, +5 degrees.

(3) The flattening must be between 60 degrees included-angle, wedge shaped knife edges, rounded to a 0.5 inch radius.

(4) Cylinders and test rings may not crack when flattened so that their outer surfaces are not more than six times wall thickness apart when made of steel or not more than ten times wall thickness apart when made of aluminum.

(5) If any cylinder or ring cracks when subjected to the specified flattening test, the lot of cylinders represented by the test must be rejected (see paragraph (h) of this section).

(h) *Rejected cylinders. Rejected cylinders must conform to the following requirements:*

(1) If the cause for rejection of a lot is determinable, and if by test or inspection defective cylinders are eliminated from the lot, the remaining cylinders must be qualified as a new lot under paragraphs (f) and (g) of this section.

(2) Repairs to welds are permitted. Following repair, a cylinder must pass the pressure test specified in paragraph (f) of this section.

(3) If a cylinder made from seamless steel tubing fails the flattening test described in paragraph (g) of this section, suitable uniform heat treatment must be used on each cylinder in the lot. All prescribed tests must be performed subsequent to this heat treatment.

(i) *Markings. (1) The markings required by this section must be durable and waterproof. The requirements of §173.24(c)(1) (ii) and (iv) of this subchapter and §178.35(h) do not apply to this section.*

(2) Required markings are as follows:

(i) DOT-39.

(ii) NRC.
(iii) The service pressure.
(iv) The test pressure.
(v) The registration number (M****) of the manufacturer.
(vi) The lot number.
(vii) The date of manufacture if the lot number does not establish the date of manufacture.
(viii) With one of the following statements:
(A) For cylinders manufactured prior to October 1, 1996: "Federal law forbids transportation if refilled-penalty up to $25,000 fine and 5 years imprisonment (49 U.S.C. 1809)" or "Federal law forbids transportation if refilled-penalty up to $500,000 fine and 5 years imprisonment (49 U.S.C. 5124)."
(B) For cylinders manufactured on or after October 1, 1996: "Federal law forbids transportation if refilled-penalty up to $500,000 fine and 5 years imprisonment (49 U.S.C. 5124)."
(3) The markings required by paragraphs (i)(2)(i) through (i)(2)(v) of this section must be in numbers and letters at least $^{1/8}$ inch high and displayed sequentially. For example:

DOT-39 NRC 250/500 M1001.

(4) No person may mark any cylinder with the specification identification "DOT-39" unless it was manufactured in compliance with the requirements of this section and its manufacturer has a registration number (M****) from the Associate Administrator.

§178.68 Specification 4E welded aluminum cylinders.

(a) *Type, size and service pressure. A DOT 4E cylinder is a welded aluminum cylinder with a water capacity (nominal) of not over 1,000 pounds and a service pressure of at least 225 to not over 500 pounds per square inch. The cylinder must be constructed of not more than two seamless drawn shells with no more than one circumferential weld. The circumferential weld may not be closer to the point of tangency of the cylindrical portion with the shoulder than 20 times the cylinder wall thickness. Cylinders or shells closed in by spinning process and cylinders with longitudinal seams are not authorized.*
(b) Authorized material. The cylinder must be constructed of aluminum of uniform quality. The following chemical analyses are authorized:

Table 1-Authorized Materials

Designation	Chemical analysis-limits in percent 5154
Iron plus silicon	0.45 maximum.
Copper	0.10 maximum.
Manganese	0.10 maximum.
Magnesium	3.10/3.90.

Chromium	0.15/0.35.
Zinc	0.20 maximum.
Titanium	0.20 maximum.
Others, each	0.05 maximum.
Others, total	0.15 maximum.
Aluminum	remainder.

[1]Analysis must regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis should be made to determine conformance with the limits specified for other elements.

(c) *Identification. Material must be identified by any suitable method that will identify the alloy and manufacturer's lot number.*

(d) Manufacture. Cylinders must be manufactured using equipment and processes adequate to ensure that each cylinder produced conforms to the requirements of this subpart. No defect is permitted that is likely to weaken the finished cylinder appreciably. A reasonably smooth and uniform surface finish is required. All welding must be by the gas shielded arc process.

(e) Welding. The attachment to the tops and bottoms only of cylinders by welding of neckrings or flanges, footrings, handles, bosses and pads and valve protection rings is authorized. However, such attachments and the portion of the cylinder to which it is attached must be made of weldable aluminum alloys.

(f) Wall thickness. The wall thickness of the cylinder must conform to the following:

(1) The minimum wall thickness of the cylinder must be 0.140 inch. In any case, the minimum wall thickness must be such that calculated wall stress at twice service pressure may not exceed the lesser value of either of the following:

(i) 20,000 pounds per square inch.

(ii) One-half of the minimum tensile strength of the material as required in paragraph (j) of this section.

(2) Calculation must be made by the following formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
d = inside diameter in inches.

(3) Minimum thickness of heads and bottoms may not be less than the minimum required thickness of the side wall.

(g) *Opening in cylinder. Openings in cylinders must conform to the following:*

(1) All openings must be in the heads or bases.

(2) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by welding by inert gas shielded arc process or by threads. If threads are used, they must comply with the following:

(i) Threads must be clean-cut, even, without checks and cut to gauge.

(ii) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(iii) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(3) Closure of a fitting, boss, or pad must be adequate to prevent leakage.

(h) *Hydrostatic test. Each cylinder must successfully withstand a hydrostatic test, as follows:*

(1) The test must be by water jacket, or other suitable method, operated so as to obtain accurate data. The pressure gauge must permit reading to an accuracy of 1 percent. The expansion gauge must permit a reading of the total expansion to an accuracy either of 1 percent or 0.1 cubic centimeter.

(2) Pressure of 2 times service pressure must be maintained for at least 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied previous to the official test may not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent over the pressure otherwise specified.

(3) Permanent volumetric expansion may not exceed 12 percent of total volumetric expansion at test pressure.

(4) Cylinders having a calculated wall stress of 18,000 pounds per square inch or less at test pressure may be tested as follows:

(i) At least one cylinder selected at random out of each lot of 200 or less must be tested in accordance with paragraphs (h)(1), (h)(2), and (h)(3) of this section.

(ii) All cylinders not tested as provided in paragraph (h)(4)(i) of this section must be examined under pressure of at least 2 times service pressure and show no defect.

(5) One finished cylinder selected at random out of each lot of 1,000 or less must be hydrostatically tested to 4 times the service pressure without bursting. Inability to meet this requirement must result in rejection of the lot.

(i) *Flattening test. After hydrostatic testing, a flattening test is required on one section of a cylinder, taken at random out of each lot of 200 or less as follows:*

(1) If the weld is not at midlength of the cylinder, the test section must be no less in width than 30 times the cylinder wall thickness. The weld must be in the center of the section. Weld reinforcement must be removed by machining or grinding so that the weld is flush with the exterior of the parent metal. There must be no evidence of cracking in the sample when it is flattened between flat plates to no more than 6 times the wall thickness.

(2) If the weld is at midlength of the cylinder, the test may be made as specified in paragraph (i)(1)(i) of this section or must be made between wedge shaped knife edges (60^{o} angle) rounded to a $^{1/2}$ inch radius. There must be no evidence of cracking in the sample when it is flattened to no more than 6 times the wall thickness.

(j) *Physical test. A physical test must be conducted to determine yield strength, tensile strength, elongation, and reduction of area of material as follows:*

(1) The test is required on 2 specimens cut from one cylinder or part thereof taken at random out of each lot of 200 or less.

(2) Specimens must conform to the following:

(i) A gauge length of 8 inches with a width not over $1^{1/2}$ inches, a gauge length of 2 inches with a width not over $1^{1/2}$ inches.

(ii) The specimen, exclusive of grip ends, may not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section.

(iii) When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical test detailed information in regard to such specimens.

(iv) Heating of a specimen for any purpose is not authorized.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length. The following conditions apply:

(i) The yield strength must be determined by the "offset" method as prescribed in ASTM Standard E8.

(ii) Cross-head speed of the testing machine may not exceed $^{1/8}$ inch per minute during yield strength determination.

(k) *Acceptable results for physical tests. An acceptable result of the physical test requires an elongation to at least 7 percent and yield strength not over 80 percent of tensile strength.*

(l) Weld tests. Welds of the cylinder are required to successfully pass the following tests:

(1) Reduced section tensile test. A specimen must be cut from the cylinder used for the physical tests specified in paragraph (j) of this section. The specimen must be taken from across the seam, edges must be parallel for a distance of approximately 2 inches on either side of the weld. The specimen must be fractured in tension. The apparent breaking stress calculated on the minimum wall thickness must be at least equal to 2 times the stress calculated under paragraph (f)(2) of this section, and in addition must have an actual breaking stress of at least 30,000 pounds per square inch. Should this specimen fail to meet the requirements, specimens may be taken from 2 additional cylinders from the same lot and tested. If either of the latter specimens fails to meet requirements, the entire lot represented must be rejected.

(2) Guided bend test. A bend test specimen must be cut from the cylinder used for the physical tests specified in paragraph (j) of this section. Specimen must be taken across the seam, must be $1^{1/2}$ inches wide, edges must be parallel and rounded with a file, and back-up strip, if used, must be removed by machining. The specimen must be bent to refusal in the guided bend test jig illustrated in paragraph 6.10 of CGA Pamphlet C-3. The root of the weld (inside surface of the cylinder) must be located away from the ram of the jig. No specimen must show a crack or other open defect exceeding $^{1/8}$ inch in any direction upon completion of the test. Should this specimen fail to meet the

requirements, specimens may be taken from each of 2 additional cylinders from the same lot and tested. If either of the latter specimens fail to meet requirements, the entire lot represented must be rejected.

(m) Rejected cylinders. Repair of welded seams is authorized. Acceptable cylinders must pass all prescribed tests.

(n) Inspector's report. In addition to the information required by §178.35, the record of chemical analyses must also include applicable information on iron, titanium, zinc, and magnesium used in the construction of the cylinder.

[Amdt. 178-114, 61 FR 25942, May 23, 1996, as amended at 62 FR 51561, Oct. 1, 1997]

[CFR] PART 178 SUBPART D - [Reserved]

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART D]

Subpart D - [Reserved]

[CFR] PART 178 SUBPART H - Specifications for Portable Tanks

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART H]

Subpart H - Specifications for Portable Tanks

Source: 29 FR 18972, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§178.245 Specification 51; steel portable tanks.

§178.245-1 Requirements for design and construction.

(a) Tanks must be seamless or welded steel construction or combination of both and have a water capacity in excess of 454 kg (1,000 pounds). Tanks must be designed, constructed, certified and stamped in accordance with the ASME Code.

(b) Tanks must be postweld heat treated and radiographed as prescribed in the ASME Code except that each tank constructed in accordance with part UHT of the ASME Code must be postweld heat treated. Where postweld heat treatment is required, the tank must be treated as a unit after completion of all the welds in and/or to the shell and heads. The method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment is made. A tank used for anhydrous ammonia must be postweld heat treated. The postweld heat treatment must be as prescribed in the ASME Code, but in no event at less than 1050 ^{o}F tank metal temperature. Additionally, tanks constructed in accordance with part UHT of the ASME Code must conform to the following requirements:
(1) Welding procedure and welder performance tests must be made annually in accordance with section IX of the ASME Code. In addition to the essential variables named therein, the following must be considered to be essential variables: number of passes, thickness of plate, heat input per pass, and manufacturer's identification of rod and flux. The number of passes, thickness of plate and heat input per pass may not vary more than 25 percent from the procedure qualification. Records of the qualification must be retained for at least 5 years by the tank manufacturer and made available to duly identified representatives of the Department of Transportation or the owner of the tank.
(2) Impact tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full-sized specimens shall be 20 foot-pounds (or 10 foot-pounds for half-sized specimens) at 0 ^{o}F Charpy V-Notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, individual plates may be accepted if they individually meet this impact requirement.
(c) Except as provided in paragraph (d) of this section, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank.
(d) The following openings may be installed at locations other than on the top or end of the tank:
(1) The openings for liquid level gauging devices, pressure gauges, or for safety devices, may be installed separately at the other location or in the side of the shell;
(2) One plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere;
(3) An opening of 3-inch National Pipe Size or less may be provided at another location, when necessary, to facilitate installation of condensing coils; or
(4) Filling and discharge connections may be installed below the normal liquid level of the tank if the tank design conforms to the following requirements:
(i) The tank must be permanently mounted in a full framework for containerized transport. For each tank design, a prototype tank, must fulfill the requirements of parts 450 through 453 of this title for compliance with the requirements of Annex II of the International Convention for Safe Containers.
(ii) Each filling and discharge connection must be equipped with an internal self-closing stop-valve capable of closing within 30 seconds of actuation. Each internal self-closing stop-valve must be protected by a shear section or sacrificial device located outboard of

the valve. The shear section or sacrificial device must break at no more than 70 percent of the load that would cause failure of the internal self-closing stop- valve.
(iii) Each internal self-closing stop-valve must be provided with remote means of automatic closure, both thermal and mechanical. The thermal means of automatic closure must actuate at a temperature of not over 250 ^{o}F.
(e) Each uninsulated tank used for the transportation of compressed gas, as defined in §173.300 of this subchapter, must have an exterior surface finish that is significantly reflective, such as a light reflecting color if painted, or a bright reflective metal or other material if unpainted.

[Amdt. 178-117, 61 FR 50627, Sept. 26, 1996]

§178.245-2 Material.

(a) All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein.

(b) A material of thickness less than $^{3/16}$ inch shall not be used for the shells and heads.

§178.245-3 Design pressure.

(a) The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115 ^{o}F., or as prescribed for a particular commodity by part 173 of this chapter, except that in no case shall the design pressure of any container be less than 100 psig or more than 500 psig. When corrosion factor is prescribed by these regulations, the wall thickness of the tank calculated in accordance with the "Code" (see §178.245-1(a)) shall be increased by 20 percent or 0.10 inch, whichever is less.

Note 1: The term *design pressure as used in this specification is identical to the term maximum allowable working pressure as used in the "Code" (see §178.245-1(a)).*

(b) [Reserved]

§178.245-4 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.
(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements of the Code under which the tanks were fabricated and shall be designed

to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used. The specific gravity used in determining the static loadings shall be shown on the marking required by §178.245-6(a) and on the report required by §178.245-7(a).
(c) Lifting lugs or hold-down lugs may be added to either the tank or tank mountings. If lifting lugs and hold-down lugs are added directly to the tank, they shall be secured to doubling plates welded to the tank and located at points of support, except that lifting lugs or hold-down lugs with integral bases serving as doubling plates may be welded directly to the tank. Each lifting lug and hold-down lug shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.
(d) All tank mountings shall be designed so as to prevent the concentration of excessive loads on the tank shell.
(e) A DOT 51 portable tank that meets the definition of "container" in §450.3(a)(2) of this title must meet the requirements of parts 450 through 453 of this title, in addition to the requirements of this subchapter.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-117, 61 FR 50628, Sept. 26, 1996; 64 FR 51919, Sept. 27, 1999]

§178.245-5 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gaging devices, and the like shall be adequately protected against mechanical damage.

(b) The protective device or housing shall conform to the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(c) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§173.32 and 173.315 of this chapter must be observed.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.245-6 Name plate.

(a) In addition to the markings required by the Code (see §178.245-1(a)) under which tanks were constructed, they shall have permanently affixed, in close proximity to the ASME "U" stamp certification, a metal plate. This plate shall be permanently affixed by means of soldering, brazing, or welding around its complete perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of tank. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming letters into or onto the metal plate itself the following information in characters at least $^{1/8}$-inch high:

____
____
____
____
____
____
____
____
____

(b) All tank outlets and inlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-67, 46 FR 49906, Oct. 8, 1981; Amdt. 178-117, 61 FR 50628, Sept. 26, 1996]

§178.245-7 Report.

(a) A copy of the manufacturer's data report required by the Code (See §178.245-1(a)) under which the tank is fabricated shall be furnished to the owner for each new tank.

(b) [Reserved]

[Amdt. 178-76, 48 FR 28102, June 20, 1983]

§178.251 [Reserved]

§178.255 Specification 60; steel portable tanks.

§178.255-1 General requirements.

(a) Tanks must be of fusion welded construction, cylindrical in shape with seamless heads concave to the pressure. Tank shells may be of seamless construction.

(b) Tanks must be designed and constructed in accordance with and fulfill all the requirements of the ASME Code.

(c) Tanks including all permanent attachments must be postweld heat treated as a unit.

(d) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§173.32 and 173.315 of this chapter must be observed.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969]

§178.255-2 Material.

(a) Material used in the tank must be steel of good weldable quality and conform with the requirements of the ASME Code.

(b) The minimum thickness of metal, exclusive of lining material, for shell and heads of tanks shall be as follows:

Tank capacity	Minimum thickness (inch)
Not more than 1,200 gallons	1/4
Over 1,200 to 1,800 gallons	5/16
Over 1,800 gallons	3/8

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969]

§178.255-3 Expansion domes.

(a) Expansion domes, if applied, must have a minimum capacity of one percent of the combined capacity of the tank and dome.

(b) [Reserved]

§178.255-4 Closures for manholes and domes.

(a) The manhole cover shall be designed to provide a secure closure of the manhole. All covers, not hinged to the tanks, shall be attached to the outside of the dome by at least $^{1/8}$ inch chain or its equivalent. Closures shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material.
(b) [Reserved]

§178.255-5 Bottom discharge outlets.
(a) Bottom discharge outlets prohibited, except on tanks used for shipments of sludge acid and alkaline corrosive liquids.
(b) If installed, bottom outlets or bottom washout chambers shall be of metal not subject to rapid deterioration by the lading, and each shall be provided with a valve or plug at its upper end and liquid-tight closure at it lower end. Each valve or plug shall be designed to insure against unseating due to stresses or shocks incident to transportation. Bottom outlets shall be adequately protected against handling damage and outlet equipment must not extend to within less than one inch of the bottom bearing surface of the skids or tank mounting.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.255-6 Loading and unloading accessories.
(a) When installed, gauging, loading and air inlet devices, including their valves, shall be provided with adequate means for their secure closure; and means shall also be provided for the closing of pipe connections of valves.
(b) Interior heater coils, if installed, must be of extra heavy pipe and so constructed that breaking off of exterior connections will not cause leakage of tanks.

§178.255-7 Protection of valves and accessories.
(a) All valves, fittings, accessories, safety devices, gauging devices, and the like shall be adequately protected against mechanical damage by a housing closed with a cover plate.
(b) Protective housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed with a minimum factor of safety of four to withstand loadings in any direction equal to two times the weight of the tank and attachments when filled with water.

§178.255-8 Safety devices.
(a) See §173.315(i) of this subchapter.
(b) [Reserved]

[Amdt. 178-83, 50 FR 11066, Mar. 19, 1985]

§178.255-9 Compartments.
(a) When the interior of the tank is divided into compartments, each compartment shall be designed, constructed and tested as a separate tank. Thickness of shell and compartment heads shall be determined on the basis of total tank capacity.
(b) [Reserved]

§178.255-10 Lining.
(a) If a lining is required, the material used for lining the tank shall be homogeneous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper. It shall be of substantially uniform thickness, not less than $^{1/32}$ inch thick if metallic, and not less than $^{1/16}$ inch thick if nonmetallic, and shall be directly bonded or attached by other equally satisfactory means. Rubber lining shall be not less than $^{3/16}$ inch thick. Joints and seams in the lining shall be made by fusing the material together or by other equally satisfactory means. The interior of the tank shall be free from scale, oxidation, moisture and all foreign matter during the lining operation.
(b) [Reserved]

§178.255-11 Tank mountings.
(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.
(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements under which the tanks are fabricated, and shall be designed with a factor of safety of four, and built to withstand loadings in any direction equal to two times the weight of the tanks and attachments when filled to the maximum permissible loaded weight.
(c) Lifting lugs or side hold-down lugs shall be provided on the tank mountings in a manner suitable for attaching lifting gear and hold-down devices. Lifting lugs and hold-down lugs welded directly to the tank shall be of the pad-eye type. Doubling plates welded to the tank and located at the points of support shall be deemed to comply with this requirement.
(d) All tank mountings shall be so designed as to prevent the concentration of excessive

loads on the tank shell.

§178.255-12 Pressure test.

(a) Each completed portable tank prior to application of lining shall be tested before being put into transportation service by completely filling the tank with water or other liquid having a similar viscosity, the temperature of which shall not exceed 100 ^{o}F during the test, and applying a pressure of 60 psig. The tank shall be capable of holding the prescribed pressure for at least 10 minutes without leakage, evidence of impending failure, or failure. All closures shall be in place while the test is made and the pressure shall be gauged at the top of the tank. Safety devices and/or vents shall be plugged during this test.
(b) [Reserved]

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.255-13 Repair of tanks.

(a) Tanks failing to meet the test may be repaired and retested, provided that repairs are made in complete compliance with the requirements of this specification.
(b) [Reserved]

§178.255-14 Marking.

(a) In addition to marking required by the American Society of Mechanical Engineers Code, every tank shall bear permanent marks at least $^{1/8}$-inch high stamped into the metal near the center of one of the tank heads or stamped into a plate permanently attached to the tank by means of brazing or welding or other suitable means as follows:

Nominal capacity ------- (gallons)
Tare weight ------- (pounds)

(b) [Reserved]

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-67, 46 FR 49906, Oct. 8, 1981]

§178.255-15 Report.

(a) A copy of the manufacturer's data report required by the Code (See §178.245-1(a)) under which the tank is fabricated must be furnished to the owner for each new tank.

Portable tank

Manufactured for ------- Company

____

Manufactured by ------- Company

____

Consigned to --------- Company

____

Size --- feet outside diameter by ---long.

Marks on tank as prescribed by §178.255-14 of this specification are as follows:

____

____

____

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____

____

Nominal capacity ------- gallons.

It is hereby certified that this tank is in complete compliance with the requirements of *DOT specification No. 60.* *(Signed)*

Manufacturer or owner

(b) [Reserved]

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-83, 50 FR 11066, Mar. 19, 1985]

§178.270 Specification IM 101 and IM 102 steel portable tanks; general design and construction requirements.

§178.270-1 Specification requirements for IM 101 and IM 102 steel portable tanks.

(a) Each IM portable tank must meet the requirements of this section in addition to the requirements of §178.271 (IM 101) or §178.272 (IM 102). These requirements apply to IM portable tanks of diameters no greater than 2438 mm (96 inches) that are designed to carry liquids having a vapor pressure of less than 2.97 bar-absolute (43 psia) at a temperature of 50 ^{o}C (122 ^{o}F).

(b) [Reserved]

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§178.270-2 General.

(a) Each tank, including attachments and service and structural equipment, must be designed to withstand, without loss of contents, the maximum internal pressure that can be anticipated to result from the contents and the static and dynamic stresses incurred in normal handling and transportation.

(b) For the purpose of this subchapter *maximum allowable working pressure or MAWP is the maximum pressure that an IM portable tank may experience during any normal operation (including loading and unloading). The only exception to this limitation is hydrostatic testing.*

(c) Each portable tank must have a cross-sectional design that is capable of being stress analyzed either mathematically or by the experimental method contained in UG-101 of the ASME Code, or other method acceptable to the Associate Administrator for Hazardous Materials Safety.

(d) Each portable tank must be designed so that the center of gravity of the filled tank is approximately centered within the points of attachment for lifting devices.

(e) When credit is taken for insulation to reduce the required emergency venting capacity of safety relief devices, the insulation must be jacketed or otherwise protected from the accumulation of moisture or foreign matter that would decrease its efficiency or corrode the tank.

(f) Each portable tank that has a lining must have a lining material that meets the following requirements:

(1) The material used to line the tank must be-

(i) Substantially immune to attack by the hazardous material transported;

(ii) Homogeneous;

(iii) Nonporous;

(iv) Imperforated when applied;

(v) At least as elastic as the material of the tank shell; and

(vi) Have thermal-expansion characteristics compatible with the tank shell.

(2) The lining of the tank, tank fitting and piping must be-

(i) Attached by bonding or other satisfactory means;

(ii) Continuous; and

(iii) Extended around the face of any flange.

(3) Joints and seams in the lining must be made by fusing the material together or by other equally effective means.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981, as amended by Amdt. 178-65, 46 FR 24184, Apr. 30, 1981; Amdt. 178-97, 56 FR 66284 and 66287, Dec. 20, 1991]

§178.270-3 Materials of construction.

(a) Each portable tank must be constructed of carbon or alloy steels. Materials included in part UHT of the ASME Code or equivalent materials are not authorized. Any materials used in the tank shell must conform to a recognized national standard and must be suitable for the external environments in which the tank will be carried. The minimum elongation for any material must be 20 percent or greater.

(b) The maximum stress allowed for a material shall be determined using one of the following methods:

(1) 1.5 times the specified values for the material at 93 °C (200 °F) in Section VIII, Division 1 of the ASME Code;

(2) Derived by test for the actual yield and tensile strengths at 93 °C (200 °F) for the actual group of plates used to fabricate the tank using the methods described in §78.270-3(d); or

(3) Derived from the minimum yield and tensile strengths at 93 °C (200 °F) specified by the national standard to which the material is manufactured using the methods described in §178.270-3(d).

(c) Maximum allowable stress values, derived for an actual group of plates, that are based on actual tensile and yield strengths of the material at 93 °C (200 °F) shall not be greater than 120 percent of the specified minimum yield and tensile strength specified in the national standard to which the material is manufactured.

(d) The maximum allowable stress values must be derived from the following criteria:

(1) For austenitic steels;

(i) When the yield strength is determined using the 0.2 percent offset, 93.75 percent of the yield strength.

(ii) When the yield strength is determined using the 1.0 percent offset, 75 percent of the yield strength.

(2) For carbon and low alloy steels, the yield strength is determined using the 0.2 percent offset. The maximum allowable stress value is the lower of 93.75 percent of the yield strength or 37.5 percent of the tensile strength.

(e) For purposes of these specifications, tensile strength, yield strength and elongation must be determined using a specimen having a gauge length:

$L_0 = 5.65(S_0)^{1/2}$

where:

L_0 = the gauge length of the specimen-millimeters (inches); and
S_0 = the cross sectional area of the specimen-square millimeters (square inches).

Tensile tests and analysis of results must be in accordance with "ISO 82 Steels-Tensile

Testing." The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length, except that for high alloy austenitic steels the yield strength shall be the stress corresponding to a permanent strain of 0.2 or 1.0 percent of the gauge length as appropriate. The elongation must be at least 20 percent.

(f) If maximum allowable stress values or minimum tank wall thicknesses are based on the actual yield strength, the actual tensile strength, or the actual elongation for the material used to fabricate the tank, the test records or certification of test results by the material producer or tank manufacturer must be approved by the approval agency, retained by the tank manufacturer for a period not less than 15 years, and made available to any duly identified representative of the Department or the owner of the tank.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981, as amended at 64 FR 10782, Mar. 5, 1999]

§178.270-4 Structural integrity.

(a) *Maximum stress values. The maximum calculated stress value in a tank at the Test Pressure must be less than or equal to that specified for the material of construction at 93 °C. (200 °F.) in §178.270-3 of this part.*

(b) Tank shell loadings. Tank shells, heads, and their fastenings shall be designed to prevent stresses in excess of two thirds those specified in §178.270-3 of this part. The design calculations must include the forces imposed by each of the following loads:

(1) An internal pressure equal to the maximum allowable working pressure less 1 bar (14.5 psig) in combination with the simultaneously applied loadings of 3W vertically downward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachments), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(2) An internal pressure equal to the maximum allowable working pressure less 1 bar (14.5 psig), in combination with the simultaneously applied loadings of 1W vertically upward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachment), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(3) The load on the tank head resulting from an internal pressure equal to the maximum allowable working pressure, less 1 bar (14.5 psig), in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 "g", and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(4) Loads resulting from any discontinuities between tank shell and heads;

(5) Superimposed loads such as operating equipment, insulation, linings and piping; and

(6) Reactions of supporting lugs and saddles or other supports.

(c) The shell thickness used in calculating the resulting stress levels in a tank shall be exclusive of any corrosion allowance.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§178.270-5 Minimum thickness of shells and heads.

(a) For the purposes of this section, mild steel is steel with a guaranteed minimum tensile strength of 37 decanewtons per square millimeter (53,650 p.s.i.) and a guaranteed elongation of 27 percent or greater.

(b) Except as otherwise provided in this subchapter, the shell and heads of each portable tank constructed of reference mild steel:

(1) With a maximum cross-sectional dimension of 1.8 meters (5.9 feet) or less, shall be at least 5mm (0.197 inches) thick; or,

(2) With a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet), shall be at least 6.35mm (0.250 inches) thick.

(c) The minimum thickness of the shell and heads of each portable tank constructed of a steel other than the reference mild steel, shall be obtained from the following formula:

Formula for metric units

$e_1 = (10e_0) / (Rm_1\ A_1)^{1/3}$

Formula for nonmetric units

$e_1 = (112.3e_0) / (Rm_1\ A_1)^{1/3}$

where:

e_0 = Required thickness of the reference steel from §178.270-5(b)-millimeters (inches);
e_1 = Equivalent thickness of the steel used-millimeters (inches);
Rm_1 = Specified minimum tensile strength of the steel used-decanewtons per square millimeter (p.s.i.); and
A_1 = Specified minimum percentage elongation of the steel used-percent times 100 (i.e., if 20% use 20.0).

(d) When other than the standard minimum thickness for the reference mild steel is specified for a tank in this subchapter, the specified minimum shell and head thickness must be at least equal to the larger of the thicknesses calculated from the formula given in §178.270-5(c) and the following formula:

Formula for metric units

$e_1 = (10e_0\ d_1) / 1.8(Rm_1\ A_1)^{1/3}$

Formula for nonmetric units

$e_1 = (112.3e_0\ d_1) / 5.9(Rm_1\ A_1)^{1/3}$

where:

e_1 = Equivalent thickness of the steel used-millimeters (inches);
e_0 = The specified minimum shell and head thickness of the reference mild steel

specified in the IM Tank Table-millimeters (inches);
d_1 = Actual outside diameter of the tank-meters (feet);
Rm_1 = Specified minimum tensile strength of the steel used-decanewtons per square millimeter (p.s.i.); and
A_1 = Specified minimum percentage elongation of the steel used-percent times 100 (i.e., if 20% use 20.0).

Note: For paragraphs (c) and (d) of this section the actual values for the tensile strength and percent elongation for the steel, as determined through tests on specimens from the group of plates to be used in the fabrication of the tank, may be substituted for the specified minimum values in the calculation prescribed in this paragraph (See §178.270-3 of this part). Test records or certification of test results by the material producer or tank manufacturer must be retained by the tank manufacturer for a period not less than 15 years and must be made available to the Department or the owner of the tank.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981, as amended by Amdt. 178-97, 56 FR 66284, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.270-6 Tank supports, frameworks and lifting attachments.

(a) Each portable tank must be constructed with a permanent support structure that provides a secure base in transport. Skids, frameworks, cradles, or similar devices are acceptable. The calculated stress in tank supports, frameworks, and lifting attachments must not exceed 80 percent of the specified minimum yield strength of the material of construction under the applicable loading conditions specified in §178.270-4(b).

(b) An IM portable tank that meets the definition of "container" in §450.3(a)(3) must meet the requirements of parts 450 through 453 of this title, in addition to the requirements of this subchapter.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§178.270-7 Joints in tank shells.

Joints in tank shells must be made by fusion welding. Such joints and their efficiencies must be as required by the ASME Code. Weld procedures and welder performance must be ASME Code qualified or must be qualified by the approval agency in accordance with the procedures in the ASME Code, Section IX, Welding and Brazing Qualifications. A record of each qualification must be retained by the manufacturer for the period prescribed in ASME Code, Section VIII, Pressure Vessels, and must be made available to any duly identified representative of the Department and the owner of the tank.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§178.270-8 Protection of valves and accessories.

Each valve, fitting, accessory, safety device, gauging device, and other appurtenance shall be adequately protected against mechanical damage.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§178.270-9 Inspection openings.

Each portable tank must be fitted with a manhole or other inspection opening sited above the maximum liquid level to allow for complete internal inspection and adequate access for maintenance and repair of the interior. Each portable tank with a capacity of more than 1894 liters (500 gallons) must be fitted with an elliptical or round manhole at least 279 x 381 millimeters (11 x 15 inches), or 254 x 405 millimeters (10 x 16 inches), or with a circular manhole at least 381 millimeters (15 inches) in diameter. Any inspection opening and closure must be designed and reinforced as required by the ASME Code.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.270-10 External design pressure.

(a) Each portable tank not fitted with vacuum relief devices must be designed to withstand a positive external pressure differential of at least 0.4 bar (6 p.s.i.).

(b) Each portable tank fitted with vacuum relief devices must be designed to withstand a positive external pressure differential not less than the set pressure of the vacuum relief device and in any case at least 0.21 bar (3 p.s.i.).

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§178.270-11 Pressure and vacuum relief devices.

(a) *Relief devices required. Each portable tank, or each independent compartment of a portable tank, must be fitted with pressure relief devices in accordance with the following:*

(1) Each portable tank, or each independent compartment of a portable tank, with a

capacity of more than 1893 liters (500 gallons), must be provided with a primary pressure relief device consisting of a spring-loaded pressure relief valve and, in addition, may have one or more emergency pressure relief devices that may be a spring-loaded pressure relief valve, a frangible disc or fusible element in parallel with the primary pressure relief device.

(2) Each portable tank, or each independent compartment of a portable tank, with a capacity of 1893 liters (500 gallons) or less, must be fitted with a primary pressure relief device that may either be a frangible disc or a spring-loaded pressure relief valve.

(3) If a frangible disc is inserted in series with required pressure relief valve, the space between the frangible disc and the pressure relief valve must be provided with a suitable tell-tale indicator to permit detection, prior to and during shipment, of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure relief system. The frangible disc must rupture at a tank pressure within the range specified in paragraph (c)(1) of this section.

(b) *Location and construction of relief devices. (1) Pressure relief devices must be spring-loaded valves, frangible discs, or fusible elements. Vacuum relief devices must be capable of reclosing in any attitude. Each pressure relief device inlet must be situated in the vapor space of the tank. The discharge from any device must be unrestricted and directed to prevent impingement upon the tank shell or structural framework. Protective devices which deflect the flow of vapor are permissible provided the required vent capacity is maintained. Pressure and vacuum relief devices including their inlets must be sited on the top of the tank in a position as near as possible to the longitudinal and transversal center of the tank within the following limitation:*

(i) Longitudinally on the tank within 107 cm ($3^{1/2}$ feet) or $^{1/6}$ the tank length, whichever is less, from the top center of the tank; and

(ii) Transversally within 12 degrees of the tank top.

(2) Except for a relief device installed in a piping system, each relief device must provide unrestricted venting under all conditions. Each pressure relief system, including any piping, must provide a venting capacity at least equal to the venting capacity specified in §178.270-11(d) for the tank on which the system is installed.

(3) Fusible elements, when installed, must not be protected from direct communication with external heat sources.

(4) Spring-loaded pressure relief valves must be constructed in a manner to prevent unauthorized adjustment of the relief setting.

(c) *Pressure settings of relief devices-(1) Primary pressure relief devices. The primary relief device required by paragraph (a) of this section must be set to function in the range of-*

(i) No less than 67 percent and no greater than 83 percent of test pressure for tanks hydrostatically tested under §178.270-13(a) of this subpart at a gauge pressure below 455 kPa (66 psi). Spring-loaded pressure relief valves must close after discharge at a pressure not less than 80 percent of start-to-discharge pressure.

(ii) No less than 67 percent and no greater than 74 percent of test pressure for tanks hydrostatically tested under §178.270-13(a) of this subpart at a gauge pressure of 455 kPa (66 psi) or higher. Spring-loaded pressure relief valves must close after discharge at a pressure not less than 90 percent of start-to-discharge pressure.

(2) *Emergency pressure relief devices. Each frangible disc, other than one used as a primary relief device in accordance with paragraph (b)(2) of this section, must be designed to burst at a pressure greater than 83 percent of and less than or equal to tank hydrostatic test pressure. Each spring-loaded pressure relief valve used as an emergency pressure relief device must be set to operate at no less than 83 percent of hydrostatic test pressure and be fully open at test pressure.*

(3) Fusible elements. Fusible elements must have a nominal yield temperature greater than the highest tank operating temperature and less than or equal to 121 ^{o}C (250 ^{o}F). The pressure developed in the tank at the fusible element yield temperature must be below the test pressure of the tank.

(4) Vacuum relief devices. Vacuum relief devices, when used, must be designed to provide total containment of product under normal and accident conditions and must be set to open at a nominal external overpressure of not less than 0.21 bar (3 pounds per square inch) but not greater than the external pressure for which the tank is designed. Each vacuum relief device must have a minimum cross sectional flow area of 2.84 cm^2 (0.44 square inches).

(d) Venting capacity of pressure relief devices-(1) Pressure relief valves (spring-loaded). Each pressure relief valve must have a minimum vent capacity of at least 170 standard cubic meters per hour (SCMH) (6,000 standard cubic feet per hour (SCFH)). The minimum total pressure relief valve vent capacity for each tank shall be 340 SCMH (12,000 SCFH) per 32.5m^2 (350 square feet) of exposed tank area, but in any case at least 340 SCMH (12,000 SCFH).

(2) Total tank vent capacity. The total vent capacity of all pressure relief devices installed on each portable tank must be sufficient with all devices operating to limit the pressure in the tank to less than or equal to the test pressure. Except as provided in paragraph (d)(3) or (d)(4) of this section, the total vent capacity must be at least equal to that shown in the following table:

Table I-Minimum Total Vent Capacity

[Metric units table in cubic meters of air per hour at atmospheric pressure and 15 ^{o}C]

Exposed area square meters	Cubic meters free air per hour	Exposed area square meters	Cubic meters free air per hour
2	841	37.5	9.306
3	1,172	40	9,810
4	1,485	42.5	10,308
5	1,783	45	10,806
6	2,069	47.5	11,392
7	2,348	50	11,778
8	2,621	52.5	12,258
9	2,821	55	12,732
10	3,146	57.5	13,206
12	3,655	60	13,674
14	4,146	62.5	14,142

16	4,625	65	14,604
18	5,092	67.5	15,066
20	5,556	70	15,516
22.5	6,120	75	16,422
25	6,672	80	17,316
27.5	7,212	85	18,198
30	7,746	90	19,074
32.5	8,268	95	19,938
35	8,790	100	20,790

[Nonmetric units in cubic feet of air per hour at atmospheric pressure and 59 °F]

Exposed area square feet	Cubic feet free air per hour	Exposed area square feet	Cubic feet free air per hour
20.	27,600	275	237,000
30	38,500	300	256,000
40	48,600	350	289,500
50	58,600	400	322,100
60	67,700	450	355,900
70	77,000	500	391,000
80	85,500	550	417,500
90	94,800	600	450,000
100	104,000	650	479,000
120	121,000	700	512,000
140	136,200	750	540,000
160	152,100	800	569,000
180	168,200	850	597,000
200	184,000	900	621,000
225	199,000	950	656,000
250	219,500	1,000	686,000

Note: Interpolate for intermediate sizes.

(3) Notwithstanding the minimum total vent capacity shown in table I, of paragraph (d)(2), a tank in dedicated service may have a lesser total vent capacity provided the approval certificate required by §173.32a of this subchapter specifies the hazardous materials for which the tank is suitable. The lesser total vent capacity must be determined in accordance with the following formula:

Formula for metric units

$Q = 5{,}660{,}000\ A^{0.82}\ (ZT)^{0.5} / (LC)(M^{0.5})$

Formula for nonmetric units

$Q = 37{,}980{,}000\ A^{0.82}\ (ZT)^{0.5} / (LC)(M^{0.5})$

where:

Q = The total required venting capacity, in cubic meters of air per hour at standard

conditions of 15.6 ^oC and 1 atm (cubic feet of air per hour at standard conditions of 60 ^oF and 14.7 psia);
T = The absolute temperature of the vapor at the venting conditions-degrees Kelvin (^oC+273) [degrees Rankine (^oF+460)];
A = The exposed surface area of tank shell-square meters (square feet);
L = The latent heat of vaporization of the lading-calories per gram (BTU/lb);
Z = The compressibiliy factor for the vapor (if this factor is unknown, let Z equal 1.0);
M = The molecular weight of vapor;
C = A constant derived from (K), the ratio of specific heats of the vapor. If (K) is unknown, let C = 315.

$C = 520[K(2/(K+1))[^{(K+1)} / (K-1)]]\backslash 1/2$

where:

$K = C_p / C_v$
C_p = The specific heat at constant pressure, in -calories per gram degree centigrade (BTU/lb ^oF.); and
C_v = The specific heat at constant volume, in -calories per gram degree centigrade (BTU/lb ^oF.).

(4) The required total venting capacity determined by using table I or paragraph (d)(3) of this section may be reduced for insulated tanks to Q_t by the following formula:

$Q_t = FQ_1$
where:

Q_t = The total required venting capacity of the insulated tank;
Q_1 = The total venting capacity required for an uninsulated tank according to table I or paragraph (d)(3) of this section;
F = A coefficient with a value greater than or equal to 0.25 according to the following formula:

Formula for metric units

$F = 8U(649-t) / 93.5 \times 10^6$

Formula for nonmetric units

$F = 8U(1200-t) / 34,500$

where:

U = The thermal conductance of the insulation system taken at 38 ^oC (100 ^oF), in gram calories per hour sq. meter ^oC (BTU per hour sq. feet ^oF); and
t = The actual temperature of the substance at loading, in ^oC (^oF).

(5) Insulation systems, used for the purpose of reducing the venting capacity, must

be approved by the approval agency. In all cases, insulation systems approved for this purpose must:

(i) Remain effective at all temperatures up to 649 °C (1200 °F); and

(ii) Be jacketed with a material having a melting point of 649 °C (1200 °F) or greater.

(6) The flow capacity rating of any pressure relief device must be certified by the manufacturer to be in accordance with the applicable provisions of the ASME Code with the following exceptions:

(i) The ASME Code stamp is not required; and

(ii) The flow capacity certification test for spring loaded pressure relief valves may be conducted at a pressure not to exceed 120% of the set pressure provided the stamped flow capacity rating is not greater than 83% of the average capacity of the valves tested.

(e) *Markings on pressure and vacuum relief devices. The following information shall be plainly displayed on each pressure relief device:*

(1) The pressure or, when appropriate, the temperature at which the device is set to function;

(2) Except for vacuum relief devices, the rated flow capacity of air discharged per minute at 15 °C (59 °F) and atmospheric pressure, at:

(i) The set pressure for frangible discs;

(ii) No greater than 20% above the start to discharge pressure for spring-loaded relief devices; or

(iii) The fusing temperature for fusible elements.

(3) The manufacturer's name and catalog number; and

(4) The allowable tolerances at the start to discharge pressure and the allowable tolerances at the discharge temperature.

[Amdt. 178-65, 46 FR 9897, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981; as amended by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.270-12 Valves, nozzles, piping, and gauging devices.

(a) All tank nozzles, except those provided for filling and discharge connections below the normal liquid level of the tank, relief devices, thermometer wells, and inspection openings, must be fitted with manually operated stop valves located as near the shell as practicable either internal or external to the shell. Each filling and discharge connection located below the normal liquid level of the tank must be equipped with an internal discharge valve. A tank nozzle installed in the vapor space to provide a filling or cleaning opening, which is closed by a blank flange or other suitable means, need not be provided with a manually operated stop valve. A tank nozzle installed for a thermometer well or inspection opening need not be provided with a manually operated stop valve.

(b) Each valve must be designed and constructed to a rated pressure not less than the maximum allowable working pressure of the tank. Each stop valve with a screwed spindle must be closed by a clockwise motion of the handwheel. All valves must be constructed to prevent unintentional opening.

(c) Each internal discharge valve shall be self-closing, located inside the tank, within the welded flange or within its companion flange.

(d) A shear section must be located outboard of each internal discharge valve seat and within 10.2 cm (4 inches) of the vessel. The shear section must break under strain without affecting the product retention capabilities of the tank and any attachments.

(e) All piping must be of suitable material. Welded joints must be used wherever practicable. The bursting strength of all piping and pipe fittings must be at least 4 times the maximum allowable working pressure of the tank. Piping must be supported in such a manner as to prevent damage due to thermal stresses, jarring or vibration.

(f) All nozzles and tank shell penetrations for nozzles shall be designed and constructed in accordance with the ASME Code.

(g) Glass liquid level gauges, or gauges of other easily destructible material, which are in direct communication with the contents of the tank are prohibited.

[Amdt. 178-65, 46 FR 9898, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981, as amended by Amdt. 178-117, 61 FR 50628, Sept. 26, 1996]

§178.270-13 Testing.

(a) *Hydrostatic test. Each portable tank and all piping, valves, and other attachments which are subject to the pressure of the contents of the tank, except pressure relief devices, must be hydrostatically tested by completely filling the tank (including domes, if any) with water or other liquid having a similar density and viscosity and applying a pressure of at least 150 percent of the maximum allowable working pressure. The pressure shall be maintained for at least 10 minutes. While under pressure, the tank shall be inspected for leakage, undue distortion, or other conditions which indicate weakness or which might render the tank unsafe for transportation service. Failure to successfully meet the test criteria shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass the test shall be suitably repaired and must successfully pass the prescribed tests prior to use for transporting any hazardous material.*

(b) Testing of internal coils. Internal coils, if installed, must be hydrostatically tested to an internal pressure of 13.8 bar (200 psig) or 150 percent of the rated pressure of the coils, whichever is greater.

(c) Tank container qualification test. For each tank design, a prototype tank, using a framework for containerized transport, must fulfill the requirements of parts 450-453 of this title for compliance with the requirements of Annex II of the International Convention for Safe Containers. In addition, the following tests must be completed without leakage or deformation that would render the tank unsuitable for use:

(1) Longitudinal inertia. The tank loaded to its maximum gross weight must be positioned with its longitudinal axis vertical. It shall be held in this position for five

minutes by support at the lower end of the base structure providing vertical and lateral restraint and by support at the upper end of the base structure providing lateral restraint only.

(2) Lateral inertia. The tank loaded to its maximum gross weight must be positioned for five minutes with its transverse axis vertical. It shall be held in this position for five minutes by support at the lower side of the base structure providing vertical and lateral restraint and by support at the upper side of the base structure providing lateral restraint only.

(d) Approval of smaller tanks of the same design. Design approval must include the prototype testing of at least one tank of each design and each size; however, a set of tests made on a tank of one size may serve for the approval of smaller tanks with equal or lesser diameter and length) made of the same material and thickness by the same fabrication technique and with identical supports and equivalent closures and other appurtenances.

(e) Pressure and vacuum relief devices. Each spring loaded relief device must be tested for the accuracy of the setting prior to installation on a tank and must be effectively sealed to maintain the required setting.

[Amdt. 178-65, 46 FR 9898, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§178.270-14 Marking of tanks.

(a) *General. Each tank must bear a corrosion resistant metal identification plate that is permanently attached to the portable tank and readily accessible for inspection. The information required in paragraph (b), and, when appropriate, paragraph (c) of this section must be stamped, embossed or otherwise marked by an equally durable method on the plate in characters at least 3 mm (0.118 inches) high. The plate must not be painted.*

(b) Required information. At least the following information must appear on the metal identification plate for each tank:

(1) US DOT Specification number.
(2) Country of manufacture.
(3) Manufacturer's name.
(4) Date of manufacture.
(5) Manufacturer's serial number.
(6) Identification of USA/DOT approval agency and approval number.
(7) Maximum allowable working pressure, in bar or psig.
(8) Test pressure, in bar or psig.
(9) Total measured water capacity at 20 ^{o}C (68 ^{o}F), in liters or gallons.
(10) Maximum allowable gross weight, in kg or lbs.
(11) Equivalent minimum shell thickness in mild steel, in mm or inches.
(12) Tank material and specification number.
(13) Metallurgical design temperature range, in ^{o}C or ^{o}F.

(c) *Additional information. The following additional information must appear on the metal identification plate when applicable:*

(1) Lining material.

(2) Heating coil maximum allowable working pressure in bar and psig.

(3) Corrosion allowance, in mm or in.

(d) In addition to the markings required above, each tank used in international transport must have a Safety Approval Plate containing the information required in §§451.21 through 451.25 of this title.

(e) Nothing in this section shall be deemed to preclude the display of other pertinent information on the required metal identification plate.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981, as amended at 62 FR 51561, Oct. 1, 1997]

§178.271 Specification IM 101 steel portable tanks.

§178.271-1 General requirements.

(a) Specification IM 101 portable tanks must conform to the general design and construction requirements in §178.270 of this subpart in addition to the specific design requirements contained in this section.

(b) The maximum allowable working pressure of each tank shall be equal to or greater than 1.75 bar (25.4 psig) and less than 6.8 bar (100 psig).

(c) Each tank shall be designed and constructed in accordance with the requirements of Section VIII, Division 1, of the ASME Code except as limited or modified in this section or in §178.270 of this subpart. ASME certification or stamp is not required.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.272 Specification IM 102 steel portable tanks.

§178.272-1 General requirements.

(a) Specification IM 102 portable tanks must conform to the general design and construction requirements in §178.270 of this subpart in addition to the specific design requirements contained in this section.

(b) The maximum allowable working pressure of each tank shall be less than 1.75 bar (25.4 psig) but at least 1.0 bar (14.5 psig).

(c) Each tank shall be designed and constructed in accordance with the requirements of Section VIII, Division 1, of the ASME Code except as limited or modified in this section or in §178.270 of this subpart. ASME certification or stamp is not required.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.272-2 Minimum thickness of shells and heads.

(a) The approval agency may authorize a minimum thickness less than that required by §178.270-5 of this subpart where additional protection against tank puncture provides equal integrity.

(b) The shell and head thickness of a tank must be at least:

(1) 3.18 mm (0.125 inches) for a tank with a maximum cross-sectional dimension of 1.8 meters (5.9 feet) or less; or

(2) 4 mm (0.157 inches) for a tank constructed of the reference mild steel having a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet). For tanks having a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet) constructed of other steels, an equivalent head and shell thickness calculated in accordance with §178.270-5(c) of this subpart may be used, subject to an absolute minimum of 3.18 mm (0.125 inches).

(c) The following additional puncture protection systems are authorized:

(1) An overall external structural protection, such as a jacket, which is rigidly secured to the tank with a layer of cushioning material installed between the external structural protection and the tank; or

(2) A complete framework surrounding the tank including both longitudinal and transverse structural members.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

[CFR] PART 178 SUBPART I - [Reserved]

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART I]

Subpart I - [Reserved]

[CFR] PART 178 SUBPART J - Specifications for Containers for Motor Vehicle Transportation

Subpart J - Specifications for Containers for Motor Vehicle Transportation

Source: 29 FR 18975, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§178.318 Specification MC 201; container for detonators and percussion caps.

§178.318-1 Scope.

(a) This specification pertains to a container to be used for the transportation of detonators and percussion caps in connection with the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, where any or all of such types of caps may be used for the detonation of liquid nitroglycerin, desentitized liquid nitroglycerin or diethylene glycol dinitrate in blasting operations. This specification is not intended to take the place of any shipping or packing requirements of this Department where the caps in question are themselves articles of commerce.
(b) [Reserved]

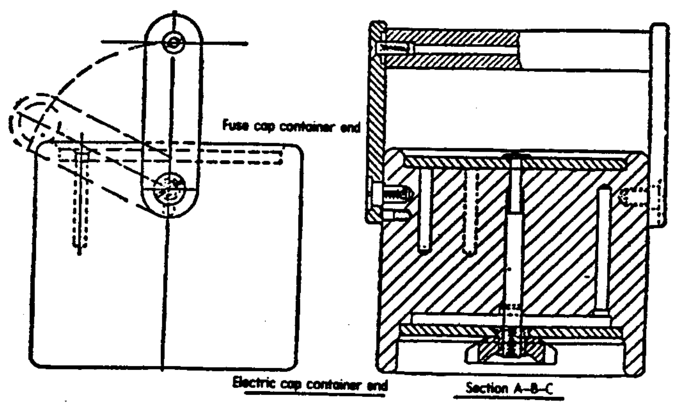
[29 FR 18975, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-60, 44 FR 70733, Dec. 10, 1979]

§178.318-2 Container.

(a) Every container for detonators and percussion caps coming within the scope of this specification shall be constructed entirely of hard rubber, phenolresinous or other resinous material, or other nonmetallic, nonsparking material, except that metal parts may be used in such locations as not in any event to come in contact with any of the caps. Space shall be provided so that each detonator of whatever nature may be inserted in an individual cell in the body of the container, into which each such cap shall snugly fit. There shall be provided no more than twenty (20) such cellular spaces. Space may be provided into which a plurality of percussion caps may be carried, provided that such space may be closed with a screw cap, and further provided that each or any such space is entirely separate from any space provided for any detonator.

Each cellular space into which a detonator is to be inserted and carried shall be capable of being covered by a rotary cover so arranged as to expose not more than one cell at any time, and capable of rotation to such a place that all cells will be covered at the same time, at which place means shall be provided to lock the cover in place. Means shall be provided to lock in place the cover for the cells provided for the carrying of detonators. The requirement that not more than one cell be exposed at one time need not apply in the case of detonators, although spaces for such caps and detonators shall be separate. Sufficient annular space shall be provided inside the cover for such detonators that, when the cover is closed, there will be sufficient space to accommodate the wires customarily attached to such caps. If the material is of such a nature as to require treatment to prevent the absorption of moisture, such treatment shall be applied as shall be necessary in order to provide against the penetration of water by permeation. A suitable carrying handle shall be provided, except for which handle no part of the container may project beyond the exterior of the body.

(b) Exhibited in plates I and II are line drawings of a container for detonators and percussion caps, illustrative of the requirements set forth in §178.318-2(a). These plates shall not be construed as a part of this specification.



BLASTING CAP CONTAINER
PLATE I

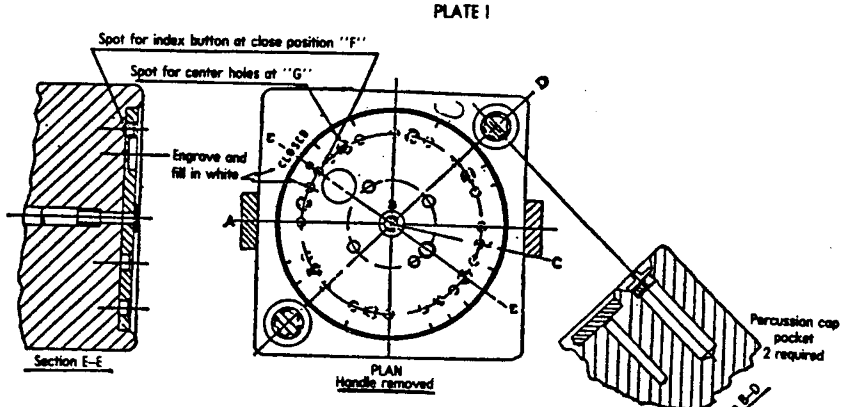


PLATE II

[29 FR 18975, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-60, 44 FR 70733, Dec. 10, 1979]

§178.318-3 Marking.

Each container must be marked as prescribed in §173.24 of this subchapter.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§178.320 General requirements applicable to all DOT specification cargo tank motor vehicles.

(a) *Definitions. For the purposes of this subpart,*

Cargo tank, as defined in §171.8 of this subchapter, means a bulk packaging which:

(1) Is a tank intended primarily for the carriage of liquids or gases (including appurtenances, reinforcements, fittings, and closures). (For definition of "tank", see §178.345-1(c), §178.337-1, or §178.338-1, as applicable);

(2) Is permanently attached to or forms a part of a motor vehicle but which, by reason of its size, construction or attachment to a motor vehicle is loaded or unloaded without being removed from the motor vehicle; and

(3) Is not fabricated under a specification for cylinders, portable tanks, tank cars, or multi-unit tank car tanks.

Cargo tank motor vehicle, as defined in §171.8 of this subchapter, means a motor vehicle with one or more cargo tanks permanently attached to or forming an integral part of the motor vehicle.

Cargo tank wall means those parts of the cargo tank which make up the primary lading retention structure including shell, bulkheads, and fittings which, when closed during transportation of lading, yields the minimum volume of the cargo tank assembly.

Design type means one or more cargo tanks which are made-

(1) To the same specification;

(2) By the same manufacturer;

(3) To the same engineering drawings and calculations, except for minor variations in piping which do not affect the lading retention capability of the cargo tank;

(4) Of the same materials of construction;

(5) To the same cross-sectional dimensions;

(6) To a length varying by no more than five percent;

(7) With the volume varying by no more than five percent (due to a change in length only); and

(8) For the purposes of §178.338 only, with the same insulation system.

Manufacturer means any person engaged in the manufacture of a DOT specification cargo tank, cargo tank motor vehicle or cargo tank equipment which forms part of the cargo tank wall. This term includes attaching a cargo tank to a motor vehicle or to a motor vehicle suspension component which involves welding on the cargo tank wall. A *manufacturer shall register with the Department in accordance with subpart F of part 107 in subchapter A of this chapter.*

(b) Design certification. (1) Each cargo tank design type shall be certified in conformance with the specification requirements by a Design Certifying Engineer registered in accordance with subpart F of part 107.

(2) The Design Certifying Engineer shall furnish to the manufacturer a certificate to indicate compliance with the specification requirements. The certificate must include the sketches, drawings, and calculations used for certification. Each certificate, including sketches, drawings, and calculations, shall be signed by the Design Certifying Engineer.

(3) The manufacturer shall retain the design certificate at his principal place of business for as long as he manufactures DOT specification cargo tanks.

(c) *Exceptions to the ASME Code. Unless otherwise specified, when exceptions are provided in this subpart from compliance with certain paragraphs of the ASME Code, compliance with those paragraphs is not prohibited.*

[Amdt. 178-89, 55 FR 37055, Sept. 7, 1990, as amended by Amdt. 178-98, 58 FR 33306, June 16, 1993; Amdt. 178-118, 61 FR 51339, Oct. 1, 1996]

§178.337 Specification MC 331; cargo tank motor vehicle primarily for transportation of compressed gases as defined in subpart G of part 173 of this subchapter.

§178.337-1 General requirements.

(a) *ASME Code construction. Tanks must be-*

(1) Seamless or welded construction, or a combination of both;

(2) Designed and constructed in accordance with the ASME Code;

(3) Made of steel or aluminum; however, if aluminum is used, the cargo tank must be insulated and the hazardous material to be transported must be compatible with the aluminum (see §§178.337-1(e)(2), 173.315(a) table, and 178.337-2(a)(1) of this subchapter); and

(4) Covered with a steel jacket if the cargo tank is insulated and used to transport a flammable gas (see §173.315(a) table Note 11 of this subchapter).

(b) *Design pressure. The design pressure of a cargo tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115 °F. or as prescribed for a particular commodity in §173.315(a) of this subchapter, except that in no case shall the design pressure of any cargo tank be less than 100 p.s.i.g. nor more than 500 p.s.i.g.*

Note 1: The term *design pressure as used in this specification, is identical to the term maximum allowable working pressure as used in the ASME Code.*

(c) Openings. (1) Excess pressure relief valves shall be located in the top of the cargo tank or heads.

(2) A chlorine cargo tank shall have only one opening. That opening shall be in the top of the cargo tank and shall be fitted with a nozzle that meets the following requirements:

(i) On a cargo tank manufactured on or before December 31, 1974, the nozzle shall be protected by a dome cover plate which conforms to either the standard of The Chlorine Institute, Inc., Dwg. 103-3, dated January 23, 1958, or to the standard specified in paragraph (c) (2) (ii) of this section.

(ii) On a cargo tank manufactured on or after January 1, 1975, the nozzle shall be protected by a manway cover which conforms to the standard of The Chlorine Institute, Inc., Dwg. 103-4, dated September 1, 1971.

(d) *Reflective design. Every uninsulated cargo tank permanently attached to a cargo tank motor vehicle shall, unless covered with a jacket made of aluminum, stainless steel, or other bright nontarnishing metal, be painted a white, aluminum or similar reflecting color on the upper two-thirds of area of the cargo tank.*

(e) Insulation. (1) Each cargo tank required to be insulated must conform with the use and performance requirements contained in §§173.315(a) table and 178.337-1 (a)(3) and (e)(2) of this subchapter.

(2) Each cargo tank intended for chlorine; carbon dioxide, refrigerated liquid; or nitrous oxide, refrigerated liquid service must have suitable insulation of such thickness that the overall thermal conductance is not more than 0.08 Btu per square foot per ^{o}F differential per hour. The conductance must be determined at 60 ^{o}F. Insulation material used on cargo tanks for nitrous oxide, refrigerated liquid must be noncombustible. Insulating material used on cargo tanks for chlorine must be corkboard or polyurethane foam, with a minimum thickness of 4 inches, or 2 inches minimum thickness of ceramic fiber/fiberglass of 4 pounds per cubic foot minimum density covered by 2 inches minimum thickness of fiber.

(f) *Postweld heat treatment. Postweld heat treatment must be as prescribed in the ASME Code except that each cargo tank constructed in accordance with Part UHT of the ASME Code must be postweld heat treated. Each chlorine cargo tank must be fully radiographed and postweld heat treated in accordance with the provisions of the ASME Code under which it is constructed. Where postweld heat treatment is required, the cargo tank must be treated as a unit after completion of all the welds in and/or to the shells and heads. The method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment. A cargo tank used for anhydrous ammonia must be postweld heat treated. The postweld heat treatment must be as prescribed in the ASME Code, but in no event at less than 1050* ^{o}*F. cargo tank metal temperature.*

(g) Definitions. The following definitions apply to §§178.337-1 through 178.337-18:

Emergency discharge control means the ability to stop a cargo tank unloading operation in the event of an unintentional release. Emergency discharge control can utilize passive or off-truck remote means to stop the unloading operation. A passive means of emergency discharge control automatically shuts off the flow of product without the need for human intervention within 20 seconds of an unintentional release caused by a complete separation of the liquid delivery hose. An off-truck remote means of emergency discharge control permits a qualified person attending the unloading operation to close the cargo tank's internal self-closing stop valve and shut off all motive and auxiliary power equipment at a distance from the cargo tank motor vehicle.

Excess flow valve, integral excess flow valve, or excess flow feature means a component that will close automatically if the flow rate of a gas or liquid through the component reaches or exceeds the rated flow of gas or liquid specified by the original valve manufacturer when piping mounted directly on the valve is sheared off before the first valve, pump, or fitting downstream from the valve.

Internal self-closing stop valve means a primary shut off valve installed in a product discharge outlet of a cargo tank and designed to be kept closed by self-stored energy.

Primary discharge control system means a primary shut-off installed at a product discharge outlet of a cargo tank consisting of an internal self-closing stop valve that may include an integral excess flow valve or an excess flow feature, together with linkages that must be installed between the valve and remote actuator to provide manual and thermal on-truck remote means of closure.

[Order 59-B, 30 FR 579, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-1, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-2 Material.

(a) *General. (1) All material used for construction of the cargo tank and appurtenances must be suitable for use with the commodities to be transported therein and must conform to the requirements of the ASME Code and/or requirements of the American Society for Testing and Materials in all respects.*

(2) Impact tests are required on steel used in the fabrication of each cargo tank constructed in accordance with part UHT of the ASME Code. The tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat treatment processing lot having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full size specimens must be 20 foot-pounds in the longitudinal direction at -30 ^{o}F., Charpy V-Notch and 15 foot-pounds in the transverse direction at -30 ^{o}F., Charpy V-Notch. The required values for subsize specimens must be reduced in direct proportion to the cross-sectional area of the specimen beneath the notch. If a lot does not meet this requirement, individual plates may be accepted if they individually meet this requirement.

(3) The fabricator shall record the heat, and slab numbers, and the certified Charpy impact values, where required, of each plate used in each cargo tank on a sketch

showing the location of each plate in the shell and heads of the cargo tank. Copies of each sketch shall be provided to the owner and retained for at least five years by the fabricator and made available to duly identified representatives of the Department of Transportation.
(4) The direction of final rolling of the shell material shall be the circumferential orientation of the cargo tank shell.
(b) *For a chlorine cargo tank. Plates, the manway nozzle, and anchorage shall be made of carbon steel which meets the following requirements:*
(1) For a cargo tank manufactured on or before December 31, 1974-
(i) Material shall conform to ASTM Specification A-300 -58, titled "Steel Plates for Pressure Vessels for Service at Low Temperatures";
(ii) Material shall be Class 1, Grade A, flange or firebox quality;
(iii) Plate impact test specimens, as required under paragraph (a) of this section, shall be of the Charpy keyhole notch type; and
(iv) Plate impact test specimens shall meet the impact test requirements in paragraph (a) of this section in both the longitudinal and transverse directions of rolling at a temperature of minus 45.5 C. (-50 ^{o}F.).
(2) For a cargo tank manufactured on or after January 1, 1975-
(i) Material shall conform to ASTM Specification A-612-72a, Grade B or A 516, Grade 65 or 70;
(ii) Material shall meet the Charpy V-notch test requirements of ASTM Specification A 20; and
(iii) Plate impact test specimens shall meet the impact test requirements in paragraph (a) of this section in both the longitudinal and transverse directions of rolling at a temperature of minus 40 ^{o}C. (-40 ^{o}F.).
(c) A cargo tank in anhydrous ammonia service must be constructed of steel. The use of copper, silver, zinc or their alloys is prohibited. Baffles made from aluminum may be used only if joined to the cargo tank by a process not requiring postweld heat treatment of the cargo tank.

[Order 59-B, 30 FR 579, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-2, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-3 Structural integrity.
(a) General requirements and acceptance criteria. (1) Except as provided in paragraph (d) of this section, the maximum calculated design stress at any point in the cargo tank may not exceed the maximum allowable stress value prescribed in Section VIII of the ASME Code, or 25 percent of the tensile strength of the material used.
(2) The relevant physical properties of the materials used in each cargo tank may be

established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.
(3) The maximum design stress at any point in the cargo tank must be calculated separately for the loading conditions described in paragraphs (b), (c), and (d) of this section. Alternate test or analytical methods, or a combination thereof, may be used in place of the procedures described in paragraphs (b), (c), and (d) of this section, if the methods are accurate and verifiable.
(4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.
(b) The static design and construction of each cargo tank must be in accordance with section VIII of the ASME Code. The cargo tank design must include calculation of stresses generated by design pressure, the weight of lading, the weight of structure supported by the cargo tank wall, and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in calculation of thermal stresses. Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G of the ASME Code.
(c) *Shell design. Shell stresses resulting from static or dynamic loadings, or combinations thereof, are not uniform throughout the cargo tank motor vehicle. The vertical, longitudinal, and lateral normal operating loadings can occur simultaneously and must be combined. The vertical, longitudinal and lateral extreme dynamic loadings occur separately and need not be combined.*
(1) Normal operating loadings. The following procedure addresses stress in the tank shell resulting from normal operating loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S = 0.5(S_y + S_x) + [0.25(S_y - S_x)^2 + S_s2]^{0}.5$$

Where:

(i) S = effective stress at any given point under the combination of static and normal operating loadings that can occur at the same time, in psi.
(ii) S_y = circumferential stress generated by the MAWP and external pressure, when applicable, plus static head, in psi.
(iii) S_x = The following net longitudinal stress generated by the following static and normal operating loading conditions, in psi:
(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending stress generated by the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The tensile or compressive stress resulting from normal operating longitudinal acceleration or deceleration. In each case, the forces applied must be 0.35 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:

(*1) The axial load generated by a decelerative force;*

(2) The bending moment generated by a decelerative force;

(3) The axial load generated by an accelerative force; and

(4) The bending moment generated by an accelerative force; and

(C) The tensile or compressive stress generated by the bending moment resulting from normal operating vertical accelerative force equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall.

(iv) S_s = The following shear stresses generated by the following static and normal operating loading conditions, in psi:

(A) The static shear stress resulting from the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The vertical shear stress generated by a normal operating accelerative force equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(C) The lateral shear stress generated by a normal operating lateral accelerative force equal to 0.2 times the vertical reaction at each suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall; and

(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(1)(iv)(C) of this section.

(2) *Extreme dynamic loadings. The following procedure addresses stress in the tank shell resulting from extreme dynamic loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:*

$S = 0.5(S_y + S_x) + [0.25(S_y - S_x)^2 + S_s 2]^0.5$

Where:

(i) S = effective stress at any given point under a combination of static and extreme dynamic loadings that can occur at the same time, in psi.

(ii) S_y = circumferential stress generated by MAWP and external pressure, when applicable, plus static head, in psi.

(iii) S_x = the following net longitudinal stress generated by the following static and extreme dynamic loading conditions, in psi:

(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending stress generated by the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the tank wall;

(B) The tensile or compressive stress resulting from extreme longitudinal acceleration or deceleration. In each case the forces applied must be 0.7 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or the anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:

(*1) The axial load generated by a decelerative force;*

(2) The bending moment generated by a decelerative force;

(3) The axial load generated by an accelerative force; and

(4) The bending moment generated by an accelerative force; and

(C) The tensile or compressive stress generated by the bending moment resulting from an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or the anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall.

(iv) S_s = The following shear stresses generated by static and extreme dynamic loading conditions, in psi:

(A) The static shear stress resulting from the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(B) The vertical shear stress generated by an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(C) The lateral shear stress generated by an extreme lateral accelerative force equal to 0.4 times the vertical reaction at the suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall; and

(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(2)(iv)(C) of this section.

(d) In order to account for stresses due to impact in an accident, the design calculations for the cargo tank shell and heads must include the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of "2g". For this loading condition the stress value used may not exceed the lesser of the yield strength or 75 percent of the ultimate tensile strength of the material of construction. For cargo tanks constructed of stainless steel the maximum design stress may not exceed 75 percent of the ultimate tensile strength of the type steel used.

(e) The minimum metal thickness for the shell and heads must be 0.187 inch for steel and 0.270 inch for aluminum, except for chlorine and sulfur dioxide cargo tanks. For a cargo tank used in chlorine or sulfur dioxide service, the cargo tank must be made of steel. A corrosion allowance of 20 percent or 0.10 inch, whichever is less, must be added to the thickness otherwise required for sulfur dioxide and chlorine tank material. In chlorine cargo tanks the wall thickness must be at least five-eighths inch, including corrosion allowance.

(f) Where a cargo tank support is attached to any part of the cargo tank wall, the stresses imposed on the cargo tank wall must meet the requirements in paragraph (a) of this section.

(g) The design, construction, and installation of an appurtenance to the cargo tank must be such that, in the event of its damage or failure, the lading retention integrity of the cargo tank will not be adversely affected.

(1) A lightweight attachment, such as a conduit clip, brakeline clip or placard holder, must be constructed of a material of lesser strength than the cargo tank wall material

and may not be more than 72 percent of the thickness of the material to which it is attached. The attachment may be secured directly to the cargo tank wall if the device is designed and installed in such a manner that, if damaged, it will not affect the lading retention integrity of the cargo tank. The lightweight attachment must be secured to the cargo tank wall by continuous weld or in such a manner as to preclude formation of pockets, which may become sites for incipient corrosion. Attachments meeting the requirements of this paragraph are not authorized for cargo tanks constructed under part UHT of the ASME Code.

(2) Except as prescribed in §178.337-3(g)(1), the welding of any appurtenance of the cargo tank wall must be made by attachment of a mounting pad, so that there will be no adverse effect upon the lading retention integrity of the cargo tank if any force is applied to the appurtenance, from any direction. The thickness of the mounting pad may not be less than that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.250 inch may be used when the shell or head thickness is over 0.250 inch. If weep holes or tell-tale holes are used, the pad must be drilled or punched at its lowest point before it is welded. Each pad must:

(i) Extend at least 2 inches in each direction from any point of attachment of an appurtenance;

(ii) Have rounded corners, or otherwise be shaped in a manner to minimize stress concentrations on the shell or head; and

(iii) Be attached by a continuous weld around the pad, except for a small gap at the lowest point for draining, using filler material conforming to the recommendations of the manufacturer of the head or shell material.

[Amdt. 178-89, 55 FR 37056, Sept. 7, 1990, as amended by Amdt. 178-104, 59 FR 49135, Sept. 26, 1994; Amdt. 178-105, 60 FR 17401, Apr. 5, 1995; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-4 Joints.

(a) Joints shall be as required by the ASME Code, with all undercutting in shell and head material repaired as specified therein.

(b) Welding procedure and welder performance must be in accordance with Section IX of the ASME Code. In addition to the essential variables named therein, the following must be considered as essential variables: Number of passes; thickness of plate; heat input per pass; and manufacturer's identification of rod and flux. When fabrication is done in accordance with part UHT of the ASME Code, filler material containing more than 0.08 percent vanadium must not be used. The number of passes, thickness of plate, and heat input per pass may not vary more than 25 percent from the procedure or welder qualifications. Records of the qualifications must be retained for at least 5 years by the cargo tank manufacturer and must be made available to duly identified representatives of the Department and the owner of the cargo tank.

(c) All longitudinal shell welds shall be located in the upper half of the cargo tank.

(d) Edge preparation of shell and head components may be by machine heat processes, provided such surfaces are remelted in the subsequent welding process. Where there will be no subsequent remelting of the prepared surface as in a tapered section, the final 0.050 inch of material shall be removed by mechanical means.

(e) The maximum tolerance for misalignment and butting up shall be in accordance with the ASME Code.

(f) Substructures shall be properly fitted before attachment, and the welding sequence shall be such as to minimize stresses due to shrinkage of welds.

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-4, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-5 Bulkheads, baffles and ring stiffeners.

(a) Not a specification requirement.

(b) [Reserved]

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.337-6 Closure for manhole.

(a) Each cargo tank marked or certified after April 21, 1994, must be provided with a manhole conforming to paragraph UG-46(g)(1) and other applicable requirements of the ASME Code, except that a cargo tank constructed of NQT steel having a capacity of 3500 water gallons or less may be provided with an inspection opening conforming to paragraph UG-46 and other applicable requirements of the ASME Code instead of a manhole.

(b) The manhole assembly of cargo tanks constructed after June 30, 1979, may not be located on the front head of the cargo tank.

[Amdt. 178-7, 34 FR 18250, Nov. 14, 1969, as amended by Amdt. 178-52, 43 FR 58820, Dec. 18, 1978; Amdt. 178-89, 54 FR 25017, June 12, 1989; 55 FR 21038, May 22, 1990; 56 FR 27876, June 17, 1991; 58 FR 12905, March 8, 1993; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-7 Overturn protection.

(a) See §178.337-10.
(b) [Reserved]

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.337-8 Openings, inlets, and outlets.

(a) *General. The requirements in this paragraph (a) apply to MC 331 cargo tanks except for those used to transport chlorine. The requirements for inlets and outlets on chlorine cargo tanks are in paragraph (b) of this section.*

(1) An opening must be provided on each cargo tank used for the transportation of liquefied materials to permit complete drainage.

(2) Except for gauging devices, thermometer wells, pressure relief valves, manhole openings, product inlet openings, and product discharge openings, each opening in a cargo tank must be closed with a plug, cap, or bolted flange.

(3) Except as provided in paragraph (b) of this section, each product inlet opening, including vapor return lines, must be fitted with a back flow check valve or an internal self-closing stop valve located inside the cargo tank or inside a welded nozzle that is an integral part of the cargo tank. The valve seat must be located inside the cargo tank or within 2.54 centimeters (one inch) of the external face of the welded flange. Damage to parts exterior to the cargo tank or mating flange must not prevent effective seating of the valve. All parts of a valve inside a cargo tank or welded flange must be made of material that will not corrode or deteriorate in the presence of the lading.

(4) Except as provided in paragraphs (a)(5), (b), and (c) of this section, each liquid or vapor discharge outlet must be fitted with a primary discharge control system as defined in §178.337-1(g). Thermal remote operators must activate at a temperature of 121.11^{o}C (250 ^{o}F) or less. Linkages between closures and remote operators must be corrosion resistant and effective in all types of environmental conditions incident to discharging of product.

(i) On a cargo tank over 13,247.5 liters (3,500 gallons) water capacity, thermal and mechanical means of remote closure must be installed at the ends of the cargo tank in at least two diagonally opposite locations. If the loading/unloading connection at the cargo tank is not in the general vicinity of one of the two locations specified in the first sentence of this paragraph (a)(4)(i), additional means of thermal remote closure must be installed so that heat from a fire in the loading/unloading connection area or the discharge pump will activate the primary discharge control system. The loading/unloading connection area is where hoses or hose reels are connected to the permanent metal piping.

(ii) On a cargo tank of 13,247.5 liters (3,500 gallons) water capacity or less, a thermal means of remote closure must be installed at or near the internal self-closing stop valve. A mechanical means of remote closure must be installed on the end of the cargo tank furthest away from the loading/unloading connection area. The loading/unloading connection area is where hoses or hose reels are connected to the permanent metal piping. Linkages between closures and remote operators must be corrosion resistant and effective in all types of environmental conditions incident to discharge of product.

(iii) All parts of a valve inside a cargo tank or within a welded flange must be made of material that will not corrode or deteriorate in the presence of the lading.

(iv) An excess flow valve, integral excess flow valve, or excess flow feature must close if the flow reaches the rated flow of a gas or liquid specified by the original valve manufacturer when piping mounted directly on the valve is sheared off before the first valve, pump, or fitting downstream from the excess flow valve, integral excess flow valve, or excess flow feature.

(v) An integral excess flow valve or the excess flow feature of an internal self-closing stop valve may be designed with a bypass, not to exceed 0.1016 centimeters (0.040 inch) diameter opening, to allow equalization of pressure.

(vi) The internal self-closing stop valve must be designed so that the self-stored energy source and the valve seat are located inside the cargo tank or within 2.54 centimeters (one inch) of the external face of the welded flange. Damage to parts exterior to the cargo tank or mating flange must not prevent effective seating of the valve.

(5) A primary discharge control system is not required on the following:

(i) A vapor or liquid discharge opening of less than $1^{1/4}$ NPT equipped with an excess flow valve together with a manually operated external stop valve in place of an internal self-closing stop valve.

(ii) An engine fuel line on a truck-mounted cargo tank of not more than $^{3/4}$ NPT equipped with a valve having an integral excess flow valve or excess flow feature.

(iii) A cargo tank motor vehicle certified before January 1, 1995, unless intended for use to transport a flammable liquid, flammable gas, hydrogen chloride, refrigerated liquid, or anhydrous ammonia.

(6) In addition to the internal self-closing stop valve, each filling and discharge line must be fitted with a stop valve located in the line between the internal self-closing stop valve and the hose connection. A back flow check valve or excess flow valve may not be used to satisfy this requirement.

(7) An excess flow valve may be designed with a bypass, not to exceed a 0.1016 centimeter (0.040 inch) diameter opening, to allow equalization of pressure.

(b) *Inlets and discharge outlets on chlorine tanks. The inlet and discharge outlets on a cargo tank used to transport chlorine must meet the requirements of §178.337-1(c)(2) and must be fitted with an internal excess flow valve. In addition to the internal excess flow valve, the inlet and discharge outlets must be equipped with an external stop valve (angle valve). Excess flow valves must conform to the standards of The Chlorine Institute, Inc., as follows:*

(1) A valve conforming to Drawing 101-7, dated July 1993, must be installed under each liquid angle valve.

(2) A valve conforming to Drawing 106-6, dated July 1993, must be installed under each gas angle valve.

(c) *Discharge outlets on carbon dioxide, refrigerated liquid, cargo tanks. A discharge outlet on a cargo tank used to transport carbon dioxide, refrigerated liquid is not* *required to be fitted with an internal self-closing stop valve.*

[64 FR 28049, May 24, 1999]

§178.337-9 Pressure relief devices, piping, valves, hoses, and fittings.

(a) *Pressure relief devices. (1) See §173.315(i) of this subchapter.*

(2) On cargo tanks for carbon dioxide or nitrous oxide see §173.315 (i) (9) and (10) of this subchapter.

(3) Each valve must be designed, constructed, and marked for a rated pressure not less than the cargo tank design pressure at the temperature expected to be encountered.

(b) *Piping, valves, hose, and fittings. (1) The burst pressure of all piping, pipe fittings, hose and other pressure parts, except for pump seals and pressure relief devices, must be at least 4 times the design pressure of the cargo tank. Additionally, the burst pressure may not be less than 4 times any higher pressure to which each pipe, pipe fitting, hose or other pressure part may be subjected to in service. For chlorine service, see paragraph (b)(7) of this section.*

(2) Pipe joints must be threaded, welded or flanged. If threaded pipe is used, the pipe and fittings must be Schedule 80 weight or heavier. Malleable metals must be used in the construction of valves and fittings. Where copper tubing is permitted, joints shall be brazed or be of equally strong metal union type. The melting point of the brazing material may not be lower than 1000 ^{o}F. The method of joining tubing must not reduce the strength of the tubing, such as by the cutting of threads.

(3) Each hose coupling must be designed for a pressure of at least 120 percent of the hose design pressure and so that there will be no leakage when connected.

(4) Piping must be protected from damage due to thermal expansion and contraction, jarring, and vibration. Slip joints are not authorized for this purpose.

(5) *Piping and fittings must be grouped in the smallest practicable space and protected from damage as required by §178.337-10.*

(6) Cargo tank manufacturers and fabricators must demonstrate that all piping, valves, and fittings on a cargo tank are free from leaks. To meet this requirement, the piping, valves, and fittings must be tested after installation at not less than 80 percent of the design pressure marked on the cargo tank.

(7) A hose assembler must:

(i) Permanently mark each hose assembly with a unique identification number.

(ii) Demonstrate that each hose assembly is free from leaks by performing the tests and inspections in §180.416(f) of this subchapter.

(iii) Mark each hose assembly with the month and year of its original pressure test.

(8) *Chlorine cargo tanks. Angle valves on cargo tanks intended for chlorine service must conform to Drawing 104-8, dated July 1993, in the standards of The Chlorine Institute. Before installation, each angle valve must be tested for leakage at not less than 225 psig using dry air or inert gas.*

(c) Marking inlets and outlets. Except for gauging devices, thermometer wells, and pressure relief valves, each cargo tank inlet and outlet must be marked "liquid" or "vapor" to designate whether it communicates with liquid or vapor when the cargo tank is filled to the maximum permitted filling density. A filling line that communicates with vapor may be marked "spray-fill" instead of "vapor."

(d) Refrigeration and heating coils. (1) Refrigeration and heating coils must be securely anchored with provisions for thermal expansion. The coils must be pressure tested externally to at least the cargo tank test pressure, and internally to either the tank test pressure or twice the working pressure of the heating/refrigeration system, whichever is higher. A cargo tank may not be placed in service if any leakage occurs or other evidence of damage is found. The refrigerant or heating medium to be circulated through the coils must not be capable of causing any adverse chemical reaction with the cargo tank lading in the event of leakage. The unit furnishing refrigeration may be mounted on the motor vehicle.

(2) Where any liquid susceptible to freezing, or the vapor of any such liquid, is used for heating or refrigeration, the heating or refrigeration system shall be arranged to permit complete drainage.

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-9, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-10 Protection of fittings.

(a) All valves, fittings, safety relief devices, and other accessories to the tank proper shall be protected in accordance with paragraph (b) of this section against such damage as could be caused by collision with other vehicles or objects, jackknifing and overturning. In addition, safety relief valves shall be so protected that in the event of overturn of the vehicle on to a hard surface, their opening will not be prevented and their discharge will not be restricted.

(b) The protective devices or housing must be designed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with the lading, using a safety factor of not less than four, based on the ultimate strength of the material to be used, without damage to the fittings protected, and must be made of metal at least $^{3/16}$-inch thick.

(c) *For chlorine tanks. There shall be a protective housing and manway cover to permit the use of standard emergency kits for controlling leaks in fittings on the dome cover plate. The housing and manway cover must conform to the Chlorine Institute's standards as follows:*

(1) Tanks manufactured on or before December 31, 1974: Dwg. 137-1, dated November 7, 1962, or Dwg. 137-2, dated September 1, 1971.

(2) Tanks manufactured on or after January 1, 1975: Dwg. 137-2, dated September 1, 1971.
(d) Each cargo tank shall be provided with at least one rear bumper designed to protect the tank and piping in the event of a rear end collision and minimize the possibility of any part of the colliding vehicle striking the tank. The design shall be such as to transmit the force of a rear end collision in a horizontal line to the chassis of the vehicle. The bumper shall be designed to withstand the impact of the fully loaded vehicle with a deceleration of 2 "g", using a safety factor of four based on the ultimate strength of the bumper material. The bumpers shall conform dimensionally to §393.86, chapter III of this title.

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-10, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-11 Emergency discharge control.
(a) *Emergency discharge control equipment. Emergency discharge control equipment must be installed in a liquid discharge line as specified by product and service in §173.315(n) of this subchapter. The performance and certification requirements for emergency discharge control equipment are specified in §173.315(n) of this subchapter and are not a part of the cargo tank motor vehicle certification made under this specification.*
(b) Engine fuel lines. On a truck-mounted cargo tank, emergency discharge control equipment is not required on an engine fuel line of not more than $^{3/4}$ NPT equipped with a valve having an integral excess flow valve or excess flow feature.

[64 FR 28050, May 24, 1999]

§178.337-12 Shear section.
(a) Design or installation of valves specified in §178.337-8(a)(2) shall provide adjacent to and outboard of such valves a section which will break under undue strain.
(b) [Reserved]

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§178.337-13 Supporting and anchoring.

(a) A cargo tank that is not permanently attached to or integral with a vehicle chassis must be secured by turnbuckles or equally efficient securing devices for drawing the cargo tank down tight on the frame. Anchors, stops, or other means must be provided to prevent relative motion between the cargo tank and the vehicle chassis when the vehicle is in operation.

(b) A cargo tank motor vehicle designed and constructed so that the cargo tank constitutes in whole or in part the stress member used in place of a frame must have the cargo tank supported by external cradles. A cargo tank mounted on a frame must be supported by external cradles or longitudinal members. The cradles, where used, must subtend at least 120 degrees of the shell circumference. The design calculations for the supports must include beam stress, shear stress, torsion stress, bending moment, and acceleration stress, for the loaded cargo tank motor vehicle as a unit, using a factor of safety of 4, based on the ultimate strength of the material and on a 2 "g" longitudinal and lateral loading and 3 times the static weight in vertical loading (see appendix G of the ASME Code).

(c) Where any cargo tank support is attached to any part of a cargo tank head, the stresses imposed upon the head shall be provided for as required in paragraph (b) of this section.

(d) No cargo tank support or bumper may be welded directly to the cargo tank. All supports and bumpers shall be attached by means of pads of the same material as the cargo tank. The pad thickness shall be no less than $^{1/4}$ inch, or the thickness of the shell material if less, and no greater than the shell material. Each pad shall extend at least 4 times its thickness, in each direction, beyond the weld attaching the support or bumper. Each pad shall be preformed to an inside radius no greater than the outside radius of the cargo tank at the place of attachment. Each pad corner shall be rounded to a radius at least one-fourth the width of the pad, and no greater than one-half the width of the pad. Weep holes and telltale holes, if used shall be drilled or punched before the pads are attached to the cargo tank. Each pad shall be attached to the cargo tank by continuous fillet welding using filler material having properties conforming to the recommendations of the maker of the shell and head material.

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-29, 38 FR 27598, Oct. 5, 1973; Amdt. 178-85, 51 FR 5977, Feb. 18, 1986; Amdt. 178-88, 52 FR 13046, Apr. 20, 1987; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-14 Gauging devices.

(a) *Liquid level gauging devices. See §173.315(h) of this subchapter.*

(b) Pressure gauges. (1) See §173.315(h) of this subchapter.

(2) Each cargo tank used in carbon dioxide, refrigerated liquid or nitrous oxide, refrigerated liquid service must be provided with a suitable pressure gauge. A shut-off valve must be installed between the pressure gauge and the cargo tank.

(c) *Orifices. See §173.315(h) (3) and (4) of this subchapter.*

[Amdt. 178-29, 38 FR 27599, Oct. 5, 1973, as amended by Amdt. 178-89, 54 FR 25018, June 12, 1989; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-15 Pumps and compressors.

(a) Liquid pumps or gas compressors, if used, must be of suitable design, adequately protected against breakage by collision, and kept in good condition. They may be driven by motor vehicle power take-off or other mechanical, electrical, or hydraulic means. Unless they are of the centrifugal type, they shall be equipped with suitable pressure actuated by-pass valves permitting flow from discharge to suction or to the cargo tank.

(b) A liquid chlorine pump may not be installed on a cargo tank intended for the transportation of chlorine.

[Amdt. 178-89, 54 FR 25018, June 12, 1989, as amended by Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-16 Testing.

(a) *Inspection and tests. Inspection of materials of construction of the cargo tank and its appurtenances and original test and inspection of the finished cargo tank and its appurtenances must be as required by the ASME Code and as further required by this specification except that for cargo tanks constructed in accordance with part UHT of the ASME Code the original test pressure must be at least twice the cargo tank design pressure.*

(b) Weld testing and inspection. (1) Each cargo tank constructed in accordance with part UHT of the ASME Code must be subjected, after postweld heat treatment and hydrostatic tests, to a wet fluorescent magnetic particle inspection to be made on all welds in or on the cargo tank shell and heads both inside and out. The method of inspection must conform to Appendix VI of the ASME Code, paragraph UA-70 through UA-72 except that permanent magnets shall not be used.

(2) On cargo tanks of over 3,500 gallons water capacity other than those described in paragraph (b)(1) of this section unless fully radiographed, a test must be made of all welds in or on the shell and heads both inside and outside by either the wet fluorescent magnetic particle method conforming to appendix VI of the ASME Code, liquid dye penetrant method, or ultrasonic testing in accordance with appendix U of the ASME Code. Permanent magnets must not be used to perform the magnetic particle inspection.

(c) All defects found shall be repaired, the cargo tanks shall then again be postweld heat treated, if such heat treatment was previously performed, and the repaired areas shall again be tested.

[Order 59-B, 30 FR 582, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.337-17 Marking.

(a) *Metal identification plate. Each cargo tank built after July 1, 1985 shall have a corrosion resistant metal plate permanently affixed by brazing or welding around its perimeter, on the left side (on the right side prior to July 1, 1985) near the front, in a place readily accessible for inspection. It must be maintained in a legible condition. On multi-cargo tank motor vehicles plates shall be attached to each cargo tank at the front in a place readily accessible for inspection. Each insulated cargo tank shall have an additional plate, as described, affixed to the jacket in the location specified. Neither the plate itself nor the means of attachment to the cargo tank or jacket may be subject to attack by the cargo tank contents. If the plate is attached directly to the cargo tank by welding it shall be welded thereto before the cargo tank is postweld heat treated. The plate shall be plainly marked by stamping, embossing, or other means of forming letters into the metal of the plate, with the following information in addition to that required by the ASME Code, in characters at least $^{3/8}$ inch high:*

Vehicle manufacturer.
Vehicle manufacturer's serial number.
D.O.T. specification number MC-331.
Vessel material specification number.
Water capacity in pounds (see Note 1).
Original test date.

Note 1: See §173.315(a) of this chapter regarding water capacity.

(b) Each cargo tank must also be marked as required by §172.328 of this subchapter.

[Order 59-B, 30 FR 582, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-17, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.337-18 Certification.

(a) At or before the time of delivery, the cargo tank motor vehicle manufacturer must

supply and the owner must obtain, a cargo tank motor vehicle manufacturer's data report as required by the ASME Code, and a certificate stating that the completed cargo tank motor vehicle conforms in all respects to Specification MC 331 and the ASME Code. The registration numbers of the manufacturer, the Design Certifying Engineer, and the Registered Inspector, as appropriate, must appear on the certificates (see subpart F, part 107 in subchapter A of this chapter).
(1) For each design type, the certificate must be signed by a responsible official of the manufacturer and a Design Certifying Engineer; and
(2) For each cargo tank motor vehicle, the certificate must be signed by a responsible official of the manufacturer and a Registered Inspector.
(3) The certificate must state whether or not it includes certification that all valves, piping, and protective devices conform to the requirements of the specification. If it does not so certify, the installer of any such valve, piping, or device shall supply and the owner shall obtain a certificate asserting complete compliance with these specifications for such devices. The certificate, or certificates, will include sufficient sketches, drawings, and other information to indicate the location, make, model, and size of each valve and the arrangement of all piping associated with the cargo tank.
(4) The certificate must contain a statement indicating whether or not the cargo tank was postweld heat treated for anhydrous ammonia as specified in §178.337-1(f).
(b) The owner shall retain the copy of the data report and certificates and related papers in his files throughout his ownership of the cargo tank motor vehicle and for at least one year thereafter; and in the event of change in ownership, retention by the prior owner of nonfading photographically reproduced copies will be deemed to satisfy this requirement. Each motor carrier using the cargo tank motor vehicle, if not the owner thereof, shall obtain a copy of the data report and certificate and retain them in his files during the time he uses the cargo tank motor vehicle and for at least one year thereafter.

[Order 59-B, 30 FR 583, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.337-18, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.338 Specification MC-338; insulated cargo tank motor vehicle.

§178.338-1 General requirements.
(a) For the purposes of this section-
(1) *Design pressure means the "maximum allowable working pressure" as used in the ASME Code, and is the gauge pressure at the top of the tank.*

(2) Design service temperature means the coldest temperature for which the tank is suitable (see §§173.318 (a)(1) and (f) of this subchapter).
(b) Each cargo tank must consist of a suitably supported welded inner vessel enclosed within an outer shell or jacket, with insulation between the inner vessel and outer shell or jacket, and having piping, valves, supports and other appurtenances as specified in this subchapter. For the purpose of this specification, tank means inner vessel and jacket means either the outer shell or insulation cover.
(c) Each tank must be designed and constructed to meet the requirements of the ASME Code.
(1) The design pressure of the tank must be at least 25.3 psig but not more than 500 psig. To determine the required thicknesses of the parts of the tank, the static head of the lading shall be added to the design pressure. If the jacket is evacuated, the tank must be designed for a pressure of 14.7 psi, plus the lading static head, higher than its design pressure. The jacket must be designed in accordance with paragraph (e) or (f) of this section, as appropriate.
(2) The design service temperature of the tank, piping and valves may not be warmer than the liquefaction temperature at one atmosphere of the lading to be transported (see §§173.318 (a)(1) and (f) of this subchapter).
(3) Design and construction details of the tank interior may not allow collection and retention of cleaning materials or contaminants. To preclude the entrapment of foreign material, the design and construction of the tank must allow washing of all interior surfaces by the normal surging of the lading during transportation.
(d) The exterior surface of the tank must be insulated with a material compatible with the lading.
(1) Each cargo tank must have an insulation system that will prevent the tank pressure from exceeding the pressure relief valve set pressure within the specified holding time when the tank is loaded with the specific cryogenic liquid at the design conditions of-
(i) The specified temperature and pressure of the cryogenic liquid, and
(ii) The exposure of the filled cargo tank to an average ambient temperature of 85 ^{o}F.
(2) For a cargo tank used to transport oxygen, the insulation may not sustain combustion in a 99.5 percent oxygen atmosphere at atmospheric pressure when contacted with a continuously heated glowing platinum wire. The cargo tank must be marked in accordance with §178.338-18(b)(7).
(3) Each vacuum-insulated cargo tank must be provided with a connection for a vacuum gauge to indicate the absolute pressure within the insulation space.
(e) The insulation must be completely covered by a metal jacket. The jacket or the insulation must be so constructed and sealed as to prevent moisture from coming into contact with the insulation (see §173.318(a)(3) of this subchapter). Minimum metal thicknesses are as follows:

Type metal	Jacket evacuated		Jacket not evacuated	
-	Gauge	Inc	Gauge	Inches

		hes		
Stainless steel	18	0.0428	22	0.0269
Low carbon mild steel	12	0.0946	14	0.0677
Aluminum	-	0.125	-	0.1000

(f) An evacuated jacket must be in compliance with the following requirements:
(1) The jacket must be designed to sustain a minimum critical collapsing pressure of 30 psi.
(2) If the jacket also supports additional loads, such as the weight of the tank and lading, the combined stress, computed according to the formula in §178.338-3(b), may not exceed 25 percent of the minimum specified tensile strength.

[Amdt. 178-77, 48 FR 27703, June 16, 1983, as amended at 49 FR 24316, June 12, 1984; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.338-2 Material.
(a) All material used in the construction of a tank and its appurtenances that may come in contact with the lading must be compatible with the lading to be transported. All material used for tank pressure parts must conform to the requirements of the ASME Code. All material used for evacuated jacket pressure parts must conform to the chemistry and steelmaking practices of one of the material specifications of Section II of the ASME Code or the following ASTM Specifications: A 242, A 441, A 514, A 572, A 588, A 606, A 607, A 633, A 715.
(b) All tie-rods, mountings, and other appurtenances within the jacket and all piping, fittings and valves must be of material suitable for use at the lowest temperature to be encountered.
(c) Impact tests are required on all tank materials, except aluminum, and must be performed using the procedure prescribed in the ASME Code.
(d) The direction of final rolling of the shell material must be the circumferential orientation of the tank shell.
(e) Each tank constructed in accordance with part UHT of the ASME Code must be postweld heat treated as a unit after completion of all welds to the shell and heads. Other tanks must be postweld heat treated as required by the ASME Code. For all tanks the method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment.
(f) The fabricator shall record the heat and slab numbers and the certified Charpy impact values of each plate used in the tank on a sketch showing the location of each plate in the shell and heads of the tank. A copy of the sketch must be provided to the owner of the cargo tank and a copy must be retained by the fabricator for at least five

years and made available, upon request, to any duly identified representative of the Department.

(Approved by the Office of Management and Budget under control number 2137-0017)

[Amdt. 178-77, 48 FR 27703 and 27713, June 16, 1983, as amended at 49 FR 24316, June 12, 1984]

§178.338-3 Structural integrity.

(a) *General requirements and acceptance criteria. (1) Except as permitted in paragraph (d) of this section, the maximum calculated design stress at any point in the tank may not exceed the lesser of the maximum allowable stress value prescribed in section VIII of the ASME Code, or 25 percent of the tensile strength of the material used.*

(2) The relevant physical properties of the materials used in each tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.

(3) The maximum design stress at any point in the tank must be calculated separately for the loading conditions described in paragraphs (b), (c), and (d) of this section. Alternate test or analytical methods, or a combination thereof, may be used in lieu of the procedures described in paragraphs (b), (c), and (d) of this section, if the methods are accurate and verifiable.

(4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.

(b) The static design and construction of each tank must be in accordance with section VIII of the ASME Code. The tank design must include calculation of stresses due to design pressure, the weight of lading, the weight of structures supported by the tank wall, and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in calculation of the thermal stresses. Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G of the ASME Code.

(c) Stresses resulting from static and dynamic loadings, or a combination thereof, are not uniform throughout the cargo tank motor vehicle. The following is a simplified procedure for calculating the effective stress in the tank resulting from static and dynamic loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S = 0.5 (S_y + S_x) +(0.25(S_y - S_x)^2 + S_s2)^{0}.5$$

Where:

(1) S = effective stress at any given point under the most severe combination of static and dynamic loadings that can occur at the same time, in psi.
(2) S_y = circumferential stress generated by internal and external pressure when applicable, in psi.
(3) S_x = the net longitudinal stress, in psi, generated by the following loading conditions:
(i) The longitudinal tensile stress generated by internal pressure;
(ii) The tensile or compressive stress generated by the axial load resulting from a decelerative force applied independently to each suspension assembly at the road surface using applicable static loadings specified in §178.338-13 (b) and (c);
(iii) The tensile or compressive stress generated by the bending moment resulting from a decelerative force applied independently to each suspension assembly at the road surface using applicable static loadings specified in §178.338-13 (b) and (c);
(iv) The tensile or compressive stress generated by the axial load resulting from an accelerative force applied to the horizontal pivot of the fifth wheel supporting the vehicle using applicable static loadings specified in §178.338-13 (b) and (c);
(v) The tensile or compressive stress generated by the bending moment resulting from an accelerative force applied to the horizontal pivot of the fifth wheel supporting the vehicle using applicable static loadings specified in §178.338-13 (b) and (c); and
(vi) The tensile or compressive stress generated by a bending moment produced by a vertical force using applicable static loadings specified in §178.338-13 (b) and (c).
(4) S_s = The following shear stresses that apply, in psi,: The vectorial sum of the applicable shear stresses in the plane under consideration, including direct shear generated by the static vertical loading; direct lateral and torsional shear generated by a lateral accelerative force applied at the road surface, using applicable static loads specified in §178.338-13 (b) and (c)
(d) In order to account for stresses due to impact in an accident, the design calculations for the tank shell and heads must include the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of "2g". For this loading condition the stress value used may not exceed the lesser of the yield strength or 75 percent of the ultimate tensile strength of the material of construction. For a cargo tank constructed of stainless steel, the maximum design stress may not exceed 75 percent of the ultimate tensile strength of the type steel used.
(e) The minimum thickness of the shell or heads of the tank must be 0.187 inch for steel and 0.270 inch for aluminum. However, the minimum thickness for steel may be 0.110 inches provided the cargo tank is:
(1) Vacuum insulated, or
(2) Double walled with a load bearing jacket designed to carry a proportionate amount of structural loads prescribed in this section.

(f) Where a tank support is attached to any part of the tank wall, the stresses imposed on the tank wall must meet the requirements in paragraph (a) of this section.

(g) The design, construction, and installation of an appurtenance to the cargo tank or jacket must be such that, in the event of its damage or failure, the lading retention integrity of the tank will not be adversely affected.

(1) A lightweight attachment, such as a conduit clip, brakeline clip or placard holder, must be constructed of a material of lesser strength than the cargo tank wall or jacket material and may not be more than 72 percent of the thickness of the material to which it is attached. The attachment may be secured directly to the cargo tank wall or jacket if the device is designed and installed in such a manner that, if damaged, it will not affect the lading retention integrity of the tank. The lightweight attachment must be secured to the cargo tank wall or jacket by continuous weld or in such a manner as to preclude formation of pockets, which may become sites for incipient corrosion. Attachments conforming with this paragraph are not authorized for cargo tanks constructed under part UHT of the ASME Code.

(2) Except as prescribed in §178.338-3(g)(1), the welding of any appurtenance to the cargo tank wall or jacket must be made by attachment of a mounting pad, so that there will be no adverse affect upon the lading retention integrity of the tank if any force is applied to the appurtenance, from any direction. The thickness of the mounting pad may not be less than that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.187 inch may be used when the shell or head thickness is over 0.187 inch. If weep holes or tell tale holes are used, the pad must be drilled or punched at its lowest point before it is welded. Each pad must-

(i) Extend at least 2 inches in each direction from any point of attachment of an appurtenance;

(ii) Be attached by a continuous weld around the pad except for a small gap at the lowest point for draining.

[Amdt. 178-89, 55 FR 37057, Sept. 7, 1990, as amended by Amdt. 178-89, 56 FR 27876, June 17, 1991; 56 FR 46354, Sept. 11, 1991]

§178.338-4 Joints.

(a) All joints in the tank, and in the jacket if evacuated, must be as prescribed in the ASME Code, except that a butt weld with one plate edge offset is not authorized.

(b) Welding procedure and welder performance tests must be made in accordance with Section IX of the ASME Code. Records of the qualification must be retained by the tank manufacturer for at least five years and must be made available, upon request, to any duly identified representative of the Department, or the owner of the cargo tank.

(c) All longitudinal welds in tanks and load bearing jackets must be located so as not to intersect nozzles or supports other than load rings and stiffening rings.

(d) Substructures must be properly fitted before attachment and the welding sequence must minimize stresses due to shrinkage of welds.

(e) Filler material containing more than 0.05 percent vanadium may not be used with quenched and tempered steel.

(f) All tank nozzle-to-shell and nozzle-to-head welds must be full penetration welds.

(Approved by the Office of Management and Budget under control number 2137-0017)

[Amdt. 178-77, 48 FR 27704 and 27713, June 16, 1983, as amended at 49 FR 24316, June 12, 1984]

§178.338-5 Stiffening rings.

(a) A tank is not required to be provided with stiffening rings, except as prescribed in the ASME Code.

(b) If a jacket is evacuated, it must be constructed in compliance with §178.338-1(f). Stiffening rings may be used to meet these requirements.

[Amdt. 178-77, 48 FR 27704, June 16, 1983]

§178.338-6 Manholes.

(a) Each tank in oxygen service must be provided with a manhole as prescribed in the ASME Code.

(b) Each tank having a manhole must be provided with a means of entrance and exit through the jacket, or the jacket must be marked to indicate the manway location on the tank.

(c) A manhole with a bolted closure may not be located on the front head of the tank.

[Amdt. 178-77, 48 FR 27704, June 16, 1983, as amended at 49 FR 24316, June 12, 1984]

§178.338-7 Openings.

(a) The inlet to the liquid product discharge opening of each tank intended for flammable ladings must be at the bottom centerline of the tank.

(b) If the leakage of a single valve, except a pressure relief valve, pressure control valve, full trycock or gas phase manual vent valve, would permit loss of flammable material, an additional closure that is leak tight at the tank design pressure must be provided outboard of such valve.

[Amdt. 178-77, 48 FR 27704, June 16, 1983]

§178.338-8 Pressure relief devices, piping, valves, and fittings.

(a) *Pressure relief devices. Each tank pressure relief device must be designed, constructed, and marked in accordance with §173.318(b) of this subchapter.*

(b) Piping, valves, and fittings. (1) The burst pressure of all piping, pipe fittings, hoses and other pressure parts, except for pump seals and pressure relief devices, must be at least 4 times the design pressure of the tank. Additionally, the burst pressure may not be less than 4 times any higher pressure to which each pipe, pipe fitting, hose or other pressure part may be subjected to in service.

(2) Pipe joints must be threaded, welded or flanged. If threaded pipe is used, the pipe and fittings must be Schedule 80 weight or heavier. Malleable metals must be used in the construction of valves and fittings. Where copper tubing is permitted, joints shall be brazed or be of equally strong metal union type. The melting point of the brazing materials may not be lower than 1000 ^{o}F. The method of joining tubing may not reduce the strength of the tubing, such as by the cutting of threads.

(3) Each hose coupling must be designed for a pressure of at least 120 percent of the hose design pressure and so that there will be no leakage when connected.

(4) Piping must be protected from damage due to thermal expansion and contraction, jarring, and vibration. Slip joints are not authorized for this purpose.

(5) All piping, valves and fittings on a cargo tank must be proved free from leaks. This requirement is met when such piping, valves, and fittings have been tested after installation with gas or air and proved leak tight at not less than the design pressure marked on the cargo tank. This requirement is applicable to all hoses used in a cargo tank, except that hose may be tested before or after installation on the tank.

(6) Each valve must be suitable for the tank design pressure at the tank design service temperature.

(7) All fittings must be rated for the maximum tank pressure and suitable for the coldest temperature to which they will be subjected in actual service.

(8) All piping, valves, and fittings must be grouped in the smallest practicable space and protected from damage as required by §178.338-10.

(9) When a pressure-building coil is used on a tank designed to handle oxygen or flammable ladings, the vapor connection to that coil must be provided with a valve or check valve as close to the tank shell as practicable to prevent the loss of vapor from the tank in case of damage to the coil. The liquid connection to that coil must also be provided with a valve.

[Amdt. 178-77, 48 FR 27704, June 16, 1983, as amended by Amdt. 178-89, 54 FR 25019, June 12, 1989]

§178.338-9 Holding time.

(a) "Holding time" is the time, as determined by testing, that will elapse from loading until the pressure of the contents, under equilibrium conditions, reaches the level of the lowest pressure control valve or pressure relief valve setting.

(b) *Holding time test. (1) The test to determine holding time must be performed by charging the tank with a cryogenic liquid having a boiling point, at a pressure of one atmosphere, absolute, no lower than the design service temperature of the tank. The tank must be charged to its maximum permitted filling density with that liquid and stabilized to the lowest practical pressure, which must be equal to or less than the pressure to be used for loading. The cargo tank together with its contents must then be exposed to ambient temperature.*

(2) The tank pressure and ambient temperature must be recorded at 3-hour intervals until the pressure level of the contents reaches the set-to-discharge pressure of the pressure control valve or pressure relief valve with the lowest setting. This total time lapse in hours represents the measured holding time at the actual average ambient temperature. This measured holding time for the test cryogenic liquid must be adjusted to an equivalent holding time for each cryogenic liquid that is to be identified on or adjacent to the specification plate, at an average ambient temperature of 85 ^{o}F. This is the rated holding time (RHT). The marked rated holding time (MRHT) displayed on or adjacent to the specification plate (see §78.338-18(b)(9)) may not exceed this RHT.

(c) *Optional test regimen. (1) If more than one cargo tank is made to the same design, only one cargo tank must be subjected to the full holding time test at the time of manufacture. However, each subsequent cargo tank made to the same design must be performance tested during its first trip. The holding time determined in this test may not be less than 90 percent of the marked rated holding time. This test must be performed in accordance with §§173.318(g)(3) and 177.840(h) of this subchapter, regardless of the classification of the cryogenic liquid.*

(2) Same design. The term "same design" as used in this section means cargo tanks made to the same design type. See §178.320(a)(3) for definition of "design type".

(3) For a cargo tank used in nonflammable cryogenic liquid service, in place of the holding time tests prescribed in paragraph (b) of this section, the marked rated holding time (MRHT) may be determined as follows:

(i) While the cargo tank is stationary, the heat transfer rate must be determined by measuring the normal evaporation rate (NER) of the test cryogenic liquid (preferably the lading, where feasible) maintained at approximately one atmosphere. The calculated heat transfer rate must be determined from:

$$q = [n(D\ h)(85-t_1)] / [t_s - t_f]$$

Where:

q = calculated heat transfer rate to cargo tank with lading, Btu/hr.

n = normal evaporation rate (NER), which is the rate of evaporation, determined by the test of a test cryogenic liquid in a cargo tank maintained at a pressure of approximately one atmosphere, absolute, lb/hr.

$D h$ = latent heat of vaporization of test fluid at test pressure, Btu/lb.
t_s = average temperature of outer shell during test, ^{o}F.
t_1 = equilibrium temperature of lading at maximum loading pressure, ^{o}F.
t_f = equilibrium temperature of test fluid at one atmosphere, ^{o}F.

(ii) The rated holding time (RHT) must be calculated as follows:

$$RHT = [(U_2 - U_1) W] / q$$

Where:

RHT = rated holding time, in hours
U_1 and U_2 = internal energy for the combined liquid and vapor lading at the pressure offered for transportation, and the set pressure of the applicable pressure control valve or pressure relief valve, respectively, Btu/lb.
W = total weight of the combined liquid and vapor lading in the cargo tank, pounds.
q = calculated heat transfer rate to cargo tank with lading, Btu/hr.

(iii) The MRHT (see §178.338-18(b)(9) of this subchapter) may not exceed the RHT.

[Amdt. 178-77, 48 FR 27704, June 16, 1983; 48 FR 50442, Nov. 1, 1983, as amended at 49 FR 24316, June 12, 1984; 49 FR 43965, Nov. 1, 1984; 59FR 55173, Nov. 3, 1994; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.338-10 Collision damage protection.

(a) All valves, fittings, pressure relief devices and other accessories to the tank proper, which are not isolated from the tank by closed intervening shut-off valves or check valves, must be installed within the motor vehicle framework or within a suitable collision resistant guard or housing, and appropriate ventilation must be provided. Each pressure relief device must be protected so that in the event of the upset of the vehicle onto a hard surface, the device's opening will not be prevented and its discharge will not be restricted.

(b) Each protective device or housing, and its attachment to the vehicle structure, must be designed to withstand static loading in any direction that it may be loaded as a result of front, rear, side, or sideswipe collision, or the overturn of the vehicle. The static loading shall equal twice the loaded weight of the tank and attachments. A safety factor of four, based on the tensile strength of the material, shall be used. The protective device or the housing must be made of steel at least $^{3/16}$-inch thick, or other material of equivalent strength.

(c) Each tank motor vehicle must be provided with at least one rear bumper designed to protect the cargo tank and piping in the event of a rear end collision. The bumper design must transmit the force of the collision directly to the chasis of the vehicle. The rear bumper and its attachments to the chasis must be designed to withstand a load equal to twice the weight of the loaded cargo tank and attachments, using a safety factor of four based on the tensile strength of the materials used, with such load being applied horizontally and parallel to the major axis of the cargo tank, or within 30 horizontal degrees thereof. The rear bumper dimensions must meet the requirements of §93.86 of this title and extend vertically to a height adequate to protect all valves and fittings located at the rear of the cargo tank from damage that could result in loss of lading.

(d) Every part of the loaded cargo tank, and any associated valve, pipe, enclosure, or protective device or structure (exclusive of wheel assemblies), must be at least 14 inches above level ground.

[Amdt. 178-77, 48 FR 27705, June 16, 1983, as amended at 49 FR 24316, June 12, 1984; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.338-11 Discharge control devices.

(a) Excess-flow valves are not required.

(b) Each liquid filling and liquid discharge line must be provided with a shut-off valve located as close to the tank as practicable. Unless this valve is manually operable at the valve, the line must also have a manual shut-off valve.

(c) Except for a cargo tank used to transport the following refrigerated liquids: argon, carbon dioxide, helium, krypton, neon, nitrogen, and xenon; each liquid filling and liquid discharge line must be provided with a remotely controlled self-closing shut-off valve. This requirement does not apply to a cargo tank motor vehicle certified before January 1, 1995, unless intended for use to transport flammable ladings. If pressure from a reservoir or from an engine driven pump or compressor is used to open this valve, the control must be of fail-safe design, spring-biased to stop the admission of such pressure. If the jacket is not evacuated, the seat of the valve must be inside the tank, in the opening nozzle or flange, or in a companion flange bolted to the nozzle. If the jacket is evacuated, the remotely controlled valve must be located as close to the tank as practicable.

(1) On a cargo tank with a capacity in excess of 3,500 gallons of water, each remotely controlled shut-off valve must be provided with remote means of automatic closure, both mechanical and thermal, installed at the ends of the cargo tank in at least two diagonally opposite locations. The thermal means shall consist of fusible elements actuated at a temperature not exceeding 250 ^{o}F., or equivalent devices. One means may be used to close more than one remotely controlled valve.

(2) On a cargo tank with a capacity of 3,500 gallons of water or less, each remotely controlled shut-off valve must be provided with at least one remote control station on the end of the cargo tank opposite the main control station. The remote control station must contain a manual means of closure. In addition, it may contain fusible elements actuated at a temperature not exceeding 250 ^{o}F., or equivalent devices. One means

may be used to close more than one remotely controlled valve.

[Amdt. 178-77, 48 FR 27705, June 16, 1983, as amended by Amdt. 178-105, 59 FR 55173, Nov. 3, 1994; 60 FR 17402, Apr. 5, 1995]

§178.338-12 Shear section.

Unless the valve is located in a rear cabinet forward of and protected by the bumper (see §178.338-10(c)), the design and installation of each valve, damage to which could result in loss of liquid or vapor, must incorporate a shear section or breakage groove adjacent to, and outboard of, the valve. The shear section or breakage groove must yield or break under strain without damage to the valve that would allow the loss of liquid or vapor. The protection specified in §178.338-10 is not a substitute for a shear section or breakage groove.

[Amdt. 178-77, 49 FR 24316, June 12, 1984]

§178.338-13 Supports and anchoring.

(a) All attachments of supports and bumpers to tanks and to load-bearing jackets must be made by means of pads of material similar to that of the tank or jacket, by load rings, or by bosses designed or gusseted to distribute the load. The pad must be at least $^{1/4}$-inch thick, or as thick as the tank or jacket material, if less, but shall in no case be thicker than the tank or jacket material. Each pad must extend at least four times its thickness, in each direction, beyond the weld attaching the support or bumper. Each pad must be preformed to an inside radius no greater than the outside radius of the tank or jacket at the place of attachment. Each pad corner must be rounded to a radius at least one-fourth the width of the pad and no greater than one-half the width of the pad. If weep holes or telltale holes are used, they must be drilled or punched before the pads are attached. Each pad must be attached to the tank or jacket by continuous fillet welding using filler material having properties conforming to the recommendations of the manufacturer of the tank or jacket material. Any fillet weld discontinuity may only be for the purpose of preventing an intersection between the fillet weld and a tank or jacket seam weld.

(b) A tank motor vehicle constructed so that the cargo tank constitutes in whole or in part the structural member used in place of a motor vehicle frame must have the tank or the jacket supported by external cradles or by load rings. A cargo tank mounted on a motor vehicle frame must have the tank or jacket supported by external cradles, load rings, or longitudinal members. If cradles are used, they must subtend at least 120 degrees of the cargo tank circumference. The design calculations for the supports and load bearing tank or jacket, and the support attachments must include beam stress, shear stress, torsion stress, bending moment, and acceleration stress for the loaded vehicle as a unit, using a safety factor of four, based on the tensile strength of the material, and static loadings that take into consideration the weight of the cargo tank and its attachments when filled to the design weight of the lading (see appendix G of the ASME Code). The effects of fatigue must also be considered in the calculations. Minimum static loadings must be as follows:

(1) For a vacuum-insulated cargo tank-

(i) Vertically downward of 2;

(ii) Vertically upward of 2;

(iii) Longitudinally of 2; and

(iv) Laterally of 2.

(2) For a nonvacuum-insulated cargo tank-

(i) Vertically downward of 3;

(ii) Vertically upward of 2;

(iii) Longitudinally of 2; and

(iv) Laterally of 2.

(c) When a loaded tank is supported within the vacuum jacket by structural members, the design calculations for the tank and its structural members must be based on a safety factor of four and the tensile strength of the material at ambient temperature. The enhanced tensile strength of the material at actual operating temperature may be substituted for the tensile strength at ambient temperature to the extent recognized in the ASME Code for static loadings. Static loadings must take into consideration the weight of the tank and the structural members when the tank is filled to the design weight of lading (see appendix G of the ASME Code). When load rings in the jacket are used for supporting the tank, they must be designed to carry the fully loaded tank at the specified static loadings, plus external pressure. Minimum static loadings must be as follows:

(1) Vertically downward of 2;

(2) Vertically upward of $1^{1/2}$;

(3) Longitudinally of $1^{1/2}$; and,

(4) Laterally of $1^{1/2}$.

[Amdt. 178-77, 48 FR 27705, June 16, 1983, as amended at 49 FR 24317, June 12, 1984]

§178.338-14 Gauging devices.

(a) *Liquid level gauging devices.*

(1) Unless a cargo tank is intended to be filled by weight, it must be equipped with one or more gauging devices, which accurately indicate the maximum permitted liquid level at the loading pressure, in order to provide a minimum of two percent outage below the inlet of the pressure control valve or pressure relief valve at the condition of incipient opening of that valve. A fixed-length dip tube, a fixed trycock line, or a differential pressure liquid level gauge must be used as the primary control for filling.

Other gauging devices, except gauge glasses, may be used, but not as the primary control for filling.

(2) The design pressure of each liquid level gauging device must be at least that of the tank.

(3) If a fixed length dip tube or trycock line gauging device is used, it must consist of a pipe or tube of small diameter equipped with a valve at or near the jacket and extending into the cargo tank to a specified filling height. The fixed height at which the tube ends in the cargo tank must be such that the device will function when the liquid reaches the maximum level permitted in loading.

(4) The liquid level gauging device used as a primary control for filling must be designed and installed to accurately indicate the maximum filling level at the point midway of the tank both longitudinally and laterally.

(b) *Pressure gauges. Each cargo tank must be provided with a suitable pressure gauge indicating the lading pressure and located on the front of the jacket so it can be read by the driver in the rear view mirror. Each gauge must have a reference mark at the cargo tank design pressure or the set pressure of the pressure relief valve or pressure control valve, whichever is lowest.*

(c) Orifices. All openings for dip tube gauging devices and pressure gauges in flammable cryogenic liquid service must be restricted at or inside the jacket by orifices no larger than 0.060-inch diameter. Trycock lines, if provided, may not be greater than $^{1/2}$-inch nominal pipe size.

[Amdt. 178-77, 48 FR 27706, June 16, 1983, as amended at 49 FR 24317, June 12, 1984]

§178.338-15 Cleanliness.

A cargo tank constructed for oxygen service must be thoroughly cleaned to remove all foreign material in accordance with CGA Pamphlet G-4.1. All loose particles from fabrication, such as weld beads, dirt, grinding wheel debris, and other loose materials, must be removed prior to the final closure of the manhole of the tank. Chemical or solvent cleaning with a material compatible with the intending lading must be performed to remove any contaminants likely to react with the lading.

[Amdt. 178-77, 48 FR 27706, June 16, 1983]

§178.338-16 Inspection and testing.

(a) *General. The material of construction of a tank and its appurtenances must be inspected for conformance to the ASME Code. The tank must be subjected to either a hydrostatic or pneumatic test. The test pressure must be one and one-half times the sum of the design pressure, plus static head of lading, plus 14.7 psi if subjected to* *external vacuum, except that for tanks constructed in accordance with Part UHT of the ASME Code the test pressure must be twice the design pressure.*

(b) Additional requirements for pneumatic test. A pneumatic test may be used in place of the hydrostatic test. Due regard for protection of all personnel should be taken because of the potential hazard involved in a pneumatic test. The pneumatic test pressure in the tank must be reached by gradually increasing the pressure to one-half of the test pressure. Thereafter, the test pressure must be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Then the pressure must be reduced to a value equal to four-fifths of the test pressure and held for a sufficient time to permit inspection of the cargo tank for leaks.

(c) Weld inspection. All tank shell or head welds subject to pressure shall be radiographed in accordance with the ASME Code. A tank which has been subjected to inspection by the magnetic particle method, the liquid penetrant method, or any method involving a material deposit on the interior tank surface, must be cleaned to remove any such residue by scrubbing or equally effective means, and all such residue and cleaning solution must be removed from the tank prior to final closure of the tank.

(d) Defect repair. All cracks and other defects must be repaired as prescribed by the ASME Code. The welder and the welding procedure must be qualified in accordance with the ASME Code. After repair, the tank must again be postweld heat-treated, if such heat treatment was previously performed, and the repaired areas must be retested.

(e) Verification must be made of the interior cleanliness of a tank constructed for oxygen service by means that assure that all contaminants that are likely to react with the lading have been removed as required by §178.338-15.

[Amdt. 178-77, 48 FR 27706, June 16, 1983, as amended at 49 FR 24317, June 12, 1984; 49 FR 42736, Oct. 24, 1984]

§178.338-17 Pumps and compressors.

(a) *Liquid pumps and gas compressors, if used, must be of suitable design, adequately protected against breakage by collision, and kept in good condition. They may be driven by motor vehicle power take-off or other mechanical, electrical, or hydraulic means. Unless they are of the centrifugal type, they shall be equipped with suitable pressure actuated by-pass valves permitting flow from discharge to suction to the tank.*

(b) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen, cryogenic liquid, may not be installed on any cargo tank used to transport oxygen, cryogenic liquid, unless the parts are anodized in accordance with ASTM Standard B 580.

[Amdt. 178-89, 54 FR 25020, June 12, 1989, as amended at 55 FR 37058, Sept. 7, 1990]

§178.338-18 Marking.

(a) *Nameplate. Each tank built after July 1, 1985 shall have a corrosion resistant metal plate permanently affixed by brazing or welding around its perimeter, on the left side (on the right side prior to July 1, 1985) near the front. If this nameplate is attached by welding, it must be welded before the tank is postweld heat-treated. The nameplate must be plainly marked by stamping, embossing, or other means of forming letters into the metal of the plate, in characters at least* $^{3/8}$*-inches high. The following information, in addition to that required by the ASME Code, must be included (parenthetical abbreviations may be used):*

(1) DOT Specification number MC-338 (DOT MC-338);

(2) Material specification number (Mat. Spec. No.);

(3) Maximum density of lading for which the tank is designed (Max. Dens. of Lading);

(4) Water capacity, in pounds net at 60 ^{o}F., with the tank at its coldest operating temperature, after deduction for the volume above the inlet to the pressure relief device or pressure control valve, structural members, baffles, piping, and other appurtenances inside the tank (W. Cap.); and

(5) Original test date (Orig. Test Date);

(b) *Specification plate. Each tank built after July 1, 1985 shall have an additional plate, in the form specified in paragraph (a) of this section. It must be welded, brazed, or riveted to the jacket on the left side (on the right side prior to July 1, 1985) near the front, or at the control station, in a position readily legible to operating personnel. It must be marked with the information specified in paragraph (a) of this section and in addition, in characters at least* $^{3/8}$*-inches high, the following (parenthetical abbreviations may be used):*

(1) Vehicle manufacturer (Veh. Mfr.);

(2) Manufacturer's vehicle serial number (Veh. No.);

(3) Lining material, if any (Lining);

(4) Date of manufacture (Date of Mfr.);

(5) Certificate date (Cert. Date);

(6) Design service temperature (Design Serv. Temp.);

(7) "Insulation for Oxygen Service" or "Not Authorized for Oxygen Service," as appropriate;

(8) Maximum weight of lading for which the cargo tank is designed, in pounds (Max. Net Wt. __ lbs.);

(9) Marked rated holding time for at least one cryogenic liquid, in hours, and the name of that cryogenic liquid (MRHT __ hrs, name of cryogenic liquid). MRHT markings for additional cryogenic liquids may be displayed on or adjacent to the specification plate.

(c) The design weight of lading used in determining the loading in §§178.338-3(b), 178.338-10 (b) and (c), and 178.338-13 (b) and (c) must be shown as the maximum weight of lading marking required by paragraph (b) of this section.

[Amdt. 178-77, 48 FR 27706, June 16, 1983, as amended at 49 FR 24317, June 12, 1984; Amdt. 178-83, 50 FR 11066, Mar. 19, 1985; Amdt. 178-85, 51 FR 5976, Feb. 18, 1986]

§178.338-19 Certification.

(a) At or before the time of delivery, the manufacturer of a cargo tank motor vehicle shall furnish to the owner of the completed vehicle the following:

(1) The tank manufacturer's data report as required by the ASME Code, and a certificate bearing the manufacturer's vehicle serial number stating that the completed cargo tank motor vehicle conforms to all applicable requirements of Specification MC 338, including the ASME Code in effect on the date (month, year) of certification. The registration numbers of the manufacturer, the Design Certifying Engineer, and the Registered Inspector, as appropriate, must appear on the certificates (See subpart F, part 107 in subchapter B of this chapter).

(i) For each design type, the certificate must be signed by a responsible official of the manufacturer and a Design Certifying Engineer; and

(ii) For each cargo tank motor vehicle, the certificate must be signed by a responsible official of the manufacturer and a Design Certifying Engineer;

(2) A photograph, pencil rub, or other facsimile of the plates required by paragraphs (a) and (b) of §178.338-18.

(b) In the case of a cargo tank vehicle manufactured in two or more stages, each manufacturer who performs a manufacturing operation on the incomplete vehicle or portion thereof shall furnish to the succeeding manufacturer, at or before the time of delivery, a certificate covering the particular operation performed by that manufacturer, and any certificates received from previous manufacturers, Registered Inspectors, and Design Certifying Engineers. The certificates must include sufficient sketches, drawings, and other information to indicate the location, make, model and size of each valve and the arrangement of all piping associated with the tank. Each certificate must be signed by an official of the manufacturing firm responsible for the portion of the complete cargo tank vehicle represented thereby, such as basic tank fabrication, insulation, jacket, or piping. The final manufacturer shall furnish the owner with all certificates, as well as the documents required by paragraph (a) of this section.

(c) The owner shall retain the data report, certificates, and related papers throughout his ownership of the cargo tank. In the event of change of ownership, the prior owner shall retain non-fading photographically reproduced copies of these documents for at least one year. Each operator using the cargo tank vehicle, if not the owner thereof, shall obtain a copy of the data report and the certificate or certificates and retain them during the time he uses the cargo tank and for at least one year thereafter.

(Approved by the Office of Management and Budget under control number 2137-0017)

[Amdt. 178-77, 48 FR 27707 and 27713, June 16, 1983, as amended by Amdt. 178-89, 55 FR 37058, Sept. 7, 1990; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; 62 FR 51561, Oct. 1, 1997]

§178.340-178.343 [Reserved]

§178.345 General design and construction requirements applicable to Specification DOT 406 (_3178.346), DOT 407 (_3178.347), and DOT 412 (_3178.348) cargo tank motor vehicles.

§178.345-1 General requirements.

(a) Specification DOT 406, DOT 407 and DOT 412 cargo tank motor vehicles must conform to the requirements of this section in addition to the requirements of the applicable specification contained in §§178.346, 178.347 or 178.348.

(b) All specification requirements are minimum requirements.

(c) *Definitions. The following terms apply to §§178.345, 178.346, 178.347 and 178.348.*

Appurtenance means any cargo tank accessory attachment that has no lading retention or containment function and provides no structural support to the cargo tank.

Baffle means a non-liquid-tight transverse partition device that deflects, checks or regulates fluid motion in a tank.

Bulkhead means a liquid-tight transverse closure at the ends of or between cargo tanks.

Charging line means a hose, tube, pipe, or similar device used to pressurize a tank with material other than the lading.

Companion flange means one of two mating flanges where the flange faces are in contact or separated only by a thin leak sealing gasket and are secured to one another by bolts or clamps.

Connecting structure means the structure joining two cargo tanks.

Constructed and certified in conformance with the ASME Code means the cargo tank is constructed and stamped in accordance with the ASME Code, and is inspected and certified by an Authorized Inspector.

Constructed in accordance with the ASME Code means the cargo tank is constructed in accordance with the ASME Code with the authorized exceptions (see §§178.346, 178.347, and 178.348) and is inspected and certified by a Registered Inspector.

External self-closing stop-valve means a self-closing stop-valve designed so that the self-stored energy source is located outside the cargo tank and the welded flange.

Extreme dynamic loading means the maximum single-acting loading a cargo tank motor vehicle may experience during its expected life, excluding accident loadings.

Flange means the structural ring for guiding or attachment of a pipe or fitting with another flange (companion flange), pipe, fitting or other attachment.

Inspection pressure means the pressure used to determine leak tightness of the cargo tank when testing with pneumatic pressure.

Internal self-closing stop-valve means a self-closing stop-valve designed so that the self-stored energy source is located inside the cargo tank or cargo tank sump, or within the welded flange, and the valve seat is located within the cargo tank or within one inch of the external face of the welded flange or sump of the cargo tank.

Lading means the hazardous material contained in a cargo tank.

Loading/unloading connection means the fitting in the loading/unloading line farthest from the loading/unloading outlet to which the loading/unloading hose or device is attached.

Loading/unloading outlet means the cargo tank outlet used for normal loading/unloading operations.

Loading/unloading stop-valve means the stop valve farthest from the cargo tank loading/unloading outlet to which the loading/unloading connection is attached.

Maximum allowable working pressure or MAWP. See §178.345-1(k).

Multi-specification cargo tank motor vehicle means a cargo tank motor vehicle equipped with two or more cargo tanks fabricated to more than one cargo tank specification.

Normal operating loading means the loading a cargo tank motor vehicle may be expected to experience routinely in operation.

Nozzle means the subassembly consisting of a pipe or tubular section with or without a welded or forged flange on one end.

Outlet means any opening in the shell or head of a cargo tank, (including the means for attaching a closure), except that the following are not outlets: A threaded opening securely closed during transportation with a threaded plug or a threaded cap, a flanged opening securely closed during transportation with a bolted or welded blank flange, a manhole, or gauging devices, thermometer wells, and safety relief devices.

Outlet stop-valve means the stop-valve at the cargo tank loading/unloading outlet.

Pipe coupling means a fitting with internal threads on both ends.

Rear bumper means the structure designed to prevent a vehicle or object from under-riding the rear of a motor vehicle. See §393.86 of this title.

Rear-end tank protection device means the structure designed to protect a cargo tank and any lading retention piping or devices in case of a rear end collision.

Sacrificial Device means an element, such as a shear section, designed to fail under load in order to prevent damage to any lading retention part or device. The device must break under strain at no more than 70 percent of the strength of the weakest piping element between the cargo tank and the sacrificial device. Operation of the sacrificial device must leave the remaining piping and its attachment to the cargo tank intact and capable of retaining lading.

Self-closing stop-valve means a stop-valve held in the closed position by means of self-stored energy, which opens only by application of an external force and which closes when the external force is removed.

Shear section means a sacrificial device fabricated in such a manner as to abruptly reduce the wall thickness of the adjacent piping or valve material by at least 30 percent.

Shell means the circumferential portion of a cargo tank defined by the basic design radius or radii excluding the closing heads.

Stop-valve means a valve that stops the flow of lading.

Sump means a protrusion from the bottom of a cargo tank shell designed to facilitate complete loading and unloading of lading.

Tank means a container, consisting of a shell and heads, that forms a pressure tight vessel having openings designed to accept pressure tight fittings or closures, but excludes any appurtenances, reinforcements, fittings, or closures.

Test pressure means the pressure to which a tank is subjected to determine pressure integrity.

Toughness of material means the capability of a material to absorb the energy represented by the area under the stress strain curve (indicating the energy absorbed per unit volume of the material) up to the point of rupture.

Vacuum cargo tank means a cargo tank that is loaded by reducing the pressure in the cargo tank to below atmospheric pressure.

Variable specification cargo tank means a cargo tank that is constructed in accordance with one specification, but which may be altered to meet another specification by changing relief device, closures, lading discharge devices, and other lading retention devices.

Void means the space between tank heads or bulkheads and a connecting structure.

Welded flange means a flange attached to the tank by a weld joining the tank shell to the cylindrical outer surface of the flange, or by a fillet weld joining the tank shell to a flange shaped to fit the shell contour.

(d) A manufacturer of a cargo tank must hold a current ASME certificate of authorization and must be registered with the Department in accordance with part 107, subpart F of this chapter.

(e) All construction must be certified by an Authorized Inspector or by a Registered Inspector as applicable to the cargo tank.

(f) Each cargo tank must be designed and constructed in conformance with the requirements of the applicable cargo tank specification. Each DOT 412 cargo tank with a maximum allowable working pressure greater than 15 psig, and each DOT 407 cargo tank with a maximum allowable working pressure greater than 35 psig must be "constructed and certified in conformance with the ASME Code" except as limited or modified by the applicable cargo tank specification. Other cargo tanks must be "constructed in accordance with the ASME Code", except as limited or modified by the applicable cargo tank specification.

(g) Requirements relating to parts and accessories on motor vehicles, which are contained in part 393 of the Federal Motor Carrier Safety Regulations of this title, are incorporated into these specifications.

(h) Any additional requirements prescribed in part 173 of this subchapter that pertain to the transportation of a specific lading are incorporated into these specifications.

(i) *Cargo tank motor vehicle composed of multiple cargo tanks.*

(1) A cargo tank motor vehicle composed of more than one cargo tank may be constructed with the cargo tanks made to the same specification or to different specifications. Each cargo tank must conform in all respects with the specification for which it is certified.

(2) The strength of the connecting structure joining multiple cargo tanks in a cargo tank motor vehicle must meet the structural design requirements in §178.345-3. Any void within the connecting structure must be vented to the atmosphere and have a drain located on the bottom centerline. Each drain must be accessible and must be kept open at all times. The drain in any void within the connecting structure of a carbon steel, self-supporting cargo tank may be either a single drain of at least 1.0 inch diameter, or two or more drains of at least 0.5 inch diameter, 6.0 inches apart, one of which is located on the bottom centerline.

(j) *Variable specification cargo tank. A cargo tank that may be physically altered to conform to another cargo tank specification must have the required physical alterations to convert from one specification to another clearly indicated on the variable specification plate.*

(k) Maximum Allowable Working Pressure (MAWP). The MAWP for each cargo tank must be greater than or equal to the largest of the following (the MAWP derived is the pressure to be used as prescribed in the ASME Code in the design of the tank):

(1) The pressure prescribed for the lading in part 173;

(2) Vapor pressure of the most volatile lading, at 115 ^{o}F (expressed in psig), plus the maximum static pressure exerted by the lading at the maximum lading density, plus any pressure exerted by a gas padding (including air in the ullage space or dome), if used; or

(3) The maximum pressure in the tank during loading or unloading.

[Amdt. 178-89, 54 FR 25020, June 12, 1989, as amended at 55 FR 37058, Sept. 7, 1990; Amdt. 178-105, 59 FR 55173, Nov. 3, 1994; Amdt. 178-118, 61 FR 51340, Oct. 1, 1996]

§178.345-2 Material and material thickness.

(a) All material for shell, heads, bulkheads, and baffles must conform to section II, parts A and B, of the ASME Code except as follows:

(1) The following steels are also authorized for cargo tanks "constructed in accordance with the ASME Code".

ASTM A 569
ASTM A 570
ASTM A 572
ASTM A 607
ASTM A 622

ASTM A 656
ASTM A 715

(2) Aluminum alloys suitable for fusion welding and conforming with the 0, H32 or H34 tempers of one of the following ASTM specifications may be used for cargo tanks "constructed in accordance with the ASME Code":

ASTM B-209 Alloy 5052
ASTM B-209 Alloy 5086
ASTM B-209 Alloy 5154
ASTM B-209 Alloy 5254
ASTM B-209 Alloy 5454
ASTM B-209 Alloy 5652

All heads, bulkheads and baffles must be of 0 temper (annealed) or stronger tempers. All shell materials shall be of H 32 or H 34 tempers except that the lower ultimate strength tempers may be used if the minimum shell thicknesses in the tables are increased in inverse proportion to the lesser ultimate strength.

(b) *Minimum thickness. The minimum thickness for the shell and heads must be such that the maximum stress levels specified in §178.345-3 of this subpart are not exceeded. In no case may the shell or head thickness be less than that specified in the applicable specification.*

(c) Corrosion or abrasion protection. When required by 49 CFR part 173 for a particular lading, a cargo tank or a part thereof, subject to thinning by corrosion or mechanical abrasion due to the lading, must be protected by providing the tank or part of the tank with a suitable increase in thickness of material, a lining or some other suitable method of protection.

(1) Corrosion allowance. Material added for corrosion allowance need not be of uniform thickness if different rates of attack can reasonably be expected for various areas of the cargo tank.

(2) Lining. Lining material must consist of a nonporous, homogeneous material not less elastic than the parent metal and substantially immune to attack by the lading. The lining material must be bonded or attached by other appropriate means to the cargo tank wall and must be imperforate when applied. Any joint or seam in the lining must be made by fusing the materials together, or by other satisfactory means.

[Amdt. 178-89, 54 FR 25021, June 12, 1989, as amended at 55 FR 37059, Sept. 7, 1990; 56 FR 27876, June 17, 1991; Amdt. 178-97, 57 FR 45465, Oct. 1, 1992; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-3 Structural integrity.

(a) *General requirements and acceptance criteria. (1) The maximum calculated design stress at any point in the cargo tank wall may not exceed the maximum allowable stress value prescribed in section VIII of the ASME Code, or 25 percent of the tensile strength of the material used at design conditions.*

(2) The relevant physical properties of the materials used in each cargo tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.

(3) The maximum design stress at any point in the cargo tank must be calculated separately for the loading conditions described in paragraphs (b) and (c) of this section. Alternate test or analytical methods, or a combination thereof, may be used in place of the procedures described in paragraphs (b) and (c) of this section, if the methods are accurate and verifiable.

(4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.

(b) *ASME Code design and construction. The static design and construction of each cargo tank must be in accordance with Section VIII, Division 1 of the ASME Code. The cargo tank design must include calculation of stresses generated by the MAWP, the weight of the lading, the weight of structures supported by the cargo tank wall and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in the calculation of thermal stresses.*

(1) Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with Appendix G of Section VIII, Division 1 of the ASME Code.

(2) Longitudinal compressive buckling stress for ASME certified vessels must be calculated using paragraph UG-23(b), Section VIII, Division 1 of the ASME Code. For cargo tanks not required to be certified in accordance with the ASME Code, compressive buckling stress may be calculated using alternative analysis methods which are accurate and verifiable. When alternative methods are used calculations must include both the static loads described in this paragraph and the dynamic loads described in paragraph (c) of this section.

(c) *Shell design. Shell stresses resulting from static or dynamic loadings, or combinations thereof, are not uniform throughout the cargo tank motor vehicle. The vertical, longitudinal, and lateral normal operating loadings can occur simultaneously and must be combined. The vertical, longitudinal and lateral extreme dynamic loadings occur separately and need not be combined.*

(1) Normal operating loadings. The following procedure addresses stress in the cargo tank shell resulting from normal operating loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S = 0.5(S_y + S_x) + [0.25(S_y-S_x)^2 + S_S2]^{0}.5$$

Where:

(i) S = effective stress at any given point under the combination of static and normal operating loadings that can occur at the same time, in psi.
(ii) S_y = circumferential stress generated by the MAWP and external pressure, when applicable, plus static head, in psi.
(iii) S_x = The following net longitudinal stress generated by the following static and normal operating loading conditions, in psi:
(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending stress generated by the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;
(B) The tensile or compressive stress resulting from normal operating longitudinal acceleration or deceleration. In each case, the forces applied must be 0.35 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:
(*1) The axial load generated by a decelerative force;*
(2) The bending moment generated by a decelerative force;
(3) The axial load generated by an accelerative force; and
(4) The bending moment generated by an accelerative force; and
(C) The tensile or compressive stress generated by the bending moment resulting from normal operating vertical accelerative force equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall.
(iv) S_S = The following shear stresses generated by the following static and normal operating loading conditions, in psi:
(A) The static shear stress resulting from the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;
(B) The vertical shear stress generated by a normal operating accelerative force

equal to 0.35 times the vertical reaction at the suspension assembly of a trailer; or the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;

(C) The lateral shear stress generated by a normal operating lateral accelerative force equal to 0.2 times the vertical reaction at each suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall; and

(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(1)(iv)(C) of this section.

(2) *Extreme dynamic loadings. The following procedure addresses stress in the cargo tank shell resulting from extreme dynamic loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:*

$S = 0.5(S_y + S_x) + [0.25(S_y - S_x)^2 + S_S\backslash 2^{]}G50.5$

Where:

(i) S = effective stress at any given point under a combination of static and extreme dynamic loadings that can occur at the same time, in psi.

(ii) S_y = circumferential stress generated by MAWP and external pressure, when applicable, plus static head, in psi.

(iii) S_x = the following net longitudinal stress generated by the following static and extreme dynamic loading conditions, in psi:

(A) The longitudinal stresses resulting from the MAWP and external pressure, when applicable, plus static head, in combination with the bending stress generated by the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the tank wall;

(B) The tensile or compressive stress resulting from extreme longitudinal acceleration or deceleration. In each case the forces applied must be 0.7 times the vertical reaction at the suspension assembly, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer during deceleration; or the horizontal pivot of the truck tractor or converter dolly fifth wheel, or the drawbar hinge on the fixed dolly during acceleration; or the anchoring and support members of a truck during acceleration and deceleration, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall. The following loadings must be included:

(*1) The axial load generated by a decelerative force;*
(2) The bending moment generated by a decelerative force;
(3) The axial load generated by an accelerative force; and
(4) The bending moment generated by an accelerative force; and
(C) The tensile or compressive stress generated by the bending moment resulting from an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or the anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall.
(iv) S_S = The following shear stresses generated by static and extreme dynamic loading conditions, in psi:
(A) The static shear stress resulting from the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;
(B) The vertical shear stress generated by an extreme vertical accelerative force equal to 0.7 times the vertical reaction at the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall;
(C) The lateral shear stress generated by an extreme lateral accelerative force equal to 0.4 times the vertical reaction at the suspension assembly of a trailer, applied at the road surface, and as transmitted to the cargo tank wall through the suspension assembly of a trailer, and the horizontal pivot of the upper coupler (fifth wheel) or turntable; or anchoring and support members of a truck, as applicable. The vertical reaction must be calculated based on the static weight of the fully loaded cargo tank motor vehicle, all structural elements, equipment and appurtenances supported by the cargo tank wall; and
(D) The torsional shear stress generated by the same lateral forces as described in paragraph (c)(2)(iv)(C) of this section.
(d) In no case may the minimum thickness of the cargo tank shells and heads be less than that prescribed in §178.346-2, §178.347-2, or §178.348-2, as applicable.
(e) For a cargo tank mounted on a frame or built with integral structural supports, the calculation of effective stresses for the loading conditions in paragraph (c) of this section may include the structural contribution of the frame or the integral structural supports.
(f) The design, construction, and installation of an appurtenance to the cargo tank must conform to the following requirements:
(1) Structural members, the suspension subframe, accident protection and external rings must be used as sites for attachment of appurtenances and other accessories to

the cargo tank, when practicable.

(2) A lightweight attachment to the cargo tank wall, such as a conduit clip, brakeline clip, skirting structure, lamp mounting bracket, or placard holder, must be of a construction having lesser strength than the cargo tank wall materials and may not be more than 72 percent of the thickness of the material to which it is attached. The lightweight attachment may be secured directly to the cargo tank wall if the device is designed and installed in such a manner that, if damaged, it will not affect the lading retention integrity of the tank. A lightweight attachment must be secured to the cargo tank shell or head by continuous weld or in such a manner as to preclude formation of pockets, which may become sites for incipient corrosion.

(3) Except as prescribed in paragraphs (g)(1) and (g)(2) of this section, the welding of any appurtenance to the cargo tank wall must be made by attachment of a mounting pad, so that there will be no adverse effect upon the lading retention integrity of the cargo tank if any force less than that prescribed in §178.345-8(b)(1) of this subchapter is applied from any direction. The thickness of the mounting pad may not be less than that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.187 inch may be used when the shell or head thickness is over 0.187 inch. If weep holes or tell-tale holes are used, the pad must be drilled or punched at its lowest point before it is welded. Each pad must-

(i) Extend at least 2 inches in each direction from any point of attachment of an appurtenance;

(ii) Have rounded corners, or otherwise be shaped in a manner to minimize stress concentrations on the shell or head; and

(iii) Be attached by a continuous weld around the pad except for a small gap at the lowest point for draining.

[Amdt. 178-89, 55 FR 37059, Sept. 7, 1990, as amended by Amdt. 178-89, 56 FR 27876, June 17, 1991; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994; Amdt. 178-105, 59 FR 55173, 55174 and 55175, Nov. 3, 1994; 60 FR 17402, Apr. 5, 1995; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-4 Joints.

(a) All joints between the cargo tank shell, heads, baffles, baffle attaching rings, and bulkheads must be welded in conformance with the ASME Code welding procedures.

(b) Where practical all welds must be easily accessible for inspection.

[Amdt. 178-89, 54 FR 25022, June 12, 1989, as amended by Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-5 Manhole assemblies.

(a) Each cargo tank with capacity greater than 400 gallons must be accessible through a manhole at least 15 inches in diameter.

(b) Each manhole, fill opening and washout assembly must be structurally capable of withstanding, without leakage or permanent deformation that would affect its structural integrity, a static internal fluid pressure of at least 36 psig, or cargo tank test pressure, whichever is greater. The manhole assembly manufacturer shall verify compliance with this requirement by hydrostatically testing at least one percent (or one manhole closure, whichever is greater) of all manhole closures of each type produced each 3 months, as follows:

(1) The manhole, fill opening, or washout assembly must be tested with the venting devices blocked. Any leakage or deformation that would affect the product retention capability of the assembly shall constitute a failure.

(2) If the manhole, fill opening, or washout assembly tested fails, then five more covers from the same lot must be tested. If one of these five covers fails, then all covers in the lot from which the tested covers were selected are to be 100% tested or rejected for service.

(c) Each manhole, filler and washout cover must be fitted with a safety device that prevents the cover from opening fully when internal pressure is present.

(d) Each manhole and fill cover must be secured with fastenings that will prevent opening of the covers as a result of vibration under normal transportation conditions or shock impact due to a rollover accident on the roadway or shoulder where the fill cover is not struck by a substantial obstacle.

(e) Each manhole cover must be permanently marked by stamping or other means with:

(1) Manufacturer's name;

(2) Test pressure __ psig;

(3) A statement certifying that the manhole cover meets the requirements in §178.345-5.

(f) All fittings and devices mounted on a manhole cover, coming in contact with the lading, must withstand the same static internal fluid pressure and contain the same permanent compliance markings as that required for the manhole cover. The fitting or device manufacturer shall verify compliance using the same test procedure and frequency of testing as specified in §178.345-5(b).

[Amdt. 178-89, 54 FR 25022, June 12, 1989, as amended by Amdt. 178-105, 59 FR 55175, Nov. 3, 1994]

§178.345-6 Supports and anchoring.

(a) A cargo tank with a frame not integral to the cargo tank must have the tank secured by restraining devices to eliminate any motion between the tank and frame that may abrade the tank shell due to the stopping, starting, or turning of the cargo tank motor vehicle. The design calculations of the support elements must include the stresses indicated in §178.345-3(b) and as generated by the loads described in §178.345-3(c). Such restraining devices must be readily accessible for inspection and maintenance, except that insulation and jacketing are permitted to cover the restraining devices.

(b) A cargo tank designed and constructed so that it constitutes, in whole or in part, the structural member used in lieu of a frame must be supported in such a manner that the resulting stress levels in the cargo tank do not exceed those specified in §178.345-3(a). The design calculations of the support elements must include the stresses indicated in §178.345-3(b) and as generated by the loads described in §178.345-3(c).

[Amdt. 178-89, 54 FR 25023, June 12, 1989, as amended by Amdt. 178-105, 59 FR 55175, Nov. 3, 1994; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-7 Circumferential reinforcements.

(a) A cargo tank with a shell thickness of less than 3/8 inch must be circumferentially reinforced with bulkheads, baffles, ring stiffeners, or any combination thereof, in addition to the cargo tank heads.

(1) Circumferential reinforcement must be located so that the thickness and tensile strength of the shell material in combination with the frame and reinforcement produces structural integrity at least equal to that prescribed in §178.345-3 and in such a manner that the maximum unreinforced portion of the shell does not exceed 60 inches. For cargo tanks designed to be loaded by vacuum, spacing of circumferential reinforcement may exceed 60 inches provided the maximum unreinforced portion of the shell conforms with the requirements of Section VIII, Division 1 of the ASME Code.

(2) Where circumferential joints are made between conical shell sections, or between conical and cylindrical shell sections, and the angle between adjacent sections is less than 160 degrees, circumferential reinforcement must be located within one inch of the shell joint, unless otherwise reinforced with structural members capable of maintaining shell stress levels authorized in §178.345-3. When the joint is formed by the large ends of adjacent conical shell sections, or by the large end of a conical shell and a cylindrical shell section, this angle is measured inside the shell; when the joint is formed by the small end of a conical shell section and a cylindrical shell section, it is measured outside the shell.

(b) Except for doubler plates and knuckle pads, no reinforcement may cover any circumferential joint.

(c) When a baffle or baffle attachment ring is used as a circumferential reinforcement member, it must produce structural integrity at least equal to that prescribed in §178.345-3 and must be circumferentially welded to the cargo tank shell. The welded portion may not be less than 50 percent of the total circumference of the cargo tank and the length of any unwelded space on the joint may not exceed 40 times the shell thickness unless reinforced external to the cargo tank.

(d) When a ring stiffener is used as a circumferential reinforcement member, whether internal or external, reinforcement must be continuous around the circumference of the cargo tank shell and must be in accordance with the following:

(1) The section modulus about the neutral axis of the ring section parallel to the shell must be at least equal to that derived from the applicable formula:

I/C = 0.00027WL, for MS, HSLA and SS; or
I/C = 0.000467WL, for aluminum alloys;

Where:

I/C = Section modulus in inches ^{3}
W = Tank width, or diameter, inches
L = Spacing of ring stiffener, inches; i.e., the maximum longitudinal distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener.

(2) If a ring stiffener is welded to the cargo tank shell, a portion of the shell may be considered as part of the ring section for purposes of computing the ring section modulus. This portion of the shell may be used provided at least 50 percent of the total circumference of the cargo tank is welded and the length of any unwelded space on the joint does not exceed 40 times the shell thickness. The maximum portion of the shell to be used in these calculations is as follows:

Number of circumferential ring stiffener-to-shell welds	J	Shell section
1	-	20t
2	Less than 20t	20t+J
2	20t or more	40t

[1]where:
t=Shell thickness, inches;
J=Longitudinal distance between parallel circumferential ring stiffener-to-shell welds.

(3) When used to meet the vacuum requirements of this section, ring stiffeners must be as prescribed in the ASME Code.

(4) If configuration of internal or external ring stiffener encloses an air space, this air space must be arranged for venting and be equipped with drainage facilities which must be kept operative at all times.

(5) Hat shaped or open channel ring stiffeners which prevent visual inspection of the cargo tank shell are prohibited on cargo tank motor vehicles constructed of carbon steel.

[Amdt. 178-89, 55 FR 37060, Sept. 7, 1990; as amended by Amdt. 178-89, 56 FR 27876, June 17, 1991; 56 FR 46354, Sept. 11, 1991; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-8 Accident damage protection.

(a) *General. Each cargo tank motor vehicle must be designed and constructed in accordance with the requirements of this section and the applicable individual specification to minimize the potential for the loss of lading due to an accident.*

(1) Any dome, sump, or washout cover plate projecting from the cargo tank wall that retains lading in any tank orientation, must be as strong and tough as the cargo tank wall and have a thickness at least equal to that specified by the appropriate cargo tank specification. Any such projection located in the lower $^{1/3}$ of the tank circumference (or cross section perimeter for non-circular cargo tanks) that extends more than half its diameter at the point of attachment to the tank or more than 4 inches from the cargo tank wall, or located in the upper $^{2/3}$ of the tank circumference (or cross section perimeter for non-circular cargo tanks) that extends more than $^{1/4}$ its diameter or more than 2 inches from the point of attachment to the tank must have accident damage protection devices that are:

(i) As specified in this section;

(ii) 125 percent as strong as the otherwise required accident damage protection device; or

(iii) Attached to the cargo tank in accordance with the requirements of paragraph (a)(3) of this section.

(2) Outlets, valves, closures, piping, or any devices that if damaged in an accident could result in a loss of lading from the cargo tank must be protected by accident damage protection devices as specified in this section.

(3) Accident damage protection devices attached to the wall of a cargo tank must be able to withstand or deflect away from the cargo tank the loads specified in this section. They must be designed, constructed and installed so as to maximize the distribution of loads to the cargo tank wall and to minimize the possibility of adversely affecting the lading retention integrity of the cargo tank. Accident induced stresses resulting from the appropriate accident damage protection device requirements in combination with the stresses from the cargo tank operating at the MAWP may not result in a cargo tank wall stress greater than the ultimate strength of the material of construction using a safety factor of 1.3. Deformation of the protection device is acceptable provided the devices being protected are not damaged when loads specified in this section are applied.

(4) Any piping that extends beyond an accident damage protection device must be equipped with a stop-valve and a sacrificial device such as a shear section. The sacrificial device must be located in the piping system outboard of the stop-valve and within the accident damage protection device to prevent any accidental loss of lading. The device must break at no more than 70 percent of the load that would be required to cause the failure of the protected lading retention device, part or cargo tank wall. The

failure of the sacrificial device must leave the protected lading retention device and its attachment to the cargo tank wall intact and capable of retaining product.

(5) *Minimum road clearance. The minimum allowable road clearance of any cargo tank motor vehicle component or protection device located between any two adjacent axles on a vehicle or vehicle combination must be at least one-half inch for each foot separating such axles, and in no case less than 12 inches.*

(b) Each outlet, projection or piping located in the lower $^{1/3}$ of the cargo tank circumference (or cross section perimeter for non-circular cargo tanks) that could be damaged in an accident that may result in the loss of lading must be protected by a bottom damage protection device, except as provided by paragraph (a)(1) of this section and §173.33(e) of this subchapter. Outlets, projections and piping may be grouped or clustered together and protected by a single protection device.

(1) Any bottom damage protection device must be able to withstand a force of 155,000 pounds (based on the ultimate strength of the material) from the front, side, or rear, uniformly distributed over each surface of the device, over an area not to exceed 6 square feet, and a width not to exceed 6 feet. Suspension components and structural mounting members may be used to provide all, or part, of this protection. The device must extend no less than 6 inches beyond any component that may contain lading in transit.

(2) A lading discharge opening equipped with an internal self-closing stop-valve need not conform to paragraph (b)(1) of this section provided it is protected so as to reasonably assure against the accidental loss of lading. This protection must be provided by a sacrificial device located outboard of each internal self-closing stop-valve and within 4 inches of the major radius of the cargo tank shell or within 4 inches of a sump, but in no case more than 8 inches from the major radius of the tank shell. The device must break at no more than 70 percent of the load that would be required to cause the failure of the protected lading retention device, part or cargo tank wall. The failure of the sacrificial device must leave the protected lading retention device or part and its attachment to the cargo tank wall intact and capable of retaining product.

(c) Each closure for openings, including but not limited to the manhole, filling or inspection openings, and each valve, fitting, pressure relief device, vapor recovery stop valve or lading retaining fitting located in the upper $^{2/3}$ of a cargo tank circumference (or cross section perimeter for non-circular tanks) must be protected by being located within or between adjacent rollover damage protection devices, or by being 125 percent of the strength that would be provided by the otherwise required damage protection device.

(1) A rollover damage protection device on a cargo tank motor vehicle must be designed and installed to withstand loads equal to twice the weight of the loaded cargo tank motor vehicle applied as follows: normal to the cargo tank shell (perpendicular to the cargo tank surface); and tangential (perpendicular to the normal load) from any direction. The stresses shall not exceed the ultimate strength of the material of construction. These design loads may be considered to be uniformly distributed and independently applied. If more than one rollover protection device is used, each device must be capable of carrying its proportionate share of the required loads and in each case at least one-fourth the total tangential load. The design must be proven capable of

carrying the required loads by calculations, tests or a combination of tests and calculations.

(2) A rollover damage protection device that would otherwise allow the accumulation of liquid on the top of the cargo tank, must be provided with a drain that directs the liquid to a safe point of discharge away from any structural component of the cargo tank motor vehicle.

(d) *Rear-end protection. Each cargo tank motor vehicle must be provided with a rear-end protection device to protect the cargo tank and piping in the event of a rear-end collision and reduce the likelihood of damage which could result in the loss of lading. The rear-end tank protection device must conform to the following requirements (Nothing in this paragraph shall be construed to relieve a manufacturer of responsibility for complying with the requirements of §393.86 of this title):*

(1) The rear-end cargo tank protection device must be designed so that it can deflect at least 6 inches horizontally forward with no contact between any part of the cargo tank motor vehicle which contains lading during transit and with any part of the rear-end protection device, or with a vertical plane passing through the outboard surface of the protection device.

(2) The dimensions of the rear-end cargo tank protection device shall conform to the following:

(i) The bottom surface of the rear-end protection device must be at least 4 inches below the lower surface of any part at the rear of the cargo tank motor vehicle which contains lading during transit and not more than 60 inches from the ground when the vehicle is empty.

(ii) The maximum width of a notch, indentation, or separation between sections of a rear-end cargo tank protection device may not exceed 24 inches. A notched, indented, or separated rear-end protection device may be used only when the piping at the rear of the cargo tank is equipped with a sacrificial device outboard of a shut-off valve.

(iii) The widest part of the motor vehicle at the rear may not extend more than 18 inches beyond the outermost ends of the device or (if separated) devices on either side of the vehicle.

(3) The structure of the rear-end protection device and its attachment to the vehicle must be designed to satisfy the conditions specified in paragraph (d)(1) of this section when subjected to an impact of the cargo tank motor vehicle at rated payload, at a deceleration of 2 "g". Such impact must be considered as being uniformly applied in the horizontal plane at an angle of 10 degrees or less to the longitudinal axis of the vehicle.

(e) *Longitudinal deceleration protection. In order to account for stresses due to longitudinal impact in an accident, the cargo tank shell and heads must be able to withstand the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 "g". For this loading condition, the allowable stress value used may not exceed the ultimate strength of the material of construction using a safety factor of 1.3. Performance testing, analytical methods, or a combination thereof, may be used to prove this capability provided the methods are accurate and verifiable. For cargo tanks with internal baffles, the decelerative force may be reduced by 0.25 "g" for each baffle assembly, but in no case may the total reduction* *in decelerative force exceed 1.0 "g".*

[Amdt. 178-89, 54 FR 25023, June 12, 1989, as amended at 55 FR 37061, Sept. 7, 1990; Amdt. 178-105, 59 FR 55175, Nov. 3, 1994; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-9 Pumps, piping, hoses and connections.

(a) Suitable means must be provided during loading or unloading operations to ensure that pressure within a cargo tank does not exceed test pressure.

(b) Each hose, piping, stop-valve, lading retention fitting and closure must be designed for a bursting pressure of the greater of 100 psig or four times the MAWP.

(c) Each hose coupling must be designed for a bursting pressure of the greater of 120 psig or 4.8 times the MAWP of the cargo tank, and must be designed so that there will be no leakage when connected.

(d) Suitable provision must be made to allow for and prevent damage due to expansion, contraction, jarring, and vibration. Slip joints may not be used for this purpose in the lading retention system.

(e) Any heating device, when installed, must be so constructed that the breaking of its external connections will not cause leakage of the cargo tank lading.

(f) Any gauging, loading or charging device, including associated valves, must be provided with an adequate means of secure closure to prevent leakage.

(g) The attachment and construction of each loading/unloading or charging line must be of sufficient strength, or be protected by a sacrificial device, such that any load applied by loading/unloading or charging lines connected to the cargo tank cannot cause damage resulting in loss of lading from the cargo tank.

(h) Use of a nonmetallic pipe, valve or connection that is not as strong and heat resistant as the cargo tank material is authorized only if such attachment is located outboard of the lading retention system.

[Amdt. 178-89, 54 FR 25025, June 12, 1989, as amended at 55 FR 37061, Sept. 7, 1990, Amdt. 178-89, 56 FR 27877, June 17, 1991; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-10 Pressure relief.

(a) Each cargo tank must be equipped to relieve pressure and vacuum conditions in conformance with this section and the applicable individual specification. The pressure and vacuum relief system must be designed to operate and have sufficient capacity to prevent cargo tank rupture or collapse due to over-pressurization or vacuum resulting from loading, unloading, or from heating and cooling of lading.

(b) *Type and construction of relief systems and devices. (1) Each cargo tank must be* *provided with a primary pressure relief system consisting of one or more reclosing pressure relief valves. A secondary pressure relief system consisting of another pressure relief valve in parallel with the primary pressure relief system may be used to augment the total venting capacity of the cargo tank. Non-reclosing pressure relief devices are not authorized in any cargo tank except when in series with a reclosing pressure relief device. Gravity actuated reclosing valves are not authorized on any cargo tank.*

(2) When provided by §173.33(c)(1)(iii) of this subchapter, cargo tanks may be equipped with a normal vent. Such vents must be set to open at not less than 1 psig and must be designed to prevent loss of lading through the device in case of vehicle overturn.

(3) Each pressure relief system must be designed to withstand dynamic pressure surges in excess of the design set pressure as specified in paragraphs (b)(3) (i) and (ii) of this section. Set pressure is a function of MAWP as set forth in paragraph (d) of this section.

(i) Each pressure relief device must be able to withstand dynamic pressure surge reaching 30 psig above the design set pressure and sustained above the set pressure for at least 60 milliseconds with a total volume of liquid released not exceeding one gallon before the relief device recloses to a leak-tight condition. This requirement must be met regardless of vehicle orientation. This capability must be demonstrated by testing. An acceptable test procedure is outlined in TTMA RP No. 81-"Performance of Spring Loaded Pressure Relief Valves on MC 306, MC 307, and MC 312 Tanks," May 24, 1989 edition.

(ii) After August 31, 1995, each pressure relief device must be able to withstand a dynamic pressure surge reaching 30 psig above the design set pressure and sustained above the design set pressure for at least 60 milliseconds with a total volume of liquid released not exceeding one liter before the relief valve recloses to a leak-tight condition. This requirement must be met regardless of vehicle orientation. This capability must be demonstrated by testing. TTMA RP No. 81, cited in paragraph (b)(3)(i) of this section, is an acceptable test procedure.

(4) Each reclosing pressure relief valve must be constructed and installed in such a manner as to prevent unauthorized adjustment of the relief valve setting.

(5) No shut-off valve or other device that could prevent venting through the pressure relief system may be installed in a pressure relief system.

(6) The pressure relief system must be mounted, shielded and drainable so as to minimize the accumulation of material that could impair the operation or discharge capability of the system by freezing, corrosion or blockage.

(c) *Location of relief devices. Each pressure relief device must communicate with the vapor space above the lading as near as practicable to the center of the vapor space. For example, on a cargo tank designed to operate in a level attitude, the device should be positioned at the horizontal and transverse center of the cargo tank; on cargo tanks sloped to the rear, the device should be located in the forward half of the cargo tank. The discharge from any device must be unrestricted. Protective devices which deflect the flow of vapor are permissible provided the required vent capacity is maintained.*

(d) Settings of pressure relief system. The set pressure of the pressure relief system is the pressure at which it starts to open, allowing discharge.

(1) Primary pressure relief system. The set pressure of each primary relief valve must be no less than 120 percent of the MAWP, and no more than 132 percent of the MAWP. The valve must reclose at not less than 108 percent of the MAWP and remain closed at lower pressures.

(2) Secondary pressure relief system. The set pressure of each pressure relief valve used as a secondary relief device must be not less than 120 percent of the MAWP.

(e) Venting capacity of pressure relief systems. The pressure relief system (primary and secondary, including piping) must have sufficient venting capacity to limit the cargo tank internal pressure to not more than the cargo tank test pressure. The total venting capacity, rated at not more than the cargo tank test pressure, must be at least that specified in table I, except as provided in §178.348-10(d).

Table I-Minimum Emergency Vent Capacity
[In cubic feet free air/hour at 60 ^{o}F and 1 atm.]

Exposed area in square feet	Cubic feet free air per hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500
180	142,300
200	158,100
225	191,300
250	203,100
275	214,300
300	225,100
350	245,700
400	265,000
450	283,200
500	300,600
550	317,300
600	333,300
650	348,800
700	363,700
750	378,200
800	392,200
850	405,900
900	419,300
950	432,300

1,000	445,000

Note 1: Interpolate for intermediate sizes.

(1) *Primary pressure relief system. Unless otherwise specified in the applicable individual specification, the primary relief system must have a minimum venting capacity of 12,000 SCFH per 350 square feet of exposed cargo tank area, but in any case at least one fourth the required total venting capacity for the cargo tank.*

(2) Secondary pressure relief system. If the primary pressure relief system does not provide the required total venting capacity, additional capacity must be provided by a secondary pressure relief system.

(f) Certification of pressure relief devices. The manufacturer of any pressure relief device, including valves, frangible (rupture) disks, vacuum vents and combination devices must certify that the device model was designed and tested in accordance with this section and the appropriate cargo tank specification. The certificate must contain sufficient information to describe the device and its performance. The certificate must be signed by a responsible official of the manufacturer who approved the flow capacity certification.

(g) Rated flow capacity certification test. Each pressure relief device model must be successfully flow capacity certification tested prior to first use. Devices having one design, size and set pressure are considered to be one model. The testing requirements are as follows:

(1) At least 3 devices of each specific model must be tested for flow capacity at a pressure not greater than the test pressure of the cargo tank. For a device model to be certified, the capacities of the devices tested must fall within a range of plus or minus 5 percent of the average for the devices tested.

(2) The rated flow capacity of a device model may not be greater than 90 percent of the average value for the devices tested.

(3) The rated flow capacity derived for each device model must be certified by a responsible official of the device manufacturer.

(h) *Marking of pressure relief devices. Each pressure relief device must be permanently marked with the following:*

(1) Manufacturer's name;

(2) Model number;

(3) Set pressure, in psig; and

(4) Rated flow capacity, in SCFH at the rating pressure, in psig.

[Amdt. 178-89, 54 FR 25025, June 12, 1989, as amended at 55 FR 21038, May 22, 1990; 55 FR 37062, Sept. 7, 1990; Amdt. 178-89, 56 FR 27877, June 17, 1991; Amdt. 178-105, 59 FR 55175, Nov. 3, 1994; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-11 Tank outlets.

(a) *General. As used in this section, "loading/unloading outlet" means any opening in the cargo tank wall used for loading or unloading of lading, as distinguished from outlets such as manhole covers, vents, vapor recovery devices, and similar closures. Cargo tank outlets, closures and associated piping must be protected in accordance with §178.345-8.*

(b) Each cargo tank loading/unloading outlet must be equipped with an internal self-closing stop-valve, or alternatively, with an external stop-valve located as close as practicable to the cargo tank wall. Each cargo tank loading/unloading outlet must be in accordance with the following provisions:

(1) Each loading/unloading outlet must be fitted with a self-closing system capable of closing all such outlets in an emergency within 30 seconds of actuation. During normal operations the outlets may be closed manually. The self-closing system must be designed according to the following:

(i) Each self-closing system must include a remotely actuated means of closure located more than 10 feet from the loading/unloading outlet where vehicle length allows, or on the end of the cargo tank farthest away from the loading/unloading outlet. The actuating mechanism must be corrosion-resistant and effective in all types of environment and weather.

(ii) If the actuating system is accidentally damaged or sheared off during transportation, each loading/unloading outlet must remain securely closed and capable of retaining lading.

(iii) When required by part 173 of this subchapter for materials which are flammable, pyrophoric, oxidizing, or Division 6.1 (poisonous liquid) materials, the remote means of closure must be capable of thermal activation. The means by which the self-closing system is thermally activated must be located as close as practicable to the primary loading/unloading connection and must actuate the system at a temperature not over 250 ^{o}F. In addition, outlets on these cargo tanks must be capable of being remotely closed manually or mechanically.

(2) Bottom loading outlets which discharge lading into the cargo tank through fixed internal piping above the maximum liquid level of the cargo tank need not be equipped with a self-closing system.

(c) Any loading/unloading outlet extending beyond an internal self-closing stop-valve, or beyond the innermost external stop-valve which is part of a self-closing system, must be fitted with another stop-valve or other leak-tight closure at the end of such connection.

(d) Each cargo tank outlet that is not a loading/unloading outlet must be equipped with a stop-valve or other leak-tight closure located as close as practicable to the cargo tank outlet. Any connection extending beyond this closure must be fitted with another stop-valve or other leak-tight closure at the end of such connection.

[Amdt. 178-89, 56 FR 27877, June 17, 1991, as amended by Amdt. 178-97, 57 FR 45465, Oct. 1, 1992; Amdt. 178-118, 61 FR 51341, Oct. 1, 1996]

§178.345-12 Gauging devices.

Each cargo tank, except a cargo tank intended to be filled by weight, must be equipped with a gauging device that indicates the maximum permitted liquid level to within 0.5 percent of the nominal capacity as measured by volume or liquid level. Gauge glasses are not permitted.

[Amdt. 178-89, 55 FR 37062, Sept. 7, 1990, as amended by Amdt. 178-118, 61 FR 51342, Oct. 1, 1996]

§178.345-13 Pressure and leakage tests.

(a) Each cargo tank must be pressure and leakage tested in accordance with this section and §§178.346-13(a), 178.347-13(a) or 178.348-13(a), as applicable.

(b) *Pressure test. Each cargo tank or cargo tank compartment must be tested hydrostatically or pneumatically. Each cargo tank of a multi-cargo tank motor vehicle must be tested with the adjacent cargo tanks empty and at atmospheric pressure. Each closure, except pressure relief devices and loading/unloading venting devices rated at less than the prescribed test pressure, must be in place during the test. If the venting device is not removed during the test, such device must be rendered inoperative by a clamp, plug or other equally effective restraining device, which may not prevent the detection of leaks, or damage the device. Restraining devices must be removed immediately after the test is completed.*

(1) Hydrostatic method. Each cargo tank, including its domes, must be filled with water or other liquid having similar viscosity, the temperature of which may not exceed 100 ^{o}F. The cargo tank must then be pressurized as prescribed in the applicable specification. The pressure must be gauged at the top of the cargo tank. The prescribed test pressure must be maintained for at least 10 minutes during which time the cargo tank must be inspected for leakage, bulging, or other defect.

(2) Pneumatic method. A pneumatic test may be used in place of the hydrostatic test. However, pneumatic pressure testing may involve higher risk than hydrostatic testing. Therefore, suitable safeguards must be provided to protect personnel and facilities should failure occur during the test. The cargo tank must be pressurized with air or an inert gas. Test pressure must be reached gradually by increasing the pressure to one half of test pressure. Thereafter, the pressure must be increased in steps of approximately one tenth of the test pressure until test pressure is reached. Test pressure must be held for at least 5 minutes. The pressure must then be reduced to the inspection pressure which must be maintained while the entire cargo tank surface is inspected for leakage and other sign of defects. The inspection method must consist of coating all joints and fittings with a solution of soap and water or other equally sensitive method.

(c) Leakage test. The cargo tank with all its accessories in place and operable must be leak tested at not less than 80 percent of tank's MAWP with the pressure maintained for at least 5 minutes.

(d) Any cargo tank that leaks, bulges or shows any other sign of defect must be rejected. Rejected cargo tanks must be suitably repaired and retested successfully prior to being returned to service. The retest after any repair must use the same method of test under which the cargo tank was originally rejected.

[Amdt. 178-89, 54 FR 25026, June 12, 1989, as amended at 55 FR 37063, Sept. 7, 1990; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994; Amdt. 178-118, 61 FR 51342, Oct. 1, 1996]

§178.345-14 Marking.

(a) *General. The manufacturer shall certify that each cargo tank motor vehicle has been designed, constructed and tested in accordance with the applicable Specification DOT 406, DOT 407 or DOT 412 (§§178.345, 178.346, 178.347, 178.348) cargo tank requirements, and when applicable, with the ASME Code. The certification shall be accomplished by marking the cargo tank as prescribed in paragraphs (b) and (c) of this section, and by preparing the certificate prescribed in §178.345-15. Metal plates prescribed by paragraphs (b), (c), (d) and (e) of this section, must be permanently attached to the cargo tank or its integral supporting structure, by brazing, welding or other suitable means. These plates must be affixed on the left side of the vehicle near the front of the cargo tank (or the frontmost cargo tank of a multi-cargo tank motor vehicle), in a place readily accessible for inspection. The plates must be permanently and plainly marked in English by stamping, embossing or other means in characters at least* $^{3/16}$ *inch high. The information required by paragraphs (b) and (c) of this section may be combined on one specification plate.*

(b) Nameplate. Each cargo tank must have a corrosion resistant nameplate permanently attached to it. The following information, in addition to any applicable information required by the ASME Code, must be marked on the tank nameplate (parenthetical abbreviations may be used):

(1) DOT Specification number DOT XXX (DOT XXX), where "XXX" is replaced with the applicable specification number.

(2) Original test date, month and year (Orig. Test Date).

(3) Tank maximum allowable working pressure (MAWP) in psig.

(4) Cargo tank test pressure (Test P), in psig.

(5) Cargo tank design temperature range (Design temp. range),_ ^{o}F to _ ^{o}F.

(6) Nominal capacity (Water cap.), in gallons.

(7) Maximum design density of lading (Max. lading density), in pounds per gallon.

(8) Material specification number-shell (Shell matl, yyy***), where "yyy" is replaced by the alloy designation and "***" by the alloy type.

(9) Material specification number-heads (Head matl, yyy***), where "yyy" is replaced by the alloy designation and "***" by the alloy type.

Note: When the shell and heads materials are the same thickness, they may be combined, (Shell&head matl, yyy***).

(10) Weld material (Weld matl.).
(11) Minimum thickness-shell (Min. shell-thick), in inches. When minimum shell thicknesses are not the same for different areas, show (top _, side _, bottom _, in inches).
(12) Minimum thickness-heads (Min. heads thick.), in inches.
(13) Manufactured thickness-shell (Mfd. shell thick.), top _, side _, bottom _, in inches. (Required when additional thickness is provided for corrosion allowance.)
(14) Manufactured thickness-heads (Mfd. heads thick.), in inches. (Required when additional thickness is provided for corrosion allowance.)
(15) Exposed surface area, in square feet.
(c) *Specification plate. Each cargo tank motor vehicle must have an additional corrosion resistant metal specification plate attached to it. The specification plate must contain the following information (parenthetical abbreviations may be used):*
(1) Cargo tank motor vehicle manufacturer (CTMV mfr.).
(2) Cargo tank motor vehicle certification date (CTMV cert. date), if different from the cargo tank certification date.
(3) Cargo tank manufacturer (CT mfr.).
(4) Cargo tank date of manufacture (CT date of mfr.), month and year.
(5) Maximum weight of lading (Max. payload), in pounds.
(6) Maximum loading rate in gallons per minute (Max. load rate, GPM) at maximum loading pressure __ psig.
(7) Maximum unloading rate in gallons per minute (Max. unload rate, GPM), at maximum unloading pressure __ psig.
(8) Lining material (Lining), if applicable.
(9) Heating system design pressure (Heating sys. press.), in psig, if applicable.
(10) Heating system design temperature (Heating sys. temp.), in ^{o}F, if applicable.
(d) *Multi-cargo tank motor vehicle. For a multi-cargo tank motor vehicle having all its cargo tanks not separated by any void, the information required by paragraphs (b) and (c) of this section may be combined on one specification plate. When separated by a void, each cargo tank must have an individual nameplate as required in paragraph (b) of this section, unless all cargo tanks are made by the same manufacturer with the same materials, manufactured thickness, minimum thickness and to the same specification. The cargo tank motor vehicle may have a combined nameplate and specification plate. When only one plate is used, the plate must be visible and not covered by insulation. The required information must be listed on the plate from front to rear in the order of the corresponding cargo tank location.*
(e) Variable specification cargo tank. Each variable specification cargo tank must have a corrosion resistant metal variable specification plate attached to it. The mounting of this variable specification plate must be such that only the plate identifying the applicable specification under which the tank is being operated is legible.
(1) The following information must be included (parenthetical abbreviations are

authorized):

Specification DOT XXX (DOT XXX), where "XXX" is replaced with the applicable specification number.

Equipment required	Required rating
Pressure relief devices:	-
Pressure actuated type	______
Frangible type	______
Lading discharge devices	______
Top	______
Bottom	______
Pressure unloading fitting	______
Closures:	-
Manhole	______
Fill openings	______
Discharge openings	______

[1]Required rating-to meet the applicable specification.

(2) If no change of information in the specification plate is required, the letters "NC" must follow the rating required. If the cargo tank is not so equipped, the word "None" must be inserted.

(3) Those parts to be changed or added must be stamped with the appropriate MC or DOT Specification markings.

(4) The alterations that must be made in order for the tank to be modified from one specification to another must be clearly indicated on the manufacturer's certificate and on the variable specification plate.

[Amdt. 178-89, 54 FR 25027, June 12, 1989, as amended at 55 FR 37063, Sept. 7, 1990; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994; 60 FR 17402, Apr. 5, 1995; Amdt. 178-118, 61 FR 51342, Oct. 1, 1996]

§178.345-15 Certification.

(a) At or before the time of delivery, the manufacturer of a cargo tank motor vehicle must provide certification documents to the owner of the cargo tank motor vehicle. The registration numbers of the manufacturer, the Design Certifying Engineer, and the Registered Inspector, as appropriate, must appear on the certificates (see subpart F, part 107 in subchapter A of this chapter).

(b) The manufacturer of a cargo tank motor vehicle made to any of these specifications must provide:

(1) For each design type, a certificate signed by a responsible official of the manufacturer and a Design Certifying Engineer certifying that the cargo tank motor

vehicle design meets the applicable specification; and

(2) For each ASME cargo tank, a cargo tank manufacturer's data report as required by the ASME Code. For each cargo tank motor vehicle, a certificate signed by a responsible official of the manufacturer and a Registered Inspector certifying that the cargo tank motor vehicle is constructed, tested and completed in conformance with the applicable specification.

(c) The manufacturer of a variable specification cargo tank motor vehicle must provide:

(1) For each design type, a certificate signed by a responsible official of the manufacturer and a Design Certifying Engineer certifying that the cargo tank motor vehicle design meets the applicable specifications; and

(2) For each variable specification cargo tank motor vehicle, a certificate signed by a responsible official of the manufacturer and a Registered Inspector certifying that the cargo tank motor vehicle is constructed, tested and completed in conformance with the applicable specifications. The certificate must include all the information required and marked on the variable specification plate.

(d) In the case of a cargo tank motor vehicle manufactured in two or more stages, each manufacturer who performs a manufacturing operation on the incomplete vehicle or portion thereof shall provide to the succeeding manufacturer, at or before the time of delivery, a certificate covering the particular operation performed by that manufacturer, including any certificates received from previous manufacturers, Registered Inspectors, and Design Certifying Engineers. Each certificate must indicate the portion of the complete cargo tank motor vehicle represented thereby, such as basic cargo tank fabrication, insulation, jacket, lining, or piping. The final manufacturer shall provide all applicable certificates to the owner.

(e) *Specification shortages. If a cargo tank is manufactured which does not meet all applicable specification requirements, thereby requiring subsequent manufacturing involving the installation of additional components, parts, appurtenances or accessories, the cargo tank manufacturer may affix the name plate and specification plate, as required by §178.345-14 (b) and (c), without the original date of certification stamped on the specification plate. The manufacturer shall state the specification requirements not complied with on the manufacturer's Certificate of Compliance. When the cargo tank is brought into full compliance with the applicable specification, the Registered Inspector shall stamp the date of compliance on the specification plate. The Registered Inspector shall issue a Certificate of Compliance stating details of the particular operations performed on the cargo tank, and the date and person (manufacturer, carrier, or repair organization) accomplishing the compliance.*

[Amdt. 178-89, 55 FR 37063, Sept. 7, 1990, as amended by Amdt. 178-98, 58 FR 33306, June 16, 1993; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994; Amdt. 178-118, 61 FR 51342, Oct. 1, 1996]

§178.346 Specification DOT 406; cargo tank motor vehicle.

§178.346-1 General requirements.

(a) Each Specification DOT 406 cargo tank motor vehicle must meet the general design and construction requirements in §178.345, in addition to the specific requirements contained in this section.

(b) *Maximum Allowable Working Pressure: The MAWP of each cargo tank must be no lower than 2.65 psig and no higher than 4 psig.*

(c) Vacuum loaded cargo tanks must not be constructed to this specification.

(d) Each cargo tank must be "constructed in accordance with the ASME Code" except as modified herein:

(1) The record-keeping requirements contained in the ASME Code Section VIII, Division I do not apply. Parts UG-90 thru 94 of Section VIII, Division I do not apply. Inspection and certification must be made by an inspector registered in accordance with subpart F of part 107.

(2) Loadings must be as prescribed in §178.346-3.

(3) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of UG-32 do not apply. Shell sections of cargo tanks designed with a non-circular cross section need not be given a preliminary curvature, as prescribed in UG-79(b).

(4) Marking, certification, data reports, and nameplates must be as prescribed in §§178.345-14, 178.346-14, 178.345-15, and 178.346-15.

(5) Manhole closure assemblies must conform to §§178.345-5 and 178.346-5.

(6) Pressure relief devices must be as prescribed in §§178.345-10 and 178.346-10.

(7) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13 and 178.346-13.

(8) The following paragraphs in parts UG and UW of the ASME Code, Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f) and the dimensional requirements found in Figure UW-13.1.

(9) Single full fillet lap joints without plug welds may be used for arc or gas welded longitudinal seams without radiographic examination under the following conditions:

(i) For a truck-mounted cargo tank, no more than two such joints may be used on the top half of the tank and no more than two joints may be used on the bottom half. They may not be located farther from the top and bottom centerline than 16 percent of the shell's circumference.

(ii) For a self-supporting cargo tank, no more than two such joints may be used on the top of the tank. They may not be located farther from the top centerline than 12.5 percent of the shell's circumference.

(iii) *Compliance test. Two test specimens of the material to be used in the* *manufacture of a cargo tank must be tested to failure in tension. The test specimens must be of the same thicknesses and joint configuration as the cargo tank, and joined by the same welding procedures. The test specimens may represent all the tanks that are made of the same materials and welding procedures, have the same joint configuration, and are made in the same facility within 6 months after the tests are completed. Before welding, the fit-up of the joints on the test specimens must represent production conditions that would result in the least joint strength. Evidence of joint fit-up and test results must be retained at the manufacturers' facility.*

(iv) Weld joint efficiency. The lower value of stress at failure attained in the two tensile test specimens shall be used to compute the efficiency of the joint as follows: Determine the failure ratio by dividing the stress at failure by the mechanical properties of the adjacent metal; this value, when multiplied by 0.75, is the design weld joint efficiency.

(10) The requirements of paragraph UW-9(d), of Section VIII, Division 1, ASME Code do not apply.

[Amdt. 178-89, 54 FR 25028, June 12, 1989, as amended at 55 FR 37063, Sept. 7, 1990; Amdt. 178-89, 56 FR 27877, June 17, 1991; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994]

§178.346-2 Material and thickness of material.

The type and thickness of material for DOT 406 cargo tank motor vehicles must conform to §178.345-2 of this part, but may in no case be less than that indicated in tables I and II below.

Table I-Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming

Material	Volume capacity in gallons per inch of length								
-	14 or less			Over 14 to 23			Over 23		
-	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Thickness	.100	.100	.160	.115	.115	.173	.129	.129	.187

Table II-Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming[1]

Cargo tank motor vehicle rated capacity (gallons)	MS	SS/HSLA	AL
More than 0 to at least 4,500	0.100	0.100	0.151
More than 4,500 to at least 8,000	0.115	0.100	0.160
More than 8,000 to at least 14,000	0.129	0.129	0.173
More than 14,000	0.143	0.143	0.187

[1]Maximum distance between bulkheads, baffles, or ring stiffeners shall not exceed 60 inches.

[Amdt. 178-89, 54 FR 25028, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994]

§178.346-3 Pressure relief.

(a) Each cargo tank must be equipped with a pressure relief system in accordance with §178.345-10 and this section.

(b) *Type and construction. In addition to the pressure relief devices required in §178.345-10:*

(1) Each cargo tank must be equipped with one or more vacuum relief devices;

(2) When intended for use only for lading meeting the requirements of §173.33(c)(1)(iii) of this subchapter, the cargo tank may be equipped with a normal vent. Such vents must be set to open at not less than 1 psig and must be designed to prevent loss of lading through the device in case of vehicle upset; and

(3) Notwithstanding the requirements in §178.345-10(b), after August 31, 1996, each pressure relief valve must be able to withstand a dynamic pressure surge reaching 30 psig above the design set pressure and sustained above the set pressure for at least 60 milliseconds with a total volume of liquid released not exceeding one liter before the relief valve recloses to a leak-tight condition. This requirement must be met regardless of vehicle orientation. This capability must be demonstrated by testing. TTMA RP No. 81, cited at §178.345-10(b)(3)(i), is an acceptable test procedure.

(c) *Pressure settings of relief valves. (1) Notwithstanding the requirements in §178.345-10(d), the set pressure of each primary relief valve must be not less than 110 percent of the MAWP or 3.3 psig, whichever is greater, and not more than 138 percent of the MAWP. The valve must close at not less than the MAWP and remain closed at lower pressures.*

(2) Each vacuum relief device must be set to open at no more than 6 ounces vacuum.

(d) *Venting capacities. (1) Notwithstanding the requirements in §178.345-10 (e) and (g), the primary pressure relief valve must have a venting capacity of at least 6,000 SCFH, rated at not greater than 125 percent of the tank test pressure and not greater than 3 psig above the MAWP. The venting capacity required in §178.345-10(e) may be rated at these same pressures.*

(2) Each vacuum relief system must have sufficient capacity to limit the vacuum to 1 psig.

(3) If pressure loading or unloading devices are provided, the relief system must have adequate vapor and liquid capacity to limit the tank pressure to the cargo tank test pressure at maximum loading or unloading rate. The maximum loading and unloading rates must be included on the metal specification plate.

[Amdt. 178-89, 54 FR 25029, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.346-4 Outlets.

(a) All outlets on each tank must conform to §178.345-11 and this section.

(b) External self-closing stop-valves are not authorized as an alternative to internal self-closing stop-valves on loading/unloading outlets.

[Amdt. 178-89, 54 FR 25029, June 12, 1989. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.346-5 Pressure and leakage tests.

(a) Each cargo tank must be tested in accordance with §178.345-13 and this section.

(b) *Pressure test. Test pressure must be as follows:*

(1) Using the hydrostatic test method, the test pressure must be the greater of 5.0 psig or 1.5 times the cargo tank MAWP.

(2) Using the pneumatic test method, the test pressure must be the greater of 5.0 psig or 1.5 times the cargo tank MAWP, and the inspection pressure must be the cargo tank MAWP.

(c) *Leakage test. Cargo tanks equipped with vapor collection equipment may be leakage tested in accordance with the Environmental Protection Agency's "Method 27-Determination of Vapor Tightness of Gasoline Delivery Tank Using Pressure-Vacuum Test," as set forth in 40 CFR part 60, appendix A. Acceptance criteria are found at 40 CFR 60.501 and 60.601.*

[Amdt. 178-89, 54 FR 25029, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990; Amdt. 178-105, 59 FR 55176, Nov. 3, 1994. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.347 Specification DOT 407; cargo tank motor vehicle.

§178.347-1 General requirements.

(a) Each specification DOT 407 cargo tank motor vehicle must conform to the general design and construction requirements in §178.345 in addition to the specific requirements contained in this section.

(b) Each tank must be of a circular cross-section and have an MAWP of at least 25 psig.

(c) Any cargo tank built to this specification with a MAWP greater than 35 psig and each tank designed to be loaded by vacuum must be "constructed and certified in accordance with the ASME Code ". The external design pressure for a cargo tank loaded by vacuum must be at least 15 psi.

(d) Each cargo tank built to this specification with MAWP of 35 psig or less must be "constructed in accordance with the ASME Code" except as modified herein:

(1) The record-keeping requirements contained in the ASME Code, Section VIII, Division I, do not apply. The inspection requirements of parts UG-90 thru 94 do not apply. Inspection and certification must be made by an inspector registered in accordance with subpart F of part 107.

(2) Loadings must be as prescribed in §178.347-3.

(3) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of UG-32 do not apply for cargo tank motor vehicles with a MAWP of 35 psig or less.

(4) Marking, certification, data reports and nameplates must be as prescribed in §§178.345-14, 178.347-14, 178.345-15, and 178.347-15.

(5) Manhole closure assemblies must conform to §§178.345-5 and 178.347-5.

(6) Pressure relief devices must be as prescribed in §§178.345-10 and 178.347-10.

(7) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13 and 178.347-13.

(8) The following paragraphs in parts UG and UW of the ASME Code, Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f), and the dimensional requirements found in Figure UW-13.1.

[Amdt. 178-89, 54 FR 25029, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990; Amdt. 178-89, 56 FR 27877, June 17, 1991]

§178.347-2 Material and thickness of material.

(a) The type and thickness of material for DOT 407 specification cargo tanks must conform to §178.345-2 and this section. In no case may the thickness be less than that indicated in tables I and II below.

Table I-Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming

Volume capacity in gallons per inch	10 or less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Thickness (MS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (HSLA)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (SS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (AL)	0.160	0.160	0.173	0.187	0.194	0.216	0.237

Table II-Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming

Volume capacity in gallons per inch	10 or less	Over 10 to 14	Over 14 to 18	Over 18 to 22	Over 22 to 26	Over 26 to 30	Over 30
Thickness (MS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (HSLA)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (SS)	0.100	0.100	0.115	0.129	0.129	0.143	0.156
Thickness (AL)	0.151	0.151	0.160	0.173	0.194	0.216	0.237

(b) [Reserved]
[Amdt. 178-89, 54 FR 25030, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994]

§178.347-3 Manhole assemblies.

Each manhole assembly must conform to §178.345-5, except that each manhole assembly must be capable of withstanding internal fluid pressures of 40 psig or test pressure of the tank, whichever is greater.

[Amdt. 178-89, 54 FR 25030, June 12, 1989. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.347-4 Pressure relief.

(a) Each cargo tank must be equipped with a pressure and vacuum relief system in accordance with §178.345-10 and this section.

(b) *Type and Construction. Vacuum relief devices are not required for cargo tanks designed to be loaded by vacuum or built to withstand full vacuum.*

(c) Pressure settings of relief valves. The setting of pressure relief valves must be in accordance with §178.345-10(d).

(d) Venting capacities. (1) The vacuum relief system must limit the vacuum to less than 80 percent of the design vacuum capability of the cargo tank.

(2) If pressure loading or unloading devices are provided, the relief system must have adequate vapor and liquid capacity to limit the tank pressure to the cargo tank test pressure at maximum loading or unloading rate. The maximum loading or unloading rate must be included on the metal specification plate.

[Amdt. 178-89, 54 FR 25030, June 12, 1989, as amended at 55 FR 37064, Sept. 7, 1990. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.347-5 Pressure and leakage test.

(a) Each cargo tank must be tested in accordance with §178.345-13 and this section.

(b) *Pressure test. Test pressure must be as follows:*

(1) Using the hydrostatic test method, the test pressure must be at least 40 psig or 1.5 times tank MAWP, whichever is greater.

(2) Using the pneumatic test method, the test pressure must be 40 psig or 1.5 times tank MAWP, whichever is greater, and the inspection pressure is tank MAWP.

[Amdt. 178-89, 54 FR 25030, June 12, 1989. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.348 Specification DOT 412; cargo tank motor vehicle.

§178.348-1 General requirements.

(a) Each specification DOT 412 cargo tank motor vehicle must conform to the general design and construction requirements in §178.345 in addition to the specific requirements of this section.

(b) The MAWP of each cargo tank must be at least 5 psig.

(c) The MAWP for each cargo tank designed to be loaded by vacuum must be at least 25 psig internal and 15 psig external.

(d) Each cargo tank having a MAWP greater than 15 psig must be of circular cross-section.

(e) Each cargo tank having a-

(1) MAWP greater than 15 psig must be "constructed and certified in conformance with the ASME Code"; or

(2) MAWP of 15 psig or less must be "constructed in accordance with the ASME Code," except as modified herein:

(i) The recordkeeping requirements contained in the ASME Code, Section VIII, Division I, do not apply. Parts UG-90 thru 94 of Section VIII, Division I do not apply. Inspection and certification must be made by an inspector registered in accordance with subpart F of part 107.

(ii) Loadings must be as prescribed in §178.348-3.

(iii) The knuckle radius of flanged heads must be at least three times the material thickness, and in no case less than 0.5 inch. Stuffed (inserted) heads may be attached to the shell by a fillet weld. The knuckle radius and dish radius versus diameter limitations of UG-32 do not apply for cargo tank motor vehicles with a MAWP of 15 psig or less. Shell sections of cargo tanks designed with a non-circular cross section need not be given a preliminary curvature, as prescribed in UG-79(b).

(iv) Marking, certification, data reports, and nameplates must be as prescribed in §§178.345-14, 178.348-14, 178.345-15, and 178.348-15.

(v) Manhole closure assemblies must conform to §§178.345-5 and 178.348-5.

(vi) Pressure relief devices must be as prescribed in §§178.345-10 and 178.348-10.

(vii) The hydrostatic or pneumatic test must be as prescribed in §§178.345-13 and 178.348-13.

(viii) The following paragraphs in parts UG and UW of the ASME Code, Section VIII, Division I do not apply: UG-11, UG-12, UG-22(g), UG-32(e), UG-34, UG-35, UG-44, UG-76, UG-77, UG-80, UG-81, UG-96, UG-97, UW-13(b)(2), UW-13.1(f), and the dimensional requirements found in Figure UW-13.1.

[Amdt. 178-89, 54 FR 25031, June 12, 1989, as amended at 55 FR 37065, Sept. 7, 1990; Amdt. 178-89, 56 FR 27877, June 17, 1991]

§178.348-2 Material and thickness of material.

(a) The type and thickness of material for DOT 412 cargo tanks must conform to §178.345-2 of this part, but in no case may the thickness be less than that indicated in tables I and II below.

Table I-Minimum Thickness of Heads (or Bulkheads and Baffles When Used as Tank Reinforcement) Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming

Volume capacity (gallons per inch)	10 or less				Over 10 to 14				Over 14 to 18			18 and over		
														-
Lading density at 60 °F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (inch), steel	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.157	.250	.312
Thickness (inch), aluminum	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.227	.360	.450

Table II-Minimum Thickness of Shell Using Mild Steel (MS), High Strength Low Alloy Steel (HSLA) or Austenitic Stainless Steel (SS) or Aluminum (AL)-Expressed in Decimals of an Inch After Forming

Volume capacity in gallons per inch	10 or less				Over 10 to 14				Over 14 to 18			18 and over		
														-
Lading density at 60 °F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (steel):	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distances between heads (and bulkheads baffles and ring stiffeners when used as tank reinforcement):	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36 in. or less	.100	.129	.157	.187	.100	.129	.157	.187	.100	.129	.157	.129	.157	.187
Over 36 in. to 54 inches	.100	.129	.157	.187	.100	.129	.157	.187	.129	.157	.187	.157	.250	.250
Over 54 in. to 60 inches	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.187	.250	.312
Thickness (aluminum):	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distances between heads (and bulkheads baffles and ring stiffeners when used as tank reinforcement):	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36 in. or less	.144	.187	.227	.270	.144	.187	.227	.270	.144	.187	.227	.187	.227	.270
Over 36 in. to 54 inches	.144	.187	.227	.270	.144	.187	.227	.270	.187	.227	.270	.157	.360	.360
Over 54 in. to 60 inches	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.270	.360	.450

(b) [Reserved]

[Amdt. 178-89, 54 FR 25031, June 12, 1989; 54 FR 28750, July 7, 1989, as amended at 55 FR 37065, Sept. 7, 1990]

§178.348-3 Pumps, piping, hoses and connections.

Each pump and all piping, hoses and connections on each cargo tank motor vehicle must conform to §178.345-9, except that the use of nonmetallic pipes, valves, or connections are authorized on DOT 412 cargo tanks.

[Amdt. 178-89, 55 FR 37065, Sept. 7, 1990. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.348-4 Pressure relief.

(a) Each cargo tank must be equipped with a pressure and vacuum relief system in accordance with §178.345-10 and this section.

(b) *Type and construction. Vacuum relief devices are not required for cargo tanks designed to be loaded by vacuum or built to withstand full vacuum.*

(c) Pressure settings of relief valves. The setting of the pressure relief devices must be in accordance with §178.345-10(d), except as provided in paragraph (d)(3) of this section.

(d) Venting capacities. (1) The vacuum relief system must limit the vacuum to less than 80 percent of the design vacuum capability of the cargo tank.

(2) If pressure loading or unloading devices are provided, the pressure relief system must have adequate vapor and liquid capacity to limit tank pressure to the cargo tank test pressure at the maximum loading or unloading rate. The maximum loading and unloading rates must be included on the metal specification plate.

(3) Cargo tanks used in dedicated service for materials classed as corrosive material, with no secondary hazard, may have a total venting capacity which is less than required by §178.345-10(e). The minimum total venting capacity for these cargo tanks must be determined in accordance with the formula contained in §178.270-11(d)(3). Use of the approximate values given for the formula in §178.270-11(d)(3) is acceptable.

[Amdt. 178-89, 54 FR 25032, June 12, 1989, as amended at 55 FR 37065, Sept. 7, 1990; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

§178.348-5 Pressure and leakage test.

(a) Each cargo tank must be tested in accordance with §178.345-13 and this section.

(b) Pressure test. Test pressure must be as follows:

(1) Using the hydrostatic test method, the test pressure must be at least 1.5 times MAWP.

(2) Using the pneumatic test method, the test pressure must be at least 1.5 times tank MAWP, and the inspection pressure is tank MAWP.

[Amdt. 178-89, 54 FR 25032, June 12, 1989. Redesignated by Amdt. 178-112, 61 FR 18934, Apr. 29, 1996]

[CFR] PART 178 SUBPART K - Specifications for Packagings for Class 7 (Radioactive) Materials

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART K]

Subpart K - Specifications for Packagings for Class 7 (Radioactive) Materials

§178.350 Specification 7A; general packaging, Type A.

(a) Each packaging must meet all applicable requirements of subpart B of part 173 of this subchapter and be designed and constructed so that it meets the requirements of §§173.403, 173.410, 173.412, 173.415 and 173.465 of this subchapter for Type A packaging.

(b) Each Specification 7A packaging must be marked on the outside "USA DOT 7A Type A" and "Radioactive Material."

[Amdt. 178-109, 60 FR 50336, Sept. 28, 1995; 60 FR 54409, Oct. 23, 1995]

§178.352 Specification 6L; metal packaging.

§178.352-1 General requirements.

Each packaging must meet the applicable requirements of §173.24 of this subchapter.

[Amdt. 178-35, 39 FR 45246. Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.352-2 Rated capacity.

(a) Rated capacity as marked (see §178.352-6). Not less than 55 gallons nor more than 110 gallons for the outer steel drum. Not more than 17.74 liters for the inner vessel.

(b) The authorized maximum gross weight of the package is 160 kilograms (350 pounds) for sizes not over 210L (55 gallons) or 220 kilograms (480 pounds) for sizes over 210L (55 gallons) but not over 420L (110 gallons).

[Amdt. 178-1, 33 FR 14934, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, and amended by Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.352-3 General construction requirements.

(a) The outer shell must be of straight sided steel, with welded body seams and at least 18-gauge body and bottom head sheets, and 14-gauge removable head sheets (unless there are one or more corrugations in the cover near the periphery, in which case 16-gauge is authorized). The shell may be either a single sheet of steel or may be fabricated by welding together two appropriate lengths of 210L (55-gallon) drums, such as a DOT Specification 6J or 17H, with rolled or swedged in hoops as prescribed for either of those specifications. The head must be convex (crowned), not extending beyond the level of the chime, with a minimum convexity of 1 centimeter ($^{3/8}$-inch). The inside diameter of the shell must be at least 57 centimeters (22.5 inches).

(b) Inner containment vessel must conform to specification 2R (except that cast iron is not authorized), with a maximum usable inside dimension of 13.3 centimeters (5.25 inches) maximum height of 127 centimeters (50 inches) (with caps in place) and minimum wall thickness of 6 millimeters (0.25 inch).

(c) Inner containment vessel must be fixed within the outer shell by one of the following types of centering devices:

(1) At least 8 steel rod spacers, of at least 6 millimeters (0.25-inch) diameter (for packages of 210 liters (55-gallon) capacity) or 1 centimeter of (0.375-inch) diameter (for packages with greater than 210 liters (55-gallon) capacity) cold rolled steel, welded to the vessel at each end by minimum 5 centimeter (2-inch) continuous weld. Each rod must be welded to the vessel at radial positions not exceeding 45 degrees as not to interfere with closure of the inner vessel. Each spacer rod must extend at least 5.6 centimeters (2.25 inches) beyond the inner vessel at each end, then radially to the wall of the outer drum (to provide a springlike snug fit) and along the entire length of the wall of the outer drum. For a packaging of more than 210 liters (55-gallon) capacity, each spacer rod must be braced by welding a 6 millimeter (0.25-inch) by 5 centimeter (2-inch) steel plate to the spacer rod and the pipe with a continuous weld at each joint, the joints being located approximately half way along the length of the drum. For containers manufactured prior to March 31, 1975, this requirement is effective December 31, 1975.

(2) At least three steel "spiders," not more than 24 inches apart, with each spider having at least four legs. Each leg must be constructed of materials having dimensions not less than those listed in this paragraph, welded by continuous weld at each joint to inner and outer steel bands of at least $^{1/4}$-inch by 1-inch steel. The inner steel band must

be welded to the inner vessel by at least six 2-inch welds on both edges of the band. The outer steel band must be welded to the outer drum by at least six 2-inch welds on both edges of the top outer band, such that the inner vessel is at least $2^{1/4}$ inches from the top and bottom of the drum. Authorized construction materials are:

(i) 2.5 centimeters (1 inch) by 2.5 centimeters (1 inch) by 6 millimeters ($^{1/4}$-inch) steel angle iron.

(ii) 3 centimeters ($1^{1/4}$ inches) by 3 centimeters ($1^{1/4}$ inches) by 5 millimeters ($^{3/16}$-inch) steel angle iron.

(iii) 2.5 centimeters (1 inch) schedule 40 steel pipe.

(iv) $1^{1/2}$-inch diameter solid steel rods, with only two such spiders required instead of three.

(3) There must not be less than 2 spacer mechanisms for a packaging of 210 liters (55-gallon) capacity nor less than 3 spacer mechanisms for a packaging greater than 210 liters (55-gallon) capacity. Each spacer mechanism must consist of not less than 6 steel angles, pipe, or rod radial supports of at least 2.7 square centimeters (0.42 square inch) cross-section. Each radial support must be welded at one end to the containment vessel by a continuous weld or to an inner steel band of at least 6 millimeters ($^{1/4}$-inch) by 2.5 centimeters (1 inch) by a continuous weld at radial positions not exceeding 60 degrees from the center of the package. The inner band, when used, must be welded to the inner containment vessel by at least 6 equally spaced 5 centimeter (2-inch) welds on each edge of the band. The opposite end of the radial support must be welded by a continuous weld to an outer steel band of at least 6 millimeters ($^{1/4}$-inch) by 2.5 centimeters (1 inch). The outer steel band must be welded to the outer shell by at least 6 equally spaced welds on each edge of the top band, such that the inner vessel is fixed at least 5.7 centimeters (2.25 inches) from the top and bottom of the drum. The spacer mechanism must be welded as specified near each end of the containment vessel so as not to interfere with the vessel closure. For a packaging greater than 210L (55-gallon) capacity, the additional spacer mechanism must be located at approximately midpoint along the length of the inner vessel.

(d) The void between the inner containment vessel and the outer shell must be completely filled with bagged or tamped vermiculite (expanded mica), with a density of at least 0.072 g/cc (4.5 pounds per cubic foot). Loose, untamped vermiculite is not authorized.

[Amdt. 178-1, 33 FR 14934, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975; 40 FR 44327, Sept. 26, 1975. Redesignated by Amdt. 178-97,55 FR 52716, Dec. 21, 1990]

§178.352-4 Welding.

Welding must be of material having a melting point in excess of 800 ^{o}C (1475 ^{o}F) (except that for packages constructed prior to March 31, 1975, this temperature may be 540 ^{o}C (1000 ^{o}F)), with a joint efficiency of at least 0.85. This requirement applies to welding used in adding spacer rods to comply with §178.352-3(c)(1).

[Amdt. 178-35, 39 FR 45246, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.352-5 Closure.

(a) The outer drum closure must be at least a 12-gauge bolted ring with drop forged lugs, one of which is threaded, and having at least a 1.6 centimeter ($^{5/8}$-inch) diameter steel bolt and a lock nut, or equivalent device.

(b) The closure device must have a means for the attachment of a tamper-proof lock wire and seal, or equivalent.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.352-6 Markings.

(a) Markings on each container, by die stamping on a metal plate attached to the outside of the outer container by spot welding, or other equally efficient method, in letters and figures of at least one-fourth inch in height, as follows:

(1) "DOT-6L".

(2) "FISSILE RADIOACTIVE MATERIAL."

(3) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(4) Gauge of metal of the outer steel drum in the thinnest part, rated capacity of the outer steel drum in gallons, and the year of manufacture of the assembled package (e.g., 18-110-68). When the gauge of the metal in the drum wall differs from that in the head, both must be indicated with a slanting line between, and with the gauge of the body indicated first (e.g., 18/16-110-68 for 18-gauge body and 16-gauge head).

(b) [Reserved]

[Order 70, 31 FR 6496, Apr. 29, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

Editorial Note: For FEDERAL REGISTER CITATIONS AFFECTING §178.352-6, SEE THE LIST OF CFR SECTIONS AFFECTED IN THE FINDING AIDS SECTION OF THIS VOLUME.

§178.354 Specification 6M; metal packaging.

§178.354-1 General requirements.
(a) Each package must meet the applicable requirements of §173.24 of this chapter.
(b) [Reserved]

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.354-2 Rated capacity.
(a) Rated capacity as marked (see §178.354-5). Not less than 10 gallons nor more than 110 gallons for the outer steel drum. Not less than 1.24 liters for the inner containment vessel.

(b) [Reserved]

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.354-3 General construction requirements.
(a) The outer shell must be of straight-sided steel, with welded body seams, and may be either a single sheet of steel, or may be fabricated by welding together two appropriate lengths of drums, such as a DOT Specification 6C or 17C, with each length to contain 3 swedged or rolled rolling hoops as prescribed for either of these specifications. A removable head for a packaging of 210 liters (55 gallons) or larger volume must have one or more corrugations in the cover near the periphery. For a packaging exceeding 57 liters (15 gallons) volume, the head must be crowned (convexed), not extending beyond the level of the chime, with a minimum convexity of 1 centimeter ($^{3/8}$-inch).

(1) The maximum authorized gross weight, metal thickness, and minimum end insulation thickness for the marked volume is as follows:

Marked capacity	Maximum authorized gross weight	Minimum thickness of uncoated sheets	Minimum thickness of end insulation	Centimeters

				and heads (gauge)		
Gallons not over	Liters	Pounds	Kilograms	-	Inches	-
15	57	160	73	20	1.88	4.7
30	114	480	219	18	3.75	9.5
55	210	640	292	16	3.75	9.5
110	420	640	292	16	3.75	9.5

(2) Each drum must have at least four 1.2 centimeter (0.5-inch) diameter vents near the top, each covered with a weatherproof tape or fusible plug; or equivalent device. A layer of porous refractory fiber may be placed behind the pressure-relief vent holes.

(b) Inner containment vessel must conform to specification 2R or equivalent (cast iron or brass are prohibited), with maximum usable inside diameter of 13.3 centimeters (5.25 inches), minimum usable inside diameter of 10 centimeters (4 inches), and minimum height of 15 centimeters (6 inches).

(c) Inner containment vessel must be fixed within the outer shell by one of the following types of solid centering media, with the sides of the inner vessel protected by at least 9.5 centimeters (3.75 inches) of insulation media, and the ends with at least the thickness as prescribed in paragraph (a)(1) of this section.

(1) Machined discs and rings made of solid industrial cane fiberboard having a density of at least 0.24 g/cc (15 pounds per cubic foot) fitted such that the radial clearances between the fiberboard, inner vessel, and shell do not exceed 6 millimeters ($^{1/4}$-inch); or

(2) Hardwood or plywood at least 1.2 centimeter ($^{1/2}$-inch) thick, having a density of at least 0.45 g/cc (28 pounds per cubic foot). There must be no gap or direct heat path from the shell to the inner vessel.

(d) Any radiation shielding material used must be placed within the inner containment vessel or must be protected in all directions by at least the thickness of the thermal insulating material prescribed in paragraph (a) of this section.

(e) For a packaging having an authorized gross weight in excess of 219 kg (480 pounds), a steel bearing plate, at least 6 millimeters (0.25-inch) thick or a plywood disc, at least 2.5 centimeters (1-inch) thick, and at least 25 centimeters (10 inches) in diameter must be provided at both ends and adjacent to the specification 2R inner containment vessel, to provide additional load-bearing surface against the insulation-centering medium.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974; 40 FR 44327, Sept. 26, 1975. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.354-4 Closure.

(a) The outer drum closure must be at least 16-gauge bolt-type locking ring having at least a $^{5/16}$-inch steel bolt for drum sizes not over 15 gallons, or a 12-gauge bolted ring with drop-forged lugs, one of which is threaded, and a $^{5/8}$-inch steel bolt for drum sizes over 15 gallons. Each bolt must be provided with a lock nut or equivalent device.

(b) The closure device must have means for the attachment of a temperproof lock wire and seal, or equivalent.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.354-5 Markings.

(a) Marking must be as prescribed in §178.3.

(b) Marking on the outside of each package must be as follows: "DOT-6M Type B," "Radioactive Materials," or "Fissile Radioactive Materials," as appropriate; and the gauge of metal of the outer drum in the thinnest part, rated capacity of the outer drum in gallons, and year of manufacture (for example, 18-30-69). When the gauge of the metal in the drum wall differs from that in the head, both must be indicated with a slanting line between, and with the gauge of the body indicated first (e.g., 18/16-55-69 for 18-gauge body and 16-gauge head).

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.356 Specification 20PF phenolic-foam insulated, metal overpack.

§178.356-1 General requirements.

(a) Each overpack must meet all of the applicable requirements of §173.24 of this subchapter.

(b) The maximum gross weight of the package, including the inner cylinder and its contents, must not exceed the following:

(1) Specification 20PF-1-138 kilograms (300 pounds).

(2) Specification 20PF-2-320 kilograms (700 pounds).

(3) Specification 20PF-3-455 kilograms (1000 pounds).

(c) The general configuration of the overpack must be a right cylinder, consisting of an insulated base section, a steel liner lid, and an insulated top section. The inner liner and outer shell must be at least 16-gauge and 18-gauge steel, respectively, with the intervening cavity filled with a molded-in-place, fire-resistant, phenolic-foam insulation interspersed with wooden members for bracing and support Wood pieces must be securely attached to both the liner and shell. No hole is permitted in the liner. Each joint between sections must be stepped a minimum of 5 centimeters (2 inches) and gaps between mating surfaces must not exceed 5 millimeters (0.2-inch). Gaps between foam surface of top section and liner lid must not exceed 1 centimeter (0.4-inch) or 5-centimeters (2 inches) where taper is required for mold stripping. For the specification 20PF-1, the top section may consist of a plug of foam insulation and a steel cover. The liner and shell closures must each be gasketed against moisture penetration. The liner must have a bolted flange closure. Shell closure must conform to §178.118-8(b).

(d) Drawings in CAPE-1662, which include bills of material are a part of this specification.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.356-2 Materials of construction and other requirements.

(a) Phenolic foam insulation must be fire-resistant and fabricated in accordance with USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, which is a part of this specification. (Note: Packagings manufactured under USAEC Specification SP-9 and Rev. 1 thereto are authorized for continued manufacture and use.) A 5.4-inch (13.7 centimeter) minimum thickness of foam must be provided over the entire liner except:

(1) Where wood spacers replace the foam; or

(2) At protrusions of liner or shell, such as flanges, baffles, etc., where minimum insulation thickness is 9 centimeters (3.5 inches); or

(3) Where alternate top section (specification 20PF-1) is used. Foam must not interfere with proper seating of screws in inner liner flange assembly. Average density of insulation must be 0.13 g/cc (8 pounds per cubic foot (pcf)) minimum for bottom section and 0.16 g/cc (10 pcf) minimum for top section, except 0.1 g/cc (6.5 pcf) for the specification 20PF-1 top section.

(b) Gaskets must be as follows:

(1) Inner liner flange-Neoprene rubber of 30 to 60 type A durometer hardness or other equivalent gasket material which is compatible with the specific contents.

(2) Outer shell-Synthetic rubber conforming to MIL-R-6855 (available from the Naval Publications Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120) class 2, grade 60.

(3) Support and pressure pads for inner liner top and bottom must be sponge rubber or equivalent.

(c) Alternate top section (specification 20PF-1 only). Average insulation density must be 0.16 g/cc (10 pcf minimum). Thickness of plug must be 11 centimeters (4.3 inches) minimum, except thickness may be reduced to 10 centimeters (4 inches) to clear bolt heads. A flush mounted top lifting device must be securely fastened to a wood block encapsulated by the foam.

(d) Vent holes 5 millimeters (0.2-inch) diameter must be drilled in the outer shell to provide pressure relief during the insulation foaming and in the event of a fire. These holes, which must be drilled in all areas of the shell which mate with the foam insulation, must be spaced in accordance with CAPE-1662.

(e) Welding must be by a fusion welding process in accordance with American Welding Society Codes B-3.0 and D-1.0. Body seams and joints for the liner or shell must be continuous welds.

(f) Waterproofing. Each screw hole in the outer shell must be sealed with appropriate resin-type sealing material, or equivalent, during installation of the screw. All exposed foam surfaces, including any vent hole, must be sealed with waterproofing material as prescribed in USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, or equivalent.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974, as amended by Amdt. 178-56, 44 FR 49458, Aug. 23, 1979. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.356-3 Tests.

(a) Leakage test-Each inner liner assembly must be tested for leakage prior to installation. Seam welds of the liner must be covered for a distance of at least 15 centimeters (6 inches) on either side of the seam with soapsuds, heavy oil, or equivalent material, and interior air pressure applied to at least 776mm Hg (15 p.s.i.g.) above atmospheric pressure must be held for at least 30 seconds. Liners failing to pass this test may not be used until repairs are made, and retests successfully passed.

(b) [Reserved]

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.356-4 Required markings.

(a) Marking must be as prescribed in §178.3.

(b) Marking on the outside of each overpack must be as follows:

(1) "USA-DOT-20PF-1" or "-2," as appropriate, and if the entire liner is made of stainless steel, additional marking such as "3041-SS" to indicate the type of stainless steel used.

(2) "TARE WT: xxx lbs." where xxx is the tare weight of the assembled overpack without the inner container.

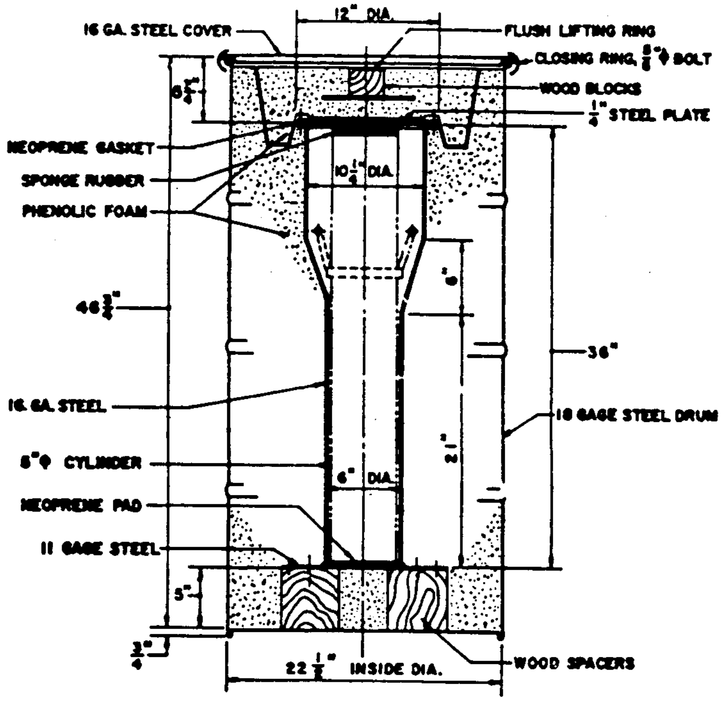
(3) Year of manufacture.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR

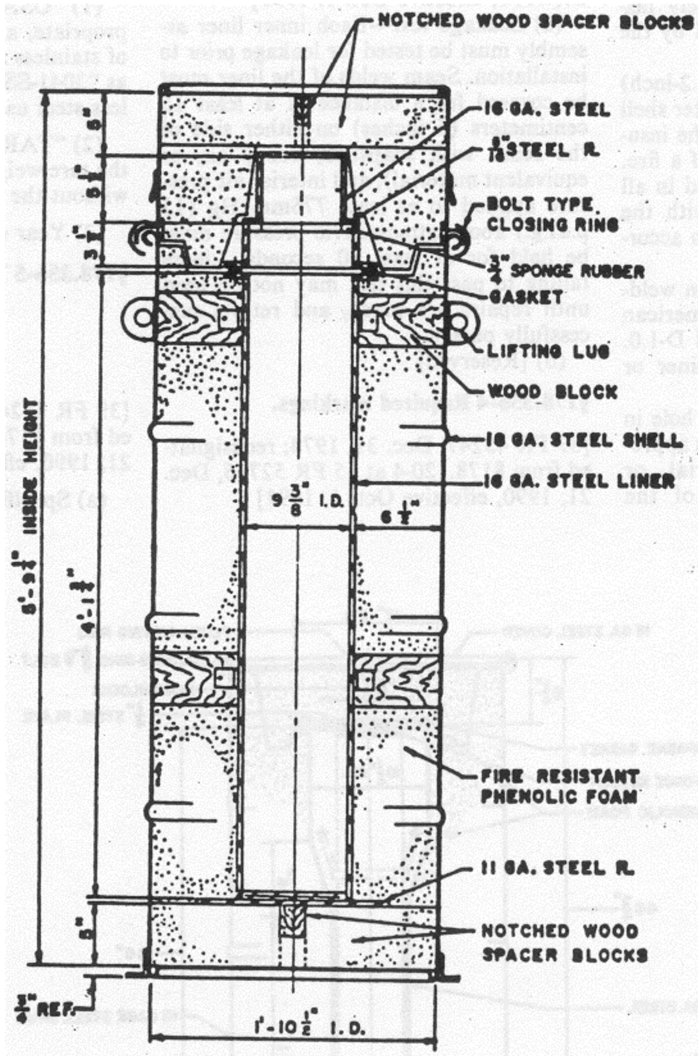
52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.356-5 Typical assembly detail.

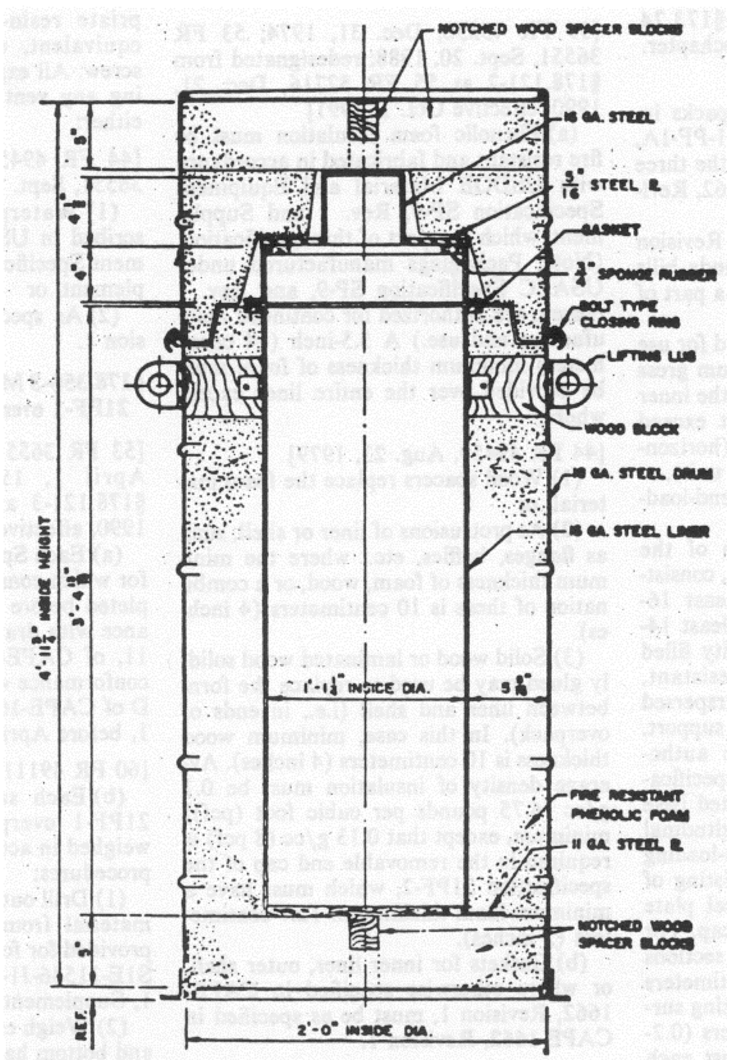
(a) Specifications 20PF-1.



(b) Specification 20PF-2.



(c) Specification 20PF-3.



[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974. Redesignated aby Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.358 Specification 21PF fire and shock resistant, phenolic-foam insulated, metal overpack.

§178.358-1 General requirements.

(a) Each overpack must meet all of the applicable requirements of §§173.24, 173.411, and 173.412 of this subchapter.

(1) Specification 21PF-1 overpacks includes the series of 21PF-1, 21PF-1A, and 21PF-1B models. Details of the three models are included in CAPE-1662, Revision 1 and Supplement 1.

(2) Drawings in CAPE-1662, Revision 1 and Supplement 1, which include bills of materials, and K/SS-471, are a part of this specification.

(b) Each overpack is authorized for use in applications where the maximum gross weight of the package, including the inner container and contents does not exceed 3725 kilograms (8200 pounds), (horizontally-loaded specification 21 PF-1 unit), or 3900 kilograms (8600 pounds), (end-loaded specification 21 PF-2 unit).

(c) The general configuration of the overpack must be a right cylinder, consisting of a steel inner liner (at least 16-gauge) and steel outer shell (at least 14-gauge) with the intervening cavity filled with a molded-in-place, fire-resistant, phenolic foam insulation and interspersed wooden members for bracing and support. Two specific configurations are authorized; a horizontal loading unit (specification 21PF-1) consisting of insulated base and top sections jointed in a longitudinal peripheral closure joint; or an end-loading unit (specification 21PF-2), consisting of an insulated main section, a steel plate liner lid, and an insulated end cap. For either type each joint between sections must be stepped at least 1.8 centimeters (0.75-inch) and gaps between mating surfaces may not exceed 5 millimeters (0.2-inch). Bolted closures, which must each be gasketed against moisture penetration, must be in accordance with CAPE-1662. Each bolt must be equipped with a locking device to prevent loosening from vibration. Outer steel bracing and support framework must be attached to the shell to facilitate normal handling.

(d) Specification 21PF-1 overpacks in use or under construction before April 1, 1989, must be modified to Specification 21PF-1A before April 1, 1991. All new construction to Specification 21PF-1 beginning after March 31, 1989, must meet Specification 21PF-1B. Use of unmodified 21PF-1 overpacks after March 31, 1991, is prohibited.

[Amdt. 178-35, 39 FR 45250, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975, as amended by Amdt. 178-90, 53 FR 36551, Sept. 20, 1988. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.358-2 Materials of construction and other requirements.

(a) Phenolic foam insulation must be fire resistant and fabricated in accordance with USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, which is a part of this specification. (Note: Packagings manufactured under USAEC Specification SP-9, and Rev. 1 thereto are authorized for continued manufacture and use.) A 5.5-inch (14 centimeter) minimum thickness of foam must be provided over the entire liner except where:

(1) Wood spacers replace the foam material; or

(2) At protrusions of liner or shell, such as flanges, baffles, etc., where the minimum thickness of foam, wood, or a combination of these is 10 centimeters (4 inches).

(3) Solid wood or laminated wood solidly glued may be used to replace the foam between liner and shell (i.e., in ends of overpack). In this case, minimum wood thickness is 10 centimeters (4 inches). Average density of insulation must be 0.1g/cc (6.75 pounds per cubic foot (pcf)) minimum, except that 0.13 g/cc (8 pcf) is required in the removable end cap of the specification 21PF-2, which must have a minimum foam thickness of 12.7 centimeters (5 inches).

(b) Gaskets for inner liner, outer shell, or where otherwise specified in CAPE-1662, Revision 1, must be as specified in CAPE-1662, Revision 1.

(c) Support and pressure pads for the inner liner must be of neoprene, sponge rubber, or equivalent.

(d) Fire-retardant (intumescent) paint must be applied to any wood blocking which is located at any joint in the shell.

(e) Vent holes 5 millimeters (0.2-inch) diameter must be drilled in the outer shell to provide pressure relief during the insulation foaming and in the event of a fire. These holes, which must be drilled in all areas of the shell which made with the foam insulation, must be spaced in accordance with CAPE-1662.

(f) Welding must be by a fusion process in accordance with the American Welding Society Code. Body seams and joints for the liner and shell must be continuous welds.

(g) *Waterproofing. Each screw hole in the outer shell must be sealed with appropriate resin-type sealing material, or equivalent, during installation of the screw. All exposed foam surfaces, including any vent hole, must be sealed with either:*

(1) Waterproofing material as prescribed in USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, or

(2) As specified in CAPE-1662, Revision 1.

[Amdt. 178-35, 39 FR 45250, Dec. 31, 1974, as amended by Amdt. 178-56, 44 FR 49459, Aug. 23, 1979; Amdt. 178-90, 53 FR 36551, Sept. 20, 1988. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.358-3 Modification of Specification 21PF-1 overpacks.

(a) Each Specification 21PF-1 overpack for which construction began or was completed before April 1, 1989, in conformance with drawing E-S-31536-J, Revision 11, of CAPE-1662 must be modified in conformance with drawing S1E-31536-J1-D of CAPE-1662, Revision 1, Supplement 1, before April 1, 1991.

(b) Each such existing Specification 21PF-1 overpack must be dried and weighed in accordance with the following procedures:

(1) Drill out or otherwise clean the plug material from the vent holes originally provided for foam expansion. See drawing S1E-31536-J1-D of CAPE-1662, Revision 1, Supplement 1, for locations.

(2) Weigh each packaging element (top and bottom halves) separately to an accuracy of +5 pounds (+2.3 kilograms) and record the weights. If this measured weight is greater than 25 pounds (11.3 Kg) more than the initially measured weight at the time of fabrication (indicating a significant retained water content), the packaging element must be dried.

(3) Place overpack element in drying oven; maintain temperature between 190^{o} and 210 ^{o}F (87.8-98.9 ^{o}C) for a minimum of 72 hours. The oven should have a provision for air exchange or other means of removing moisture driven from the foam structure.

(4) Drying may be discontinued after 72 hours if the weight of the packaging element is not higher than 25 pounds (11.3 Kg) more than the initially measured tare weight of that element at the time of fabrication. If the weight of the packaging element is greater than 25 pounds (11.3 Kg) more than the initial fabricated weight (indicating a significant remaining water content), drying must be continued until the weight differential is not higher than 25 pounds (11.3 Kg), or until the rate of weight loss is less than 2.5 pounds (1.1 Kg) per day.

(5) As an alternate moisture measurement, a calibrated moisture meter reading for 20 percent maximum water content may be used to indicate an end point in the drying cycle (see details in report "Renovation of DOT Specification 21PF-1 Protective Shipping Packages," Report No. K-2057, Revision 1, November 21, 1986, available from the USDOE and part of USDOE Report No. K/SS-471).

(6) Following drying, each overpack element (top and bottom halves) must be weighed and the weight in both pounds and kilograms must be engraved on the identification plate required by §178.358-5(c).

(c) After modification as provided for herein, each Specification 21PF-1 overpack must be marked "USA-DOT-21PF-1A". See the marking requirements of §178.358-5.

[Amdt. 178-90, 53 FR 36551, Sept. 20, 1988. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990; Amdt. 178-110, 60 FR 49111, Sept. 21, 1995; 63 FR 37462, July 10, 1998]

§178.358-4 Construction of Specification 21PF-1B overpacks.

(a) Each Specification 21PF-1 overpack for which construction began after March 31, 1989, must meet the requirements of Specification 21PF-1B, in conformance with drawings E-S-31536-J-P, and S1E-31536-J2-B of CAPE-1662, Revision 1, Supplement 1.

(b) With the exception of the closure nuts and bolts, all metal parts of the Specification 21PF-1B must be of stainless steel as shown on the drawings referred to in paragraph (a) of this section.

[Amdt. 178-90, 53 FR 36551, Sept. 20, 1988. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.358-5 Required markings.

(a) Markings must be as prescribed in §178.3.

(b) Specification marking on the outside of each overpack must be as follows: "USA-DOT-21PF-1", "1A", "1B", or "2", as appropriate.

(1) For Specifications 21PF-1 and 21PF-2 only, if the inner shell is constructed of stainless steel, additional marking such as "304L-SS" are to be marked on the outside of the overpack to indicate the type of stainless steel used.

(2) For Specification 21PF-1 and 21PF-2 only, "TARE WT: * * * lbs. (* * * kg)" where * * * is the tare weight in pounds and kilograms, respectively, of the assembled overpack without the inner product container.

(3) For Specification 21PF-1A and 21PF-1B only: "TARE WT. of Cover: * * * lbs (* * * kg) TARE WT. of BOTTOM: * * * lbs (* * * kg)" where * * * is the tare weight in pounds and kilograms, respectively, of the separate halves of the overpack without the inner product container. For Specification 21PF-1A overpacks, the previous tare weight must be changed to reflect the modified tare weight value or must be covered or removed.

(4) Year of manufacture followed by the year of modification, if applicable.

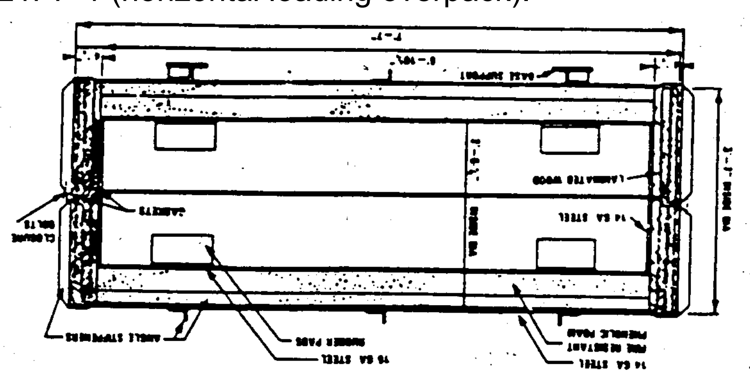
(5) The name or symbol of maker or party certifying compliance with specification requirements. A symbol, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

(c) For Specification 21PF-1A and -1B only, the markings required by this section must be affixed to each overpack by inscription upon a metal identification plate 11 inches wide x 15 inches long (28 cm x 38 cm), fabricated of 16 to 20 gauge stainless steel sheet, ASTM A-240, Type 304L.

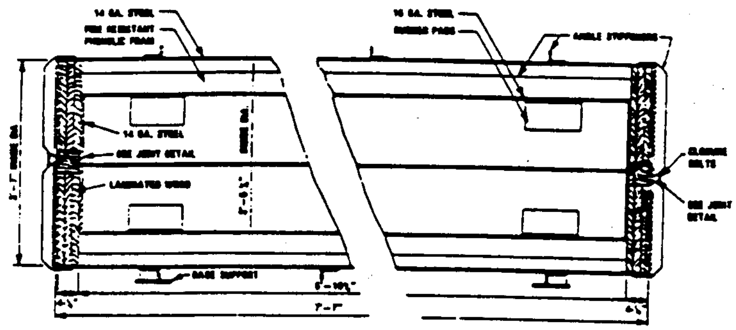
[Amdt. 178-90, 53 FR 36552, Sept. 20, 1988. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, and amended at Amdt. 178-97, 56 FR 66287, Dec. 20, 1991; 63 FR 37462, July 10, 1998]

§178.358-6 Typical assembly detail.

(a) Specification 21PF-1 (horizontal loading overpack).

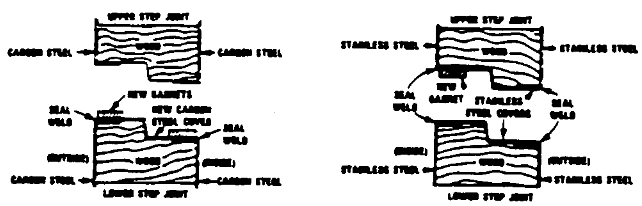


(b) Specification 21PF-1A and 21PF-1B (horizontal loading overpack).



SECTION
DOT SPECIFICATION 21PF-1A
OVERPACK

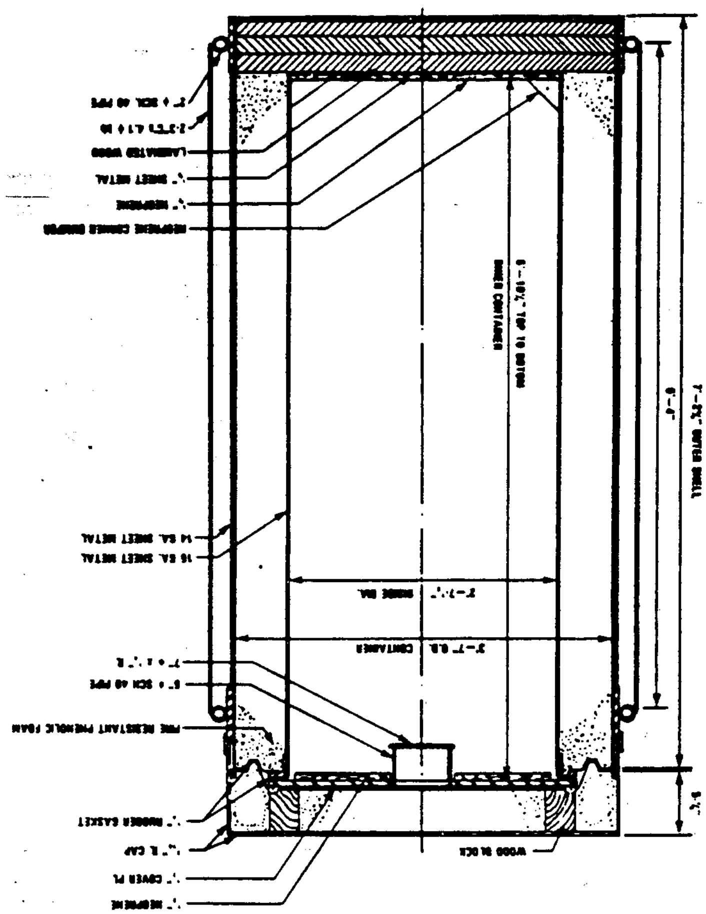
SECTION
DOT SPECIFICATION 21PF-1B
OVERPACK



JOINT DETAIL
DOT SPECIFICATION 21PF-1A
OVERPACK

JOINT DETAIL
DOT SPECIFICATION 21PF-1B
OVERPACK

(c) Specification 21PF-2 (end loading overpack).



[Amdt. 178-90, 53 FR 36552, Sept. 20, 1988. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.360 Specification 2R; inside containment vessel.

§178.360-1 General requirements.

(a) Each vessel must be made of stainless steel, malleable iron, or brass, or other material having equivalent physical strength and fire resistance.

(b) Each vessel must meet all of the applicable requirements of §173.24 (c) and (d) of this subchapter. Letters and numerals at least 6 millimeters ($^{1/4}$-inch) in height are authorized for the marking of a vessel not exceeding 5 centimeters (2 inches) inside diameter.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.360-2 Manufacture.

The ends of the vessel must be fitted with screw-type closures or flanges (see §178.360-4), except that one or both ends of the vessel may be permanently closed by a welded or brazed plate. Welded or brazed side seams are authorized.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.360-3 Dimensions.

(a) The inside diameter of the vessel may not exceed 30 centimeters (12 inches) exclusive of flanges for handling or fastening devices and must have wall thickness and length in accordance with the following:

Inside diameter maximum		Threaded closure		Wall thickness minimum-Flanged closure	Length maximum	
Inches	Centimeters	Inches	Millimeters	-	Inches	Centimeters
2	5	3/32	2.5	Not less than that prescribed for schedule 40 pipe	16	41
6	15	1/8	3.2	-	72	183
12	30	1/4	6.5	-	72	183

(b) [Reserved]

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.360-4 Closure devices.

(a) Each closure device must be as follows:

(1) Screw-type cap or plug; number of threads per inch must not be less than United States standard pipe threads and must have sufficient length of thread to engage at least 5 threads when securely tightened. Pipe threads must be luted with an appropriate non-hardening compound which must be capable of withstanding up to 149 °C (300 °F) without loss of efficiency. Tightening torque must be adequate to maintain leak tightness with the specific luting compound.

(2) An opening may be closed by a securely bolted flange and leak-tight gasket. Each

flange must be welded or brazed to the body of the 2R vessel per (ANSI) Standard B16.5 or (AWWA) Standard C207-55, section 10. A torque wrench must be used in securing the flange with a corresponding torque of no more than twice the force necessary to seal the selected gasket. Gasket material must be capable of withstanding up to 149 ^{o}C (300 ^{o}F) without loss of efficiency. The flange, whether of ferrous or nonferrous metal, must be constructed from the same metal as the vessel and must meet the dimensional and fabrication specifications for welded construction as follows:

(i) Pipe flanges described in Tables 13, 14, 16, 17, 19, 20, 22, 23, 25 and 26 of ANSI B16.5.

(ii) For nominal pipe sizes, 6, 8, 10, and 12 inches, AWWA Standard C207-55, Table 1, class B, may be used in place of the tables prescribed by paragraph (a)(2)(i) of this section.

(iii) Sizes under 6 inches, nominal pipe size, the following table with the same configuration as illustrated in AWWA C207-55, Table 1, class B, may be used in place of paragraph (a)(2)(i) of this section.

Nominal pipe size		Flange O.D.		Number of bolts	Bolt circle diameter		Diameter of bolts		Flange thickness	
Inches	Centimeters	Inches	Centimeters	-	Inches	Centimeters	Inches	Centimeters	Inches	Centimeters
2	5	6	15	4	$4^{3/4}$	11.8	1/2	1.2	5/8	1.6
$2^{1/2}$	6.2	7	17.5	4	$5^{1/2}$	13.8	1/2	-	5/8	-
3	7.5	$7^{1/2}$	18.8	4	6	15	1/2	-	5/8	-
$3^{1/2}$	8.8	$8^{1/2}$	21.3	8	7	17.5	1/2	-	5/8	-
4	10	9	22.5	8	$7^{1/2}$	18.8	1/2	-	5/8	-
5	12.6	10	25.4	8	$8^{1/2}$	21.3	1/2	-	5/8	-

(iv) Cast iron flanges prohibited.

(b) [Reserved]

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975, as amended at 40 FR 44327, Sept. 26, 1975. Redesignated by Amdt. 178-97, 56 FR 66284, Dec. 20, 1991]

§178.362 Specification 20WC wooden protective jacket.

§178.362-1 General requirements.

(a) Each jacket must meet the applicable requirements of §173.24 of this subchapter.

(b) Maximum gross weight of the jacket plus the contents may not exceed the following:

(1) Specification 20WC-1: 225 kilograms (500 pounds).
(2) Specification 20WC-2: 225 kilograms (500 pounds).
(3) Specification 20WC-3: 455 kilograms (1000 pounds).
(4) Specification 20WC-4: 910 kilograms (2000 pounds).
(5) Specification 20WC-5: 1820 kilograms (4000 pounds).
(6) Specification 20WC-6: 2230 kilograms (6000 pounds).

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.362-2 Materials of construction.

(a) The general configuration of the wooden protective jacket must be a hollow cylindrical shell constructed of one-piece discs and rings of plywood or solid hardwood reinforced with steel rods.

(1) The specification 20WC-2 must be additionally completely encased, snugly fit, within an 18-gauge steel shell. The steel shell must be provided with at least four 6 millimeter (0.25-inch) diameter vent holes. Each hole must be covered with durable weatherproof tape, or equivalent device.

(2) The specification 20WC-6 jacket must be additionally completely encased, snugly-fit, within a 12-gauge steel shell. The steel shell must be provided with at least twelve 1.2 centimeters (0.5-inch) diameter vent holes, located in 3 rows of 4 holes each, spaced at 90 degree intervals near the top, middle, and bottom of the drum. Each hole must be covered with durable weatherproof tape, or equivalent device.

(b) Plywood must be exterior-grade, void-free, Douglas fir (or equivalent) not more than 2.5 centimeters (1 inch) thick. Solid hardwood is authorized for specification 20WC-2 only.

(c) Discs and rings must be glued together with a strong, shock-resistant adhesive, such as either of the following:

(1) A resorcinol-formaldehyde adhesive, which has been bonded under both heat and pressure; or

(2) A polyvinyl-acetate emulsion, which has been reinforced with cement-coated nails. The nails must be randomly spaced and must be at least 2.5 times as long as the minimum thickness of the plywood discs or rings.

(d) Full-length steel rods are required for reinforcement and lid closure.

(1) The minimum number of rods and the minimum rod diameter are as shown in the following table:

Specification	Minimum number or rods	Minimum rod diameter

-	-	Inches	Millimeters
20WC-1	6	0.25	6.0
20WC-2	6	.25	6.0
20WC-3	12	.375	9.5
20WC-4	16	.375	9.5
20WC-5	16	.50	12.0
20WC-6	16	.50	12.0

(2) For specifications 20WC-1 and 20WC-2, steel rods must be equally spaced around the circumference to the rings and discs, midway between the O.D. and I.D. of the rings. For specifications 20WC-3 and 20WC-4, bolts may be staggered alternately in two rows, at 1.2 centimeters (0.5-inch) from the line midway between the O.D. and I.D. of the rings. For specifications 20WC-5 and 20WC-6, bolts may be staggered alternately in two rows at 2.5 centimeters (1 inch) from the line midway between the O.D. and I.D. of the rings.

(3) Rod ends must be threaded and secured with lock nuts and steel washers, or equivalent device, to provide at least a 2.5 centimeters (1 inch) diameter bearing surface on each end. Ends of the rods must terminate 1.4 centimeters (0.75-inch) below the surface of the plywood for specifications 20WC-1 and 20WC-2. For specifications 20WC-3, 20WC-4, 20WC-5 and 20WC-6, the ends of the rods must terminate 3.7 centimeters (1.5 inches) below the surface of the plywood, and that portion of each end disc which extends beyond the rod ends must be further held in place with lag screws at least 10 centimeters (4 inches) long.

(e) Thickness of wooden shell:

(1) Specification 20WC-1: At least 10 centimeters (4 inches) thick.

(2) Specification 20WC-2: At least 7.5 centimeters (3 inches) thick.

(3) Specification 20WC-3: At least 13 centimeters (5 inches) thick for the jacket wall, and at least 15 centimeters (6 inches) thick for the end discs. In addition, at least 3 plywood chines, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and midway along the length of the jacket.

(4) Specification 20WC-4: At least 15 centimeters (6 inches) thick for the jacket wall, and at least 15 centimeters (6 inches) thick for the end discs. In addition, at least 3 plywood chines, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and midway along the length of the jacket.

(5) Specifications 20WC-5 and 20WC-6: At least 15 centimeters (6 inches) thick for the jacket wall, and at least 20 centimeters (8 inches) thick for the end discs. In addition, at least 5 plywood chimes, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and equally spaced along the length of the jacket.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, and amended by Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.362-3 Closure.

(a) Closure for the wooden protective jacket is provided by the steel reinforcing rods. The end cap (lid) must fit tightly to the body of the jacket to prevent a heat path to the inside of the jacket. The lid joint for specifications 20WC-3, 20WC-4, 20WC-5, and 20WC-6, may not be coplanar with the end of the inner containment vessel.

(b) Specifications 20WC-2 and 20WC-6. Locking ring closure, if used, must conform to §178.354-4. Flanged closure, if used, must have at least 8 steel bolts (at least 6 millimeters (0.25-inch) diameter for 20WC-2 or 1.2 centimeters (0.50-inch) diameter for 20WC-6) and lock nuts (or equivalent device), spaced not more than 13 centimeters (5 inches) between centers.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.362-4 Tests.

Prior to each use, each jacket must be visually inspected for defects such as improper bonding, cracking, corrosion of steel rods, and improperly fitting closure lid, or other manufacturing defects. Particular attention must be given to any separation of the plywood discs and rings which would provide a heat path to the inside of the jacket.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.362-5 Painting.

Each jacket (other than 20WC-2 and 20WC-6) must be completely painted with a high quality exterior weather resistant paint.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.362-6 Marking.

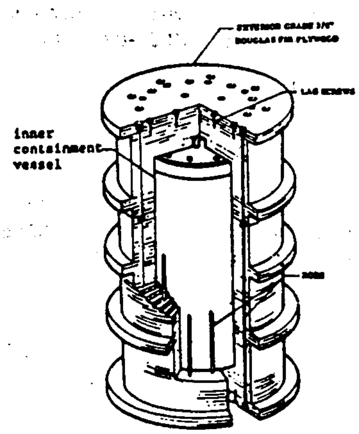
(a) Each jacket must be marked on the external surface as follows: "USA-DOT 20WC-( ) TYPE B." The appropriate numeral must be inserted in the marking to indicate the appropriate specification 20WC category: e.g., "20WC-2."

(b) Each jacket must also be marked with the name or symbol of person making the marks specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.

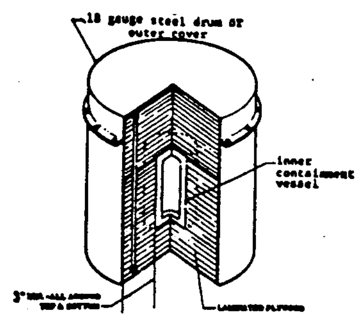
[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974, as amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, and amended at Amdt. 178-97, 56 FR 66287, Dec. 20, 1991]

§178.362-7 Typical assembly sketches.

(a) Spec. 20WC-2.



(b) Spec. 20WC-5.



[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.364 Specification 21WC wooden-steel protective overpack.

§178.364-1 General requirements.

(a) Each jacket must meet all the applicable requirements of §173.24 of this subchapter.

(b) The maximum authorized gross weight of the overpack, including its inner container and contents may not exceed 1360 kilograms (3000 pounds).

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974. Redesignated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.364-2 Materials of construction and other requirements.

(a) The general configuration of the protective overpack must be a combination of two nested plywood boxes, each 2.5 centimeters (1 inch) thick, nested within a third wooden box of nominal 5 centimeters (2-inch) thickness solid hardwood. The three nested boxes must be enclosed within a welded framework 10 cement-coated nails spaced on nominally 1 centimeter ($^{3/8}$-inch) thick by 8-10 centimeters (3-4 inches) wide. All outer surfaces of each box must be coated with intumescent paint.

(b) Plywood must be exterior-grade, void-free, Douglas fir, or equivalent, at least 2.5 centimeters (1 inch) thick. Solid hardwood must be maple, or equivalent.

(c) All box joints and interior surfaces must be glued with a strong, shock-resistant adhesive such as polyvinylacetate emulsion, or equivalent.

(d) All hardwood joints must be mitered, or equivalent, reinforced with No. 10 cement-coated nails space on nominal 15 centimeters (6-inch) centers.

(e) All plywood joints must be butt-type, or equivalent, reinforced with No. 10 cement-coated nails spaced on nominal 15 centimeters (6-inch) centers.

(f) The angles and strapping of the metal frame must be spaced such that separation distances do not exceed 15 centimeters (6 inches).

(g) The lid must be of the same material as the box and fabricated in such a manner that closure forms a mitered joint with the hardwood box and 2 stepped-joints with the plywood boxes.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.364-3 Closure.

Closure for the protective overpack must be provided by at least 4 mild steel hinges formed from minimum 2.5-centimeter (1-inch) x 5-millimeter ($^{3/16}$-inch) bar stock. Hinge pins must be minimum 6-millimeter ($^{1/4}$-inch) diameter by 13.3 centimeters ($5^{1/4}$ inches) long mild steel rod drilled at both ends for cotter pins.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.364-4 Tests.

Prior to each use, each overpack must be visually inspected for defects such as wood checking or splintering weld cracking, corrosion of steel parts, improper joint bonding, or improperly fitting closure lid.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

§178.364-5 Required marking.

(a) Marking must be as prescribed in §178.3.

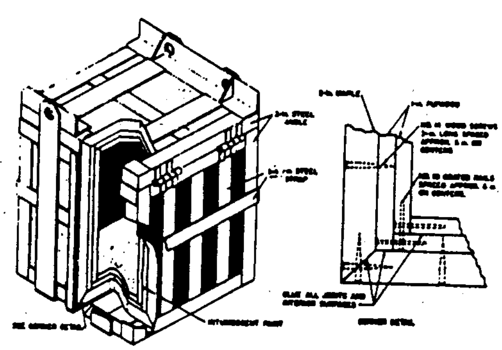
(b) Marking on the outside of each overpack must include the following:

(1) "USA-DOT 21WC" and "TYPE B" as appropriate.

(2) [Reserved]

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990, as amended at 63 FR 37462, July 10, 1998]

§178.364-6 Typical assembly detail.



RADIOISOTOPES SHIPPING CASE FIRE AND IMPACT SHIELD

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974; 40 FR 2435, Jan. 31, 1975. Redesigntated by Amdt. 178-97, 55 FR 52716, Dec. 21, 1990]

[CFR] PART 178 SUBPART L - Non-bulk Performance-Oriented Packaging Standards

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART L]

Subpart L - Non-bulk Performance-Oriented Packaging Standards

Source: Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, unless otherwise noted.

§178.500 Purpose, scope and definitions.

(a) This subpart prescribes certain requirements for non-bulk packagings for hazardous materials. Standards for these packagings are based on the UN Recommendations.
(b) Terms used in this subpart are defined in §171.8 of this subchapter.

§178.502 Identification codes for packagings.

(a) Identification codes for designating kinds of packagings consist of the following:
(1) A numeral indicating the kind of packaging, as follows:
(i) "1" means a drum.
(ii) "2" means a wooden barrel.
(iii) "3" means a jerrican.
(iv) "4" means a box.
(v) "5" means a bag.
(vi) "6" means a composite packaging.
(vii) "7" means a pressure receptacle.
(2) A capital letter indicating the material of construction, as follows:
(i) "A" means steel (all types and surface treatments).

(ii) "B" means aluminum.
(iii) "C" means natural wood.
(iv) "D" means plywood.
(v) "F" means reconstituted wood.
(vi) "G" means fiberboard.
(vii) "H" means plastic.
(viii) "L" means textile.
(ix) "M" means paper, multi-wall.
(x) "N" means metal (other than steel or aluminum).
(xi) "P" means glass, porcelain or stoneware.
(3) A numeral indicating the category of packaging within the kind to which the packaging belongs. For example, for steel drums ("1A"), "1" indicates a non-removable head drum (i.e., "1A1") and "2" indicates a removable head drum (i.e., "1A2").
(b) For composite packagings, two capital letters are used in sequence in the second position of the code, the first indicating the material of the inner receptacle and the second, that of the outer packaging. For example, a plastic receptacle in a steel drum is designated "6HA1".
(c) For combination packagings, only the code number for the outer packaging is used.
(d) Identification codes are set forth in the standards for packagings in §§178.504 through 178.523 of this subpart.

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-106, 59 FR 67519, Dec. 29, 1994]

§178.503 Marking of packagings.

(a) A manufacturer must mark every packaging that is represented as manufactured to meet a UN standard with the marks specified in this section. The markings must be durable, legible and placed in a location and of such a size relative to the packaging as to be readily visible, as specified in §178.3(a). Except as otherwise provided in this section, every reusable packaging liable to undergo a reconditioning process which might obliterate the packaging marks must bear the marks specified in paragraphs (a)(1) through (a)(6) and (a)(9) of this section in a permanent form (e.g. embossed) able to withstand the reconditioning process. A marking may be applied in a single line or in multiple lines provided the correct sequence is used. As illustrated by the examples in paragraph (e) of this section, the following information must be presented in the correct sequence. Slash marks should be used to separate this information. A packaging conforming to a UN standard must be marked as follows:

(1) The United Nations symbol as illustrated in paragraph (e)(1) of this section (for embossed metal receptacles, the letters UN may be applied in place of the symbol);

(2) A packaging identification code designating the type of packaging, the material of construction and, when appropriate, the category of packaging under §§178.504 through 178.523 of this subpart within the type to which the packaging belongs. The

letter "V" must follow the packaging identification code on packagings tested in accordance with §178.601(g)(2); for example, "4GV". The letter "W" must follow the packaging identification code on packagings when required by an approval under the provisions of §178.601(h) of this part;

(3) A letter identifying the performance standard under which the packaging design type has been successfully tested, as follows:

(i) X-for packagings meeting Packing Group I, II and III tests;

(ii) Y-for packagings meeting Packing Group II and III tests; or

(iii) Z-for packagings only meeting Packing Group III tests;

(4) A designation of the specific gravity or mass for which the packaging design type has been tested, as follows:

(i) For packagings without inner packagings intended to contain liquids, the designation shall be the specific gravity rounded down to the first decimal but may be omitted when the specific gravity does not exceed 1.2; and

(ii) For packagings intended to contain solids or inner packagings, the designation shall be the maximum gross mass in kilograms;

(5)(i) For single and composite packagings intended to contain liquids, the test pressure in kilopascals rounded down to the nearest 10 kPa of the hydrostatic pressure test that the packaging design type has successfully passed;

(ii) For packagings intended to contain solids or inner packagings, the letter "S";

(6) The last two digits of the year of manufacture. Packagings of types 1H and 3H shall also be marked with the month of manufacture in any appropriate manner; this may be marked on the packaging in a different place from the remainder of the markings;

(7) The state authorizing allocation of the mark. The letters `USA' indicate that the packaging is manufactured and marked in the United States in compliance with the provisions of this subchapter;

(8) The name and address or symbol of the manufacturer or the approval agency certifying compliance with subpart L and subpart M of this part. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety;

(9) For metal or plastic drums or jerricans intended for reuse or reconditioning as single packagings or the outer packagings of a composite packaging, the thickness of the packaging material, expressed in millimeters (rounded to the nearest 0.1 mm), as follows:

(i) Metal drums or jerricans must be marked with the nominal thickness of the metal used in the body. The marked nominal thickness must not exceed the minimum thickness of the steel used by more than the thickness tolerance stated in ISO Standard 3574. (See appendix C of this part.) The unit of measure is not required to be marked. When the nominal thickness of either head of a metal drum is thinner than that of the body, the nominal thickness of the top head, body, and bottom head must be marked (eg., "1.0-1.2-1.0" or "0.9-1.0-1.0").

(ii) Plastic drums or jerricans must be marked with the minimum thickness of the packaging material. Minimum thicknesses of plastic must be as determined in accordance with §173.28(b)(4). The unit of measure is not required to be marked;

(10) In addition to the markings prescribed in paragraphs (a)(1) through (a)(9) of this section, every new metal drum having a capacity greater than 100 L must bear the marks described in paragraphs (a)(1) through (a)(6), and (a)(9)(i) of this section, in a permanent form, on the bottom. The markings on the top head or side of these packagings need not be permanent, and need not include the thickness mark described in paragraph (a)(9) of this section. This marking indicates a drum's characteristics at the time it was manufactured, and the information in paragraphs (a)(1) through (a)(6) of this section that is marked on the top head or side must be the same as the information in paragraphs (a)(1) through (a)(6) of this section permanently marked by the original manufacturer on the bottom of the drum; and

(11) Rated capacity of the packaging expressed in liters may be marked.

(b) For a packaging with a removable head, the markings may not be applied only to the removable head.

(c) *Marking of reconditioned packagings. (1) If a packaging is reconditioned, it shall be marked by the reconditioner near the marks required in paragraphs (a)(1) through (6) of this section with the following additional information:*

(i) The name of the country in which the reconditioning was performed (in the United States, use the letters "USA");

(ii) The name and address or symbol of the reconditioner. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety;

(iii) The last two digits of the year of reconditioning;

(iv) The letter "R"; and

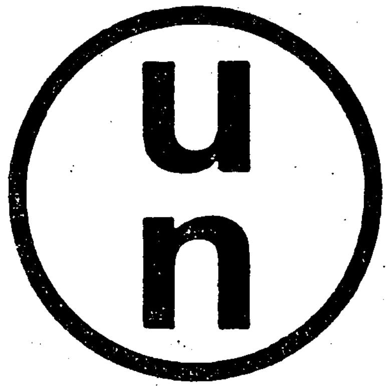
(v) For every packaging successfully passing a leakproofness test, the additional letter "L".

(2) When, after reconditioning, the markings required by paragraph (a)(1) through (a)(5) of this section no longer appear on the top head or the side of the metal drum, the reconditioner must apply them in a durable form followed by the markings in paragraph (c)(1) of this section. These markings may identify a different performance capability than that for which the original design type had been tested and marked, but may not identify a greater performance capability. The markings applied in accordance with this paragraph may be different from those which are permanently marked on the bottom of a drum in accordance with paragraph (a)(10) of this section.

(d) *Marking of remanufactured packagings. For remanufactured metal drums, if there is no change to the packaging type and no replacement or removal of integral structural components, the required markings need not be permanent (e.g., embossed). Every other remanufactured drum must bear the marks required in paragraphs (a)(1) through (a)(6) of this section in a permanent form (e.g., embossed) on the top head or side. If the metal thickness marking required in paragraph (a)(9)(i) of this section does not appear on the bottom of the drum, or if it is no longer valid, the remanufacturer also must mark this information in permanent form.*

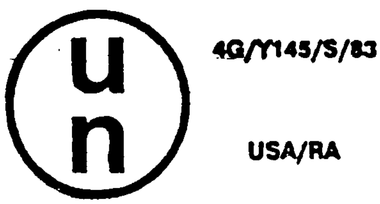
(e) The following are examples of symbols and required markings:

(1) The United Nations symbol is:



(2) Examples of markings for a new packaging are as follows:

(i) For a fiberboard box designed to contain an inner packaging:

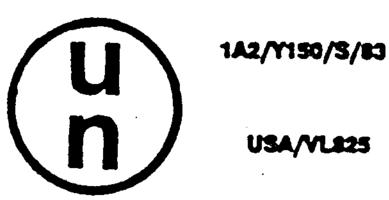


(as in §178.503 (a)(1) through (a)(9) of this subpart).

(ii) For a steel drum designed to contain liquids:

(as in §178.503 (a)(1) through (a)(10) of this subpart).

(iii) For a steel drum to transport solids or inner packagings:



(as in §178.503 (a)(1) through (a)(8) of this subpart).

(3) Examples of markings for reconditioned packagings are as follows:

1A1/Y1.4/150/92
USA/RB/93 RL

(as in §178.503(c) (1), (2), (3), (4), and (5)).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66284, Dec. 20, 1991; Amdt. 178-102, 59 FR 28493, June 2, 1994; Amdt. 178-106, 59 FR 67520, 67521, Dec. 29, 1994; Amdt. 178-107, 60 FR 26806, May 18, 1995; 62 FR 51561, Oct. 1, 1997]

§178.504 Standards for steel drums.

(a) The following are identification codes for steel drums:

(1) 1A1 for a non-removable head steel drum; and

(2) 1A2 for a removable head steel drum.

(b) Construction requirements for steel drums are as follows:

(1) Body and heads must be constructed of steel sheet of suitable type and adequate thickness in relation to the capacity and intended use of the drum. Minimum thickness and marking requirements in §§173.28(b)(4) and 178.503(a)(9) of this subchapter apply to drums intended for reuse.

(2) Body seams must be welded on drums designed to contain more than 40 L (11 gallons) of liquids. Body seams must be mechanically seamed or welded on drums intended to contain only solids or 40 L (11 gallons) or less of liquids.

(3) Chimes must be mechanically seamed or welded. Separate reinforcing rings may be applied.

(4) The body of a drum of a capacity greater than 60 L (16 gallons) may have at least two expanded rolling hoops or two separate rolling hoops. If there are separate rolling hoops, they must be fitted tightly on the body and so secured that they cannot shift. Rolling hoops may not be spot-welded.

(5) Openings for filling, emptying and venting in the bodies or heads of non-removable head (1A1) drums may not exceed 7.0 cm (3 inches) in diameter. Drums with larger openings are considered to be of the removable head type (1A2). Closures for openings in the bodies and heads of drums must be so designed and applied that they will remain secure and leakproof under normal conditions of transport. Closure flanges may be mechanically seamed or welded in place. Gaskets or other sealing elements must be used with closures unless the closure is inherently leakproof.

(6) Closure devices for removable head drums must be so designed and applied that they will remain secure and drums will remain leakproof under normal conditions of transport. Gaskets or other sealing elements must be used with all removable heads.

(7) If materials used for body, heads, closures, and fittings are not in themselves compatible with the contents to be transported, suitable internal protective coatings or treatments must be applied. These coatings or treatments must retain their protective properties under normal conditions of transport.

(8) Maximum capacity of drum: 450 L (119 gallons).

(9) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66284, Dec. 20, 1991; Amdt. 178-110, 60 FR 49111, Sept. 21, 1995]

§178.505 Standards for aluminum drums.

(a) The following are the identification codes for aluminum drums:

(1) 1B1 for a non-removable head aluminum drum; and

(2) 1B2 for a removable head aluminum drum.

(b) Construction requirements for aluminum drums are as follows:

(1) Body and heads must be constructed of aluminum at least 99 percent pure or an aluminum base alloy. Material must be of suitable type and adequate thickness in relation to the capacity and the intended use of the drum. Minimum thickness and marking requirements in §§173.28(b)(4) and 178.503(a)(9) of this subchapter apply to drums intended for reuse.

(2) All seams must be welded. Chime seams, if any, must be reinforced by the application of separate reinforcing rings.

(3) The body of a drum of a capacity greater than 60 L (16 gallons) may have at least two expanded rolling hoops or two separate rolling hoops. If there are separate rolling hoops, the hoops must be fitted tightly on the body and so secured that they cannot shift. Rolling hoops may not be spot-welded.

(4) Openings for filling, emptying, or venting in the bodies or heads of non-removable head (1B1) drums may not exceed 7.0 cm (3 inches) in diameter. Drums with larger openings are considered to be of the removable head type (1B2). Closures for openings in the bodies and heads of drums must be so designed and applied that they will remain secure and leakproof under normal conditions of transport. Closure flanges may be welded in place so that the weld provides a leakproof seam. Gaskets or other sealing elements must be used with closures unless the closure is inherently leakproof.

(5) Closure devices for removable head drums must be so designed and applied that they remain secure and drums remain leakproof under normal conditions of transport. Gaskets or other sealing elements must be used with all removable heads.

(6) Maximum capacity of drum: 450 L (119 gallons).

(7) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66284, Dec. 20, 1991; Amdt. 178-102, 59 FR 28494, June 2, 1994]

§178.506 Standards for metal drums other than steel or aluminum.

(a) The following are the identification codes for metal drums other than steel or aluminum:

(1) 1N1 for a non-removable head metal drum; and

(2) 1N2 for a removable head metal drum.

(b) Construction requirements for metal drums other than steel or aluminum are as follows:

(1) Body and heads must be constructed of metal (other than steel or aluminum) of suitable type and adequate thickness in relation to the capacity and the intended use of the drum. Minimum thickness and marking requirements in §§173.28(b)(4) and 178.503(a)(9) of this subchapter apply to drums intended for reuse.

(2) All seams must be welded. Chime seams, if any, must be reinforced by the application of separate reinforcing rings.

(3) The body of a drum of a capacity greater than 60 L (16 gallons) may have at least two expanded rolling hoops or two separate rolling hoops. If there are separate rolling hoops, the hoops must be fitted tightly on the body and so secured that they cannot shift. Rolling hoops may not be spot-welded.

(4) Openings for filling, emptying, or venting in the bodies or heads of non-removable head (1N1) drums may not exceed 7.0 cm (3 inches) in diameter. Drums with larger openings are considered to be of the removable head type (1N2). Closures for openings in the bodies and heads of drums must be so designed and applied that they will remain secure and leakproof under normal conditions of transport. Closure flanges may be welded in place so that the weld provides a leakproof seam. Gaskets or other sealing elements must be used with closures unless the closure is inherently leakproof.

(5) Closure devices for removable head drums must be so designed and applied that they remain secure and drums remain leakproof under normal conditions of transport. Gaskets or other sealing elements must be used with all removable heads.

(6) Maximum capacity of drum: 450 L (119 gallons).

(7) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66285, Dec. 20, 1991; Amdt. 178-102, 59 FR 28494, June 2, 1994]

§178.507 Standards for plywood drums.

(a) The identification code for a plywood drum is 1D.

(b) Construction requirements for plywood drums are as follows:

(1) The wood used must be well-seasoned, commercially dry and free from any

defect likely to lessen the effectiveness of the drum for the purpose intended. A material other than plywood, of at least equivalent strength and durability, may be used for the manufacture of the heads.

(2) At least two-ply plywood must be used for the body and at least three-ply plywood for the heads; the plies must be firmly glued together, with their grains crosswise.

(3) The body and heads of the drum and their joints must be of a design appropriate to the capacity of the drum and its intended use.

(4) In order to prevent sifting of the contents, lids must be lined with kraft paper or some other equivalent material which must be securely fastened to the lid and extend to the outside along its full circumference.

(5) Maximum capacity of drum: 250 L (66 gallons).

(6) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 57 FR 45465, Oct. 1, 1992]

§178.508 Standards for fiber drums.

(a) The identification code for a fiber drum is 1G.

(b) Construction requirements for fiber drums are as follows:

(1) The body of the drum must be constructed of multiple plies of heavy paper or fiberboard (without corrugations) firmly glued or laminated together and may include one or more protective layers of bitumen, waxed kraft paper, metal foil, plastic material, or similar materials.

(2) Heads must be of natural wood, fiberboard, metal, plywood, plastics, or other suitable material and may include one or more protective layers of bitumen, waxed kraft paper, metal foil, plastic material, or similar material.

(3) The body and heads of the drum and their joints must be of a design appropriate to the capacity and intended use of the drum.

(4) The assembled packaging must be sufficiently water-resistant so as not to delaminate under normal conditions of transport.

(5) Maximum capacity of drum: 450 L (119 gallons).

(6) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.509 Standards for plastic drums and jerricans.

(a) The following are identification codes for plastic drums and jerricans:

(1) 1H1 for a non-removable head plastic drum;

(2) 1H2 for a removable head plastic drum;

(3) 3H1 for a non-removable head jerrican; and

(4) 3H2 for a removable head jerrican.

(b) Construction requirements for plastic drums and jerricans are as follows:

(1) The packaging must be manufactured from suitable plastic material and be of adequate strength in relation to its capacity and intended use. No used material other than production residues or regrind from the same manufacturing process may be used unless approved by the Associate Administrator for Hazardous Materials Safety. The packaging must be adequately resistant to aging and to degradation caused either by the substance contained or by ultra-violet radiation. Any permeation of the substance contained may not constitute a danger under normal conditions of transport.

(2) If protection against ultra-violet radiation is required, it must be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives must be compatible with the contents and remain effective throughout the life of the packaging. Where use is made of carbon black, pigments or inhibitors other than those used in the manufacture of the design type, retesting may be omitted if the carbon black content does not exceed 2 percent by mass or if the pigment content does not exceed 3 percent by mass; the content of inhibitors of ultra-violet radiation is not limited.

(3) Additives serving purposes other than protection against ultra-violet radiation may be included in the composition of the plastic material provided they do not adversely affect the chemical and physical properties of the packaging material.

(4) The wall thickness at every point of the packaging must be appropriate to its capacity and its intended use, taking into account the stresses to which each point is liable to be exposed. Minimum thickness and marking requirements in §§173.28(b)(4) and 178.503(a)(9) of this subchapter apply to drums intended for reuse.

(5) Openings for filling, emptying and venting in the bodies or heads of non-removable head (1H1) drums and jerricans (3H1) may not exceed 7.0 cm (3 inches) in diameter. Drums and jerricans with larger openings are considered to be of the removable head type (1H2 and 3H2). Closures for openings in the bodies or heads of drums and jerricans must be so designed and applied that they remain secure and leakproof under normal conditions of transport. Gaskets or other sealing elements must be used with closures unless the closure is inherently leakproof.

(6) Closure devices for removable head drums and jerricans must be so designed and applied that they remain secure and leakproof under normal conditions of transport. Gaskets must be used with all removable heads unless the drum or jerrican design is such that when the removable head is properly secured, the drum or jerrican is inherently leakproof.

(7) Maximum capacity of drums and jerricans: 1H1, 1H2: 450 L (119 gallons); 3H1, 3H2: 60 L (16 gallons).

(8) Maximum net mass: 1H1, 1H2: 400 kg (882 pounds); 3H1, 3H2: 120 kg (265 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-102, 59 FR 28494, June 2, 1994; 64 FR 10782, Mar. 5, 1999]

§178.510 Standards for wooden barrels.

(a) The following are identification codes for wooden barrels:

(1) 2C1 for a bung type wooden barrel; and

(2) 2C2 for a slack type (removable head) wooden barrel.

(b) Construction requirements for wooden barrels are as follows:

(1) The wood used must be of good quality, straight-grained, well-seasoned and free from knots, bark, rotten wood, sapwood or other defects likely to lessen the effectiveness of the barrel for the purpose intended.

(2) The body and heads must be of a design appropriate to the capacity and intended use of the barrel.

(3) Staves and heads must be sawn or cleft with the grain so that no annual ring extends over more than half the thickness of a stave or head.

(4) Barrel hoops must be of steel or iron of good quality. The hoops of 2C2 barrels may be of a suitable hardwood.

(5) For wooden barrels 2C1, the diameter of the bung-hole may not exceed half the width of the stave in which it is placed.

(6) For wooden barrels 2C2, heads must fit tightly into crozes.

(7) Maximum capacity of barrel: 250 L (66 gallons).

(8) Maximum net mass: 400 kg (882 pounds).

§178.511 Standards for aluminum and steel jerricans.

(a) The following are identification codes for aluminum and steel jerricans:

(1) 3A1 for a non-removable head steel jerrican;

(2) 3A2 for a removable head steel jerrican;

(3) 3B1 for a non-removable head aluminum jerrican; and

(4) 3B2 for a removable head aluminum jerrican.

(b) Construction requirements for aluminum and steel jerricans are as follows:

(1) For steel jerricans the body and heads must be constructed of steel sheet of suitable type and adequate thickness in relation to the capacity of the jerrican and its intended use. Minimum thickness and marking requirements in §§173.28(b)(4) and 178.503(a)(9) of this subchapter apply to jerricans intended for reuse.

(2) For aluminum jerricans the body and heads must be constructed of aluminum at least 99% pure or of an aluminum base alloy. Material must be of a type and of adequate thickness in relation to the capacity of the jerrican and to its intended use.

(3) Chimes of all jerricans must be mechanically seamed or welded. Body seams of jerricans intended to carry more than 40 L (11 gallons) of liquid must be welded. Body seams of jerricans intended to carry 40 L (11 gallons) or less must be mechanically seamed or welded.

(4) Openings in jerricans (3A1) may not exceed 7.0 cm (3 inches) in diameter. Jerricans with larger openings are considered to be of the removable head type. Closures must be so designed that they remain secure and leakproof under normal conditions of

transport. Gaskets or other sealing elements must be used with closures, unless the closure is inherently leakproof.
(5) If materials used for body, heads, closures and fittings are not in themselves compatible with the contents to be transported, suitable internal protective coatings or treatments must be applied. These coatings or treatments must retain their protective properties under normal conditions of transport.
(6) Maximum capacity of jerrican: 60 L (16 gallons).
(7) Maximum net mass: 120 kg (265 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-102, 59 FR 28494, June 2, 1994; Amdt. 178-119, 62 FR 24742, May 6, 1997]

§178.512 Standards for steel or aluminum boxes.

(a) The following are identification codes for steel or aluminum boxes:
(1) 4A for a steel box; and
(2) 4B for an aluminum box.
(b) Construction requirements for steel or aluminum boxes are as follows:
(1) The strength of the metal and the construction of the box must be appropriate to the capacity and intended use of the box.
(2) Boxes must be lined with fiberboard or felt packing pieces or must have an inner liner or coating of suitable material in accordance with subpart C of part 173 of this subchapter. If a double seamed metal liner is used, steps must be taken to prevent the ingress of materials, particularly explosives, into the recesses of the seams.
(3) Closures may be of any suitable type, and must remain secure under normal conditions of transport.
(4) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.513 Standards for boxes of natural wood.

(a) The following are the identification codes for boxes of natural wood:
(1) 4C1 for an ordinary box; and
(2) 4C2 for a box with sift-proof walls.
(b) Construction requirements for boxes of natural wood are as follows:
(1) The wood used must be well-seasoned, commercially dry and free from defects that would materially lessen the strength of any part of the box. The strength of the material used and the method of construction must be appropriate to the capacity and intended use of the box. The tops and bottoms may be made of water-resistant reconstituted wood such as hard board, particle board or other suitable type.

(2) Fastenings must be resistant to vibration experienced under normal conditions of transportation. End grain nailing must be avoided whenever practicable. Joints which are likely to be highly stressed must be made using clenched or annular ring nails or equivalent fastenings.

(3) Each part of the 4C2 box must be one piece or equivalent. Parts are considered equivalent to one piece when one of the following methods of glued assembly is used: Linderman joint, tongue and groove joint, ship lap or rabbet joint, or butt joint with at least two corrugated metal fasteners at each joint.

(4) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.514 Standards for plywood boxes.

(a) The identification code for a plywood box is 4D.

(b) Construction requirements for plywood boxes are as follows:

(1) Plywood used must be at least 3 ply. It shall be made from well-seasoned rotary cut, sliced or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the box. The strength of the material used and the method of construction must be appropriate to the capacity and intended use of the box. All adjacent plies must be glued with water-resistant adhesive. Other suitable materials may be used together with plywood in the construction of boxes. Boxes must be nailed or secured to corner posts or ends or assembled with other equally suitable devices.

(2) Maximum net mass: 400 kg (882 pounds).

§178.515 Standards for reconstituted wood boxes.

(a) The identification code for a reconstituted wood box is 4F.

(b) Construction requirements for reconstituted wood boxes are as follows:

(1) The walls of boxes must be made of water-resistant, reconstituted wood such as hardboard, particle board, or other suitable type. The strength of the material used and the method of construction must be appropriate to the capacity of the boxes and their intended use.

(2) Other parts of the box may be made of other suitable materials.

(3) Boxes must be securely assembled by means of suitable devices.

(4) Maximum net mass: 400 kg (882 pounds).

§178.516 Standards for fiberboard boxes.

(a) The identification code for a fiberboard box is 4G.

(b) Construction requirements for fiberboard boxes are as follows:
(1) Strong, solid or double-faced corrugated fiberboard (single or multi-wall) must be used, appropriate to the capacity and intended use of the box. The water resistance of the outer surface must be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 g per square meter (0.0316 pounds per square foot)-see ISO International Standard 535. Fiberboard must have proper bending qualities. Fiberboard must be cut, creased without cutting through any thickness of fiberboard, and slotted so as to permit assembly without cracking, surface breaks, or undue bending. The fluting of corrugated fiberboard must be firmly glued to the facings.
(2) The ends of boxes may have a wooden frame or be entirely of wood or other suitable material. Reinforcements of wooden battens or other suitable material may be used.
(3) Manufacturing joints. (i) Manufacturing joints in the bodies of boxes must be-
(A) Taped;
(B) Lapped and glued; or
(C) Lapped and stitched with metal staples.
(ii) Lapped joints must have an appropriate overlap.
(4) Where closing is effected by gluing or taping, a water resistant adhesive must be used.
(5) Boxes must be designed so as to provide a snug fit to the contents.
(6) Maximum net mass: 400 kg (882 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, and amended by Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.517 Standards for plastic boxes.

(a) The following are identification codes for plastic boxes:
(1) 4H1 for an expanded plastic box; and
(2) 4H2 for a solid plastic box.
(b) Construction requirements for plastic boxes are as follows:
(1) The box must be manufactured from suitable plastic material and be of adequate strength in relation to its capacity and intended use. The box must be adequately resistant to aging and to degradation caused either by the substance contained or by ultra-violet radiation.
(2) An expanded plastic box must consist of two parts made of a molded expanded plastic material: a bottom section containing cavities for the inner receptacles, and a top section covering and interlocking with the bottom section. The top and bottom sections must be so designed that the inner receptacles fit snugly. The closure cap for any inner receptacle may not be in contact with the inside of the top section of the box.
(3) For transportation, an expanded plastic box must be closed with a self-adhesive tape having sufficient tensile strength to prevent the box from opening. The adhesive

tape must be weather-resistant and its adhesive compatible with the expanded plastic material of the box. Other closing devices at least equally effective may be used.

(4) For solid plastic boxes, protection against ultra-violet radiation, if required, must be provided by the addition of carbon black or other suitable pigments or inhibitors. These additives must be compatible with the contents and remain effective throughout the life of the box. Where use is made of carbon black pigment or inhibitors other than those used in the manufacture of the tested design type, retesting may be waived if the carbon black content does not exceed 2 percent by mass or if the pigment content does not exceed 3 percent by mass; the content of inhibitors of ultra-violet radiation is not limited.

(5) Additives serving purposes other than protection against ultra-violet radiation may be included in the composition of the plastic material if they do not adversely affect the material of the box. Addition of these additives does not change the design type.

(6) Solid plastic boxes must have closure devices made of a suitable material of adequate strength and so designed as to prevent the box from unintentionally opening.

(7) Maximum net mass 4H1: 60 kg (132 pounds); 4H2: 400 kg (882 pounds).

§178.518 Standards for woven plastic bags.

(a) The following are identification codes for woven plastic bags:

(1) 5H1 for an unlined or non-coated woven plastic bag;

(2) 5H2 for a sift-proof woven plastic bag; and

(3) 5H3 for a water-resistant woven plastic bag.

(b) Construction requirements for woven plastic fabric bags are as follows:

(1) Bags must be made from stretched tapes or monofilaments of a suitable plastic material. The strength of the material used and the construction of the bag must be appropriate to the capacity and intended use of the bag.

(2) If the fabric is woven flat, the bags must be made by sewing or some other method ensuring closure of the bottom and one side. If the fabric is tubular, the bag must be closed by sewing, weaving, or some other equally strong method of closure.

(3) Bags, sift-proof, 5H2 must be made sift-proof by appropriate means such as use of paper or a plastic film bonded to the inner surface of the bag or one or more separate inner liners made of paper or plastic material.

(4) Bags, water-resistant, 5H3: To prevent the entry of moisture, the bag must be made waterproof by appropriate means, such as separate inner liners of water-resistant paper (e.g., waxed kraft paper, double-tarred kraft paper or plastic-coated kraft paper), or plastic film bonded to the inner or outer surface of the bag, or one or more inner plastic liners.

(5) Maximum net mass: 50 kg (110 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, and amended by Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.519 Standards for plastic film bags.

(a) The identification code for a plastic film bag is 5H4.

(b) Construction requirements for plastic film bags are as follows:

(1) Bags must be made of a suitable plastic material. The strength of the material used and the construction of the bag must be appropriate to the capacity and the intended use of the bag. Joints and closures must be capable of withstanding pressures and impacts liable to occur under normal conditions of transportation.

(2) Maximum net mass: 50 kg (110 pounds).

§178.520 Standards for textile bags.

(a) The following are identification codes for textile bags:

(1) 5L1 for an unlined or non-coated textile bag;

(2) 5L2 for a sift-proof textile bag; and

(3) 5L3 for a water-resistant textile bag.

(b) Construction requirements for textile bags are as follows:

(1) The textiles used must be of good quality. The strength of the fabric and the construction of the bag must be appropriate to the capacity and intended use of the bag.

(2) Bags, sift-proof, 5L2: The bag must be made sift-proof, by appropriate means, such as by the use of paper bonded to the inner surface of the bag by a water-resistant adhesive such as bitumen, plastic film bonded to the inner surface of the bag, or one or more inner liners made of paper or plastic material.

(3) Bags, water-resistant, 5L3: To prevent entry of moisture, the bag must be made waterproof by appropriate means, such as by the use of separate inner liners of water-resistant paper (e.g., waxed kraft paper, tarred paper, or plastic-coated kraft paper), or plastic film bonded to the inner surface of the bag, or one or more inner liners made of plastic material or metalized film or foil.

(4) Maximum net mass: 50 kg (110 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66285, Dec. 20, 1991]

§178.521 Standards for paper bags.

(a) The following are identification codes for paper bags:

(1) 5M1 for a multi-wall paper bag; and

(2) 5M2 for a multi-wall water-resistant paper bag.

(b) Construction requirements for paper bags are as follows:

(1) Bags must be made of a suitable kraft paper, or of an equivalent paper with at least three plies. The strength of the paper and the construction of the bag must be

appropriate to the capacity and intended use of the bag. Seams and closures must be sift-proof.

(2) Paper bags 5M2: To prevent the entry of moisture, a bag of four plies or more must be made waterproof by the use of either a water-resistant ply as one of the two outermost plies or a water-resistant barrier made of a suitable protective material between the two outermost plies. A 5M2 bag of three plies must be made waterproof by the use of a water-resistant ply as the outermost ply. When there is danger of the lading reacting with moisture, or when it is packed damp, a waterproof ply or barrier, such as double-tarred kraft paper, plastics-coated kraft paper, plastics film bonded to the inner surface of the bag, or one or more inner plastics liners, must also be placed next to the substance. Seams and closures must be waterproof.

(3) Maximum net mass: 50 kg (110 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended at 56 FR 66285, Dec. 20, 1991; Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.522 Standards for composite packagings with inner plastic receptacles.

(a) The following are the identification codes for composite packagings with inner plastic receptacles:

(1) 6HA1 for a plastic receptacle within a protective steel drum;

(2) 6HA2 for a plastic receptacle within a protective steel crate or box;

(3) 6HB1 for a plastic receptacle within a protective aluminum drum.

(4) 6HB2 for a plastic receptacle within a protective aluminum crate or box.

(5) 6HC for a plastic receptacle within a protective wooden box.

(6) 6HD1 for a plastic receptacle within a protective plywood drum;

(7) 6HD2 for a plastic receptacle within a protective plywood box;

(8) 6HG1 for a plastic receptacle within a protective fiber drum;

(9) 6HG2 for a plastic receptacle within a protective fiberboard box;

(10) 6HH1 for a plastic receptacle within a protective plastic drum; and

(11) 6HH2 for a plastic receptacle within a protective plastic box.

(b) Construction requirements for composite packagings with inner receptacles of plastic are as follows:

(1) Inner receptacles must be constructed under the applicable construction requirements prescribed in §178.509(b) (1) through (7) of this subpart.

(2) The inner plastic receptacle must fit snugly inside the outer packaging, which must be free of any projections which may abrade the plastic material.

(3) Outer packagings must be constructed as follows:

(i) 6HA1 or 6HB1: Protective packaging must conform to the requirements for steel drums in §178.504(b) of this subpart, or aluminum drums in §178.505(b) of this subpart.

(ii) 6HA2 or 6HB2: Protective packagings with steel or aluminum crate must conform to the requirements for steel or aluminum boxes found in §178.512(b) of this subpart.

(iii) 6HC protective packaging must conform to the requirements for wooden boxes in

§178.513(b) of this subpart.
(iv) 6HD1: Protective packaging must conform to the requirements for plywood drums, in §178.507(b) of this subpart.
(v) 6HD2: Protective packaging must conform to the requirements of plywood boxes, in §178.514(b) of this subpart.
(vi) 6HG1: Protective packaging must conform to the requirements for fiber drums, in §178.508(b) of this subpart.
(vii) 6HG2: protective packaging must conform to the requirements for fiberboard boxes, in §178.516(b) of this subpart.
(viii) 6HH1: Protective packaging must conform to the requirements for plastic drums, in §178.509(b).
(ix) 6HH2: Protective packaging must conform to the requirements for plastic boxes, in §178.517(b).
(4) Maximum capacity of inner receptacles is as follows: 6HA1, 6HB1, 6HD1, 6HG1, 6HH1-250 L (66 gallons); 6HA2, 6HB2, 6HC, 6HD2, 6HG2, 6HH2-60 L (16 gallons).
(5) Maximum net mass is as follows: 6HA1, 6HB1, 6HD1, 6HG1, 6HH1-400kg (882 pounds); 6HB2, 6HC, 6HD2, 6HG2, 6HH2-75 kg (165 pounds).

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, as amended by Amdt. 178-106, 59 FR 67521, Dec. 29, 1994]

§178.523 Standards for composite packagings with inner glass, porcelain, or stoneware receptacles.
(a) The following are identification codes for composite packagings with inner receptacles of glass, porcelain, or stoneware:
(1) 6PA1 for glass, porcelain, or stoneware receptacles within a protective steel drum;
(2) 6PA2 for glass, porcelain, or stoneware receptacles within a protective steel crate or box;
(3) 6PB1 for glass, porcelain, or stoneware receptacles within a protective aluminum drum;
(4) 6PB2 for glass, porcelain, or stoneware receptacles within a protective aluminum crate or box;
(5) 6PC for glass, porcelain, or stoneware receptacles within a protective wooden box;
(6) 6PD1 for glass, porcelain, or stoneware receptacles within a protective plywood drum;
(7) 6PD2 for glass, porcelain, or stoneware receptacles within a protective wickerwork hamper;
(8) 6PG1 for glass, porcelain, or stoneware receptacles within a protective fiber drum;
(9) 6PG2 for glass, porcelain, or stoneware receptacles within a protective fiberboard

box;

(10) 6PH1 for glass, porcelain, or stoneware receptacles within a protective expanded plastic packaging; and

(11) 6PH2 for glass, porcelain, or stoneware receptacles within a protective solid plastic packaging.

(b) Construction requirements for composite packagings with inner receptacles of glass, porcelain, or stoneware are as follows:

(1) Inner receptacles must conform to the following requirements:

(i) Receptacles must be of suitable form (cylindrical or pear-shaped), be made of good quality materials free from any defect that could impair their strength, and be firmly secured in the outer packaging.

(ii) Any part of a closure likely to come into contact with the contents of the receptacle must be resistant to those contents. Closures must be fitted so as to be leakproof and secured to prevent any loosening during transportation. Vented closures must conform to §173.24(f) of this subchapter.

(2) Protective packagings must conform to the following requirements:

(i) For receptacles with protective steel drum 6PAl, the drum must comply with §178.504(b) of this subpart. However, the removable lid required for this type of packaging may be in the form of a cap.

(ii) For receptacles with protective packaging of steel crate or steel box 6PA2, the protective packaging must conform to the following:

(A) Section 178.512(b) of this subpart.

(B) In the case of cylindrical receptacles, the protective packaging must, when upright, rise above the receptacle and its closure; and

(C) If the protective crate surrounds a pear-shaped receptacle and is of matching shape, the protective packaging must be fitted with a protective cover (cap).

(iii) For receptacles with protective aluminum drum 6PB1, the requirements of §178.505(b) of this subpart apply to the protective packaging.

(iv) For receptacles with protective aluminum box or crate 6PB2, the requirements of §178.512(b) of this subpart apply to the protective packaging.

(v) For receptacles with protective wooden box 6PC, the requirements of §178.513(b) of this subpart apply to the protective packaging.

(vi) For receptacles with protective plywood drum 6PD1, the requirements of §178.507(b) of this subpart apply to the protective packaging.

(vii) For receptacles with protective wickerwork hamper 6PD2, the wickerwork hamper must be properly made with material of good quality. The hamper must be fitted with a protective cover (cap) so as to prevent damage to the receptacle.

(viii) For receptacles with protective fiber drum 6PG1, the drum must conform to the requirements of §178.508(b) of this subpart.

(ix) For receptacles with protective fiberboard box 6PG2, the requirements of §178.516(b) of this subpart apply to the protective packaging.

(x) For receptacles with protective solid plastic or expanded plastic packaging 6PH1 or 6PH2, the requirements of §178.517(b) of this subpart apply to the protective packaging. Solid protective plastic packaging must be manufactured from high-density polyethylene from some other comparable plastic material. The removable lid required for this type of packaging may be a cap.

(3) Quantity limitations are as follows:

(i) Maximum net capacity for packaging for liquids: 60 L (16 gallons).

(ii) Maximum net mass for packagings for solids: 75 kg (165 pounds).

[CFR] PART 178 SUBPART M - Testing of Non-bulk Packagings and Packages

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART M]

Subpart M - Testing of Non-bulk Packagings and Packages

Source: Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, unless otherwise noted.

§178.600 Purpose and scope.

This subpart prescribes certain testing requirements for performance-oriented packagings identified in subpart L of this part.

[Amdt. 178-97, 55 FR 52717, Dec. 21, 1990, and amended by Amdt. 178-99, 58 FR 51534, Oct. 1, 1993]

§178.601 General requirements.

(a) *General. The test procedures prescribed in this subpart are intended to ensure that packages containing hazardous materials can withstand normal conditions of transportation and are considered minimum requirements. Each packaging must be manufactured and assembled so as to be capable of successfully passing the prescribed tests and of conforming to the requirements of §173.24 of this subchapter at all times while in transportation.*

(b) Responsibility. It is the responsibility of the packaging manufacturer to assure that each package is capable of passing the prescribed tests. To the extent that a package assembly function, including final closure, is performed by the person who offers a hazardous material for transportation, that person is responsible for performing the function in accordance with §§173.22 and 178.2 of this subchapter.

(c) Definitions. For the purpose of this subpart:

(1) Design qualification testing is the performance of the drop, leakproofness, hydrostatic pressure, stacking, and cooperage tests, as applicable, prescribed in

§§178.603, 178.604, 178.605, 178.606, or §178.607, respectively, for each new or different packaging, at the start of production of that packaging.

(2) Periodic retesting is the performance of the drop, leakproofness, hydrostatic pressure, and stacking tests, as applicable, prescribed in §§178.603, 178.604, 178.605, or §178.606, respectively, at the frequency specified in §178.601(e) of this subpart.

(3) Production testing is the performance of the leakproofness test prescribed in §178.604 of this subpart on each single or composite packaging intended to contain a liquid.

(4) A different packaging is one that differs (i.e. is not identical) from a previously produced packaging in structural design, size, material of construction, wall thickness or manner of construction but does not include:

(i) A packaging which differs only in surface treatment;

(ii) A combination packaging which differs only in that the outer packaging has been successfully tested with different inner packagings. A variety of such inner packagings may be assembled in this outer packaging without further testing;

(iii) A plastic packaging which differs only with regard to additives which conform to §178.509(b)(3) or §178.517(b) (4) or (5) of this part;

(iv) A combination packaging with inner packagings conforming to the provisions of paragraph (g) of this section;

(v) Packagings which differ from the design type only in their lesser design height; or

(vi) For a steel drum, variations in design elements which do not constitute a different design type under the provisions of paragraph (g)(8) of this section.

(d) *Design qualification testing. The packaging manufacturer shall achieve successful test results for the design qualification testing at the start of production of each new or different packaging.*

(e) Periodic retesting. The packaging manufacturer shall achieve successful test results for the periodic retesting at intervals established by the manufacturer of sufficient frequency to ensure that each packaging produced by the manufacturer is capable of passing the design qualification tests. Changes in retest frequency are subject to the approval of the Associate Administrator for Hazardous Materials Safety. For single or composite packagings, the periodic retests must be conducted at least once every 12 months. For combination packagings, the periodic retests must be conducted at least once every 24 months.

(f) Test samples. The manufacturer shall conduct the design qualification and periodic tests prescribed in this subpart using random samples of packagings, in the numbers specified in the appropriate test section. In addition, the leakproofness test, when required, shall be performed on each packaging produced by the manufacturer, and each packaging prior to reuse under §173.28 of this subchapter, by the reconditioner.

(g) Selective testing. The selective testing of packagings that differ only in minor respects from a tested type is permitted as described in this section. For air transport, packagings must comply with §173.27(c)(1) and (c)(2) of this subchapter.

(1) Selective testing of combination packagings. Variation 1. Variations are permitted in inner packagings of a tested combination package, without further testing of the

package, provided an equivalent level of performance is maintained, as follows:

(i) Inner packagings of equivalent or smaller size may be used provided-

(A) The inner packagings are of similar design to the tested inner packagings (i.e. shape-round, rectangular, etc.);

(B) The material of construction of the inner packagings (glass, plastic, metal, etc.) offers resistance to impact and stacking forces equal to or greater than that of the originally tested inner packaging;

(C) The inner packagings have the same or smaller openings and the closure is of similar design (e.g., screw cap, friction lid, etc.);

(D) Sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings;

(E) Inner packagings are oriented within the outer packaging in the same manner as in the tested package; and,

(F) The gross mass of the package does not exceed that originally tested.

(ii) A lesser number of the tested inner packagings, or of the alternative types of inner packagings identified in paragraph (g)(1)(i) of this section, may be used provided sufficient cushioning is added to fill void space(s) and to prevent significant movement of the inner packagings.

(2) *Selective testing of combination packagings. Variation 2. Articles or inner packagings of any type, for solids or liquids, may be assembled and transported without testing in an outer packaging under the following conditions:*

(i) The outer packaging must have been successfully tested in accordance with §178.603 with fragile (e.g. glass) inner packagings containing liquids at the Packing Group I drop height;

(ii) The total combined gross mass of inner packagings may not exceed one-half the gross mass of inner packagings used for the drop test;

(iii) The thickness of cushioning material between inner packagings and between inner packagings and the outside of the packaging may not be reduced below the corresponding thickness in the originally tested packaging; and when a single inner packaging was used in the original test, the thickness of cushioning between inner packagings may not be less than the thickness of cushioning between the outside of the packaging and the inner packaging in the original test. When either fewer or smaller inner packagings are used (as compared to the inner packagings used in the drop test), sufficient additional cushioning material must be used to take up void spaces.

(iv) The outer packaging must have successfully passed the stacking test set forth in §178.606 of this subpart when empty, i.e., without either inner packagings or cushioning materials. The total mass of identical packages must be based on the combined mass of inner packagings used for the drop test;

(v) Inner packagings containing liquids must be completely surrounded with a sufficient quantity of absorbent material to absorb the entire liquid contents of the inner packagings;

(vi) When the outer packaging is intended to contain inner packagings for liquids and is not leakproof, or is intended to contain inner packagings for solids and is not siftproof, a means of containing any liquid or solid contents in the event of leakage must be provided in the form of a leakproof liner, plastic bag, or other equally efficient means of containment. For packagings containing liquids, the absorbent material required in paragraph (g)(2)(v) of this section must be placed inside the means of containing liquid contents; and

(vii) Packagings must be marked in accordance with §178.503 of this part as having been tested to Packing Group I performance for combination packagings. The marked maximum gross mass may not exceed the sum of the mass of the outer packaging plus one half the mass of the filled inner packagings of the tested combination packaging. In addition, the marking required by §178.503(a)(2) of this part must include the letter "V".

(3) *Variation 3. Packagings other than combination packagings which are produced with reductions in external dimensions (i.e., length, width or diameter) of up to 25 percent of the dimensions of a tested packaging may be used without further testing provided an equivalent level of performance is maintained. The packagings must, in all other respects (including wall thicknesses), be identical to the tested design-type. The marked gross mass (when required) must be reduced in proportion to the reduction in volume.*

(4) Variation 4. Variations are permitted in outer packagings of a tested design-type combination packaging, without further testing, provided an equivalent level of performance is maintained, as follows:

(i) Each external dimension (length, width and height) is less than or equal to the corresponding dimension of the tested design-type;

(ii) The structural design of the tested outer packaging (i.e. methods of construction, materials of construction, strength characteristics of materials of construction, method of closure and material thicknesses) is maintained;

(iii) The inner packagings are identical to the inner packagings used in the tested design type except that their size and mass may be less; and they are oriented within the outer packaging in the same manner as in the tested packaging;

(iv) The same type or design of absorbent materials, cushioning materials and any other components necessary to contain and protect inner packagings, as used in the tested design type, are maintained. The thickness of cushioning material between inner packagings and between inner packagings and the outside of the packaging may not be less than the thicknesses in the tested design type packaging; and

(v) Sufficient additional cushioning material is used to take up void spaces and to prevent significant movement of the inner packagings.

An outer packaging qualifying for use in transport in accordance with all of the above conditions may also be used without testing to transport inner packagings substituted for the originally tested inner packagings in accordance with the conditions set out in Variation 1 in paragraph (g)(1) of this section.

(5) *Variation 5. Single packagings (i.e., non-bulk packagings other than combination packagings), that differ from a tested design type only to the extent that the closure device or gasketing differs from that used in the originally tested design type, may be used without further testing, provided an equivalent level of performance is maintained, subject to the following conditions (the qualifying tests):*

(i) A packaging with the replacement closure devices or gasketing must successfully pass the drop test specified in §178.603 in the orientation which most severely tests the integrity of the closure or gasket;

(ii) When intended to contain liquids, a packaging with the replacement closure devices or gasketing must successfully pass the leakproofness test specified in §178.604, the hydrostatic pressure test specified in §178.605, and the stacking test specified in §178.606.

Replacement closures and gasketings qualified under the above test requirements are authorized without additional testing for packagings described in paragraph (g)(3) of this section. Replacement closures and gasketings qualified under the above test requirements also are authorized without additional testing for different tested design types packagings of the same type as the originally tested packaging, provided the original design type tests are more severe or comparable to tests which would otherwise be conducted on the packaging with the replacement closures or gasketings. (For example: The packaging used in the qualifying tests has a lesser packaging wall thickness than the packaging with replacement closure devices or gasketing; the gross mass of the packaging used in the qualifying drop test equals or exceeds the mass for which the packaging with replacement closure devices or gasketing was tested; the packaging used in the qualifying drop test was dropped from the same or greater height than the height from which the packaging with replacement closure devices or gasketing was dropped in design type tests; and the specific gravity of the substance used in the qualifying drop test was the same or greater than the specific gravity of the liquid used in the design type tests of the packaging with replacement closure devices or gasketing.)

(6) The provisions in Variations 1, 2, and 4 in paragraphs (g)(1), (2) and (4) of this section for combination packagings may be applied to packagings containing articles, where the provisions for inner packagings are applied analogously to the articles. In this case, inner packagings need not comply with §173.27(c)(1) and (c)(2) of this subchapter.

(7) *Approval of selective testing. In addition to the provisions of §178.601(g)(1) through (g)(6) of this subpart, the Associate Administrator for Hazardous Materials Safety may approve the selective testing of packagings that differ only in minor respects from a tested type.*

(8) For a steel drum with a capacity greater than 50 L (13 gallons) manufactured from low carbon, cold-rolled sheet steel meeting ASTM designations A366/A366M or A568/A568M, variations in elements other than the following design elements are considered minor and do not constitute a different drum design type, or "different packaging" as defined in paragraph (c) of this section for which design qualification testing and periodic retesting are required. Minor variations authorized without further testing include changes in the identity of the supplier of component material made to the same specifications, or the original manufacturer of a DOT specification or UN standard drum to be remanufactured. A change in any one or more of the following design elements constitutes a different drum design type:

(i) The packaging type and category of the original drum and the remanufactured drum, i.e., 1A1 or 1A2;

(ii) The style, (i.e., straight-sided or tapered);

(iii) Except as provided in paragraph (g)(3) of this section, the rated (marked) capacity and outside dimensions;

(iv) The physical state for which the packaging was originally approved (e.g., tested for solids or liquids);

(v) An increase in the marked level of performance of the original drum (i.e., to a higher packing group, hydrostatic test pressure, or specific gravity to which the packaging has been tested);

(vi) Type of side seam welding;

(vii) Type of steel;

(viii) An increase greater than 10% or any decrease in the steel thickness of the head, body, or bottom;

(ix) End seam type, (e.g., triple or double seam);

(x) A reduction in the number of rolling hoops which equal or exceed the diameter over the chimes;

(xi) The location, type or size, and material of closures (other than the cover of UN 1A2 drums); and

(xii) For UN 1A2 drums:

(A) Gasket material (e.g., plastic), or properties affecting the performance of the gasket;

(B) Configuration or dimensions of the gasket;

(C) Closure ring style including bolt size, (e.g., square or round back, 0.625" bolt); and

(D) Closure ring thickness.

(h) *Approval of equivalent packagings. A packaging having specifications different from those in §§178.504-178.523 of this part, or which is tested using methods or test intervals, other than those specified in subpart M of this part, may be used if approved by the Associate Administrator for Hazardous Materials Safety. Such packagings must be shown to be equally effective, and testing methods used must be equivalent.*

(i) Proof of compliance. Notwithstanding the periodic retest intervals specified in paragraph (e) of this section, the Associate Administrator for Hazardous Materials Safety may at any time require demonstration of compliance by a manufacturer, through testing in accordance with this subpart, that packagings meet the requirements of this subpart. As required by the Associate Administrator for Hazardous Materials Safety, the manufacturer shall either-

(1) Conduct performance tests, or have tests conducted by an independent testing facility, in accordance with this subpart; or

(2) Supply packagings, in quantities sufficient to conduct tests in accordance with this subpart, to the Associate Administrator for Hazardous Materials Safety or a designated representative of the Associate Administrator.

(j) *Coatings. If an inner treatment or coating of a packaging is required for safety reasons, the manufacturer shall design the packaging so that the treatment or coating* *retains its protective properties even after withstanding the tests prescribed by this subpart.*

(k) Number of test samples. Provided the validity of the test results is not affected and with the approval of the Associate Administrator for Hazardous Materials Safety, several tests may be performed on one sample.

(l) Record retention. Following each design qualification test and each periodic retest on a packaging, a test report must be prepared. The test report must be maintained at each location where the packaging is manufactured and each location where the design qualification tests are conducted, for as long as the packaging is produced and for at least two years thereafter, and at each location where the periodic retests are conducted until such tests are successfully performed again and a new test report produced. In addition, a copy of the test report must be maintained by a person certifying compliance with this part. The test report must be made available to a user of a packaging or a representative of the Department upon request. The test report, at a minimum, must contain the following information:

(1) Name and address of test facility;

(2) Name and address of applicant (where appropriate);

(3) A unique test report identification;

(4) Date of the test report;

(5) Manufacturer of the packaging;

(6) Description of the packaging design type (e.g. dimensions, materials, closures, thickness, etc.), including methods of manufacture (e.g. blow molding) and which may include drawing(s) and/or photograph(s);

(7) Maximum capacity;

(8) Characteristics of test contents, e.g. viscosity and relative density for liquids and particle size for solids;

(9) Test descriptions and results; and

(10) Signed with the name and title of signatory.

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66285, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 178-102, 59 FR 28494, June 2, 1994; Amdt. 178-106, 59 FR 67521, 67522, Dec. 29, 1994; Amdt. 178-117, 61 FR 50628, Sept. 26, 1996]

§178.602 Preparation of packagings and packages for testing.

(a) Except as otherwise provided in this subchapter, each packaging and package must be closed in preparation for testing and tests must be carried out in the same manner as if prepared for transportation, including inner packagings in the case of combination packagings.

(b) For the drop and stacking test, inner and single-unit receptacles must be filled to not less than 95 percent of maximum capacity (see §171.8 of this subchapter) in the case of solids and not less than 98 percent of maximum capacity in the case of liquids.

The material to be transported in the packagings may be replaced by a non-hazardous material, except for chemical compatibility testing or where this would invalidate the results of the tests.

(c) If the material to be transported is replaced for test purposes by a non-hazardous material, the material used must be of the same or higher specific gravity as the material to be carried, and its other physical properties (grain, size, viscosity) which might influence the results of the required tests must correspond as closely as possible to those of the hazardous material to be transported. Water may also be used for the liquid drop test under the conditions specified in §178.603(e) of this subpart. It is permissible to use additives, such as bags of lead shot, to achieve the requisite total package mass, so long as they are placed so that the test results are not affected.

(d) Paper or fiberboard packagings must be conditioned for at least 24 hours immediately prior to testing in an atmosphere maintained-

(1) At 50 percent +2 percent relative humidity, and at a temperature of 23 ^{o}C+2 ^{o}C (73 ^{o}F+4 ^{o}F). Average values should fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to + 5 percent relative humidity without significant impairment of test reproducibility;

(2) At 65 percent +2 percent relative humidity, and at a temperature of 20 ^{o}C+2 ^{o}C (68 ^{o}F+4 ^{o}F), or 27 ^{o}C+2 ^{o}C (81 ^{o}F+4 ^{o}F). Average values should fall within these limits. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to + 5 percent relative humidity without significant impairment of test reproducibility; or

(3) For testing at periodic intervals only (i.e., other than initial design qualification testing), at ambient conditions.

(e) Except as otherwise provided, each packaging must be closed in preparation for testing in the same manner as if prepared for actual shipment. All closures must be installed using proper techniques and torques.

(f) Bung-type barrels made of natural wood must be left filled with water for at least 24 hours before the tests.

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991; Amdt. 178-106, 59 FR 67522, Dec. 29, 1994]

§178.603 Drop test.

(a) *General. The drop test must be conducted for the qualification of all packaging design types and performed periodically as specified in §178.601(e). For other than flat drops, the center of gravity of the test packaging must be vertically over the point of impact. Where more than one orientation is possible for a given drop test, the orientation most likely to result in failure of the packaging must be used. The number of drops required and the packages' orientations are as follows:*

Packaging	No. of tests (samples)	Drop orientation of samples
Steel drums, Aluminum drums, Metal drums (other than steel or aluminum), Steel Jerricans, Plywood drums, Wooden barrels, Fiber drums, Plastic drums and Jerricans, Composite packagings which are in the shape of a drum	Six-(three for each drop)	First drop (using three samples): The package must strike the target diagonally on the chime or, if the packaging has no chime, on a circumferential seam or an edge. Second drop (using the other three samples): The package must strike the target on the weakest part not tested by the first drop, for example a closure or, for some 7 cylindrical drums, the welded longitudinal seam of the drum body.
Boxes of natural wood, Plywood boxes, Reconstituted wood boxes, Fiberboard boxes, Plastic boxes, Steel or aluminum boxes, Composite packagings which are in the shape of a box	Five-(one for each drop)	First drop: Flat on the bottom (using the first sample). Second drop: Flat on the top (using the second sample). Third drop: Flat on the long side (using the third sample). Fourth drop: Flat on the short side (using the fourth sample). Fifth drop: On a corner (using the fifth sample).
Bags-single-ply with a side seam	Three-(three drops per bag)	First drop: Flat on a wide face (using all three samples). Second drop: Flat on a narrow face (using all three samples). Third drop: On an end of the bag (using all three samples).
Bags-single-ply without a side seam, or multi-ply	Three-(two drops per bag)	First drop: Flat on a wide face (using all three samples). Second drop: On an end of the bag (using all three samples).

(b) *Exceptions. For testing of single or composite packagings constructed of stainless steel, nickel, or monel at periodic intervals only (i.e., other than design qualification testing), the drop test may be conducted with two samples, one sample each for the two drop orientations. These samples may have been previously used for the hydrostatic pressure or stacking test. Exceptions for the number of steel and aluminum packaging samples used for conducting the drop test are subject to the approval of the Associate Administrator for Hazardous Materials Safety.*

(c) Special preparation of test samples for the drop test. Testing of plastic drums, plastic jerricans, plastic boxes other than expanded polystyrene boxes, composite packagings (plastic material), and combination packagings with plastic inner packagings other than plastic bags intended to contain solids or articles must be carried out when the temperature of the test sample and its contents has been reduced to -18 ^{o}C (0 ^{o}F) or lower. Test liquids shall be kept in the liquid state, if necessary, by the addition of anti-freeze. Test samples prepared in this way are not required to be conditioned in accordance with §178.602(d).

(d) Target. The target must be a rigid, non-resilient, flat and horizontal surface.

(e) Drop height. Drop heights, measured as the vertical distance from the target to the lowest point on the package, must be determined as follows:

(1) For solids and liquids, if the test is performed with the solid or liquid to be transported or with a non-hazardous material having essentially the same physical characteristic, the drop height must be determined according to packing group, as follows:

(i) Packing Group I: 1.8 m (5.9 feet).
(ii) Packing Group II: 1.2 m (3.9 feet).
(iii) Packing Group III: 0.8 m (2.6 feet).
(2) For liquids, if the test is performed with water-
(i) Where the materials to be carried have a specific gravity not exceeding 1.2, drop height must be determined according to packing group, as follows:
(A) Packing Group I: 1.8 m (5.9 feet).
(B) Packing Group II: 1.2 m (3.9 feet).
(C) Packing Group III: 0.8 m (2.6 feet).
(ii) Where the materials to be transported have a specific gravity exceeding 1.2, the drop height must be calculated on the basis of the specific gravity (SG) of the material to be carried, rounded up to the first decimal, as follows:
(A) Packing Group I: SG x 1.5 m (4.9 feet).
(B) Packing Group II: SG x 1.0 m (3.3 feet).
(C) Packing Group III: SG x 0.67 m (2.2 feet).
(f) *Criteria for passing the test. A package is considered to successfully pass the drop tests if for each sample tested-*
(1) For packagings containing liquid, each packaging does not leak when equilibrium has been reached between the internal and external pressures, except for inner packagings of combination packagings when it is not necessary that the pressures be equalized;
(2) For removable head drums for solids, the entire contents are retained by an inner packaging (e.g., a plastic bag) even if the closure on the top head of the drum is no longer sift-proof;
(3) For a bag, neither the outermost ply nor an outer packaging exhibits any damage likely to adversely affect safety during transport;
(4) For a composite or combination packaging, there is no damage to the outer packaging likely to adversely affect safety during transport, and there is no leakage of the filling substance from the inner packaging;
(5) For a drum, jerrican or bag, any discharge from a closure is slight and ceases immediately after impact with no further leakage; and
(6) No rupture is permitted in packagings for materials in Class 1 which would permit spillage of loose explosive substances or articles from the outer packaging.

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-106, 59 FR 67522, Dec. 29, 1994]

§178.604 Leakproofness test.
(a) *General. The leakproofness test must be performed with compressed air or other suitable gases on all packagings intended to contain liquids, except that:*
(1) The inner receptacle of a composite packaging may be tested without the outer

packaging provided the test results are not affected; and
(2) This test is not required for inner packagings of combination packagings.
(b) *Number of packagings to be tested-(1) Production testing. All packagings subject to the provisions of this section must be tested and must pass the leakproofness test:*
(i) Before they are first used in transportation; and
(ii) Prior to reuse, when authorized for reuse by §173.28 of this subchapter.
(2) *Design qualification and periodic testing. Three samples of each different packaging must be tested and must pass the leakproofness test. Exceptions for the number of samples used in conducting the leakproofness test are subject to the approval of the Associate Administrator for Hazardous Materials Safety.*
(c) Special preparation-(1) For design qualification and periodic testing, packagings must be tested with closures in place. For production testing, packagings need not have their closures in place. Removable heads need not be installed during production testing.
(2) For testing with closures in place, vented closures must either be replaced by similar non-vented closures or the vent must be sealed.
(d) *Test method. The packaging must be restrained under water while an internal air pressure is applied; the method of restraint must not affect the results of the test. The test must be conducted, for other than production testing, for a minimum time of five minutes. Other methods, at least equally effective, may be used in accordance with appendix B of this part.*
(e) Pressure applied. An internal air pressure (gauge) must be applied to the packaging as indicated for the following packing groups:
(1) Packing Group I: Not less than 30 kPa (4 psi).
(2) Packing Group II: Not less than 20 kPa (3 psi).
(3) Packing Group III: Not less than 20 kPa (3 psi).
(f) *Criteria for passing the test. A packaging passes the test if there is no leakage of air from the packaging.*

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991; Amdt. 178-106, 59 FR 67522, Dec. 29, 1994]

§178.605 Hydrostatic pressure test.

(a) *General. The hydrostatic pressure test must be conducted for the qualification of all metal, plastic, and composite packaging design types intended to contain liquids and be performed periodically as specified in §178.601(e). This test is not required for inner packagings of combination packagings. For internal pressure requirements for inner packagings of combination packagings intended for transportation by aircraft, see §173.27(c) of this subchapter.*
(b) Number of test samples. Three test samples are required for each different packaging. For packagings constructed of stainless steel, monel, or nickel, only one sample is required for periodic retesting of packagings. Exceptions for the number of

aluminum and steel sample packagings used in conducting the hydrostatic pressure test are subject to the approval of the Associate Administrator for Hazardous Materials Safety.

(c) Special preparation of receptacles for testings. Vented closures must either be replaced by similar non-vented closures or the vent must be sealed.

(d) Test method and pressure to be applied. Metal packagings and composite packagings other than plastic (e.g., glass, porcelain or stoneware), including their closures, must be subjected to the test pressure for 5 minutes. Plastic packagings and composite packagings (plastic material), including their closures, must be subjected to the test pressure for 30 minutes. This pressure is the one to be marked as required in §178.503(a)(5) of this part. The receptacles must be supported in a manner that does not invalidate the test. The test pressure must be applied continuously and evenly, and it must be kept constant throughout the test period. The hydraulic pressure (gauge) applied, taken at the top of the receptacle, and determined by any one of the following methods must be:

(1) Not less than the total gauge pressure measured in the packaging (i.e., the vapor pressure of the filling material and the partial pressure of the air or other inert gas minus 100 kPa (15 psi)) at 55 ^{o}C (131 ^{o}F), multiplied by a safety factor of 1.5. This total gauge pressure must be determined on the basis of a maximum degree of filling in accordance with §173.24a(b)(3) of this subchapter and a filling temperature of 15 ^{o}C (59 ^{o}F);

(2) Not less than 1.75 times the vapor pressure at 50 ^{o}C (122 ^{o}F) of the material to be transported minus 100 kPa (15 psi) but with a minimum test pressure of 100 kPa (15 psi); or

(3) Not less than 1.5 times the vapor pressure at 55 ^{o}C (l3l ^{o}F) of the material to be transported minus 100 kPa (15 psi), but with a minimum test pressure of 100 kPa (15 psi).

Packagings intended to contain hazardous materials of Packing Group I must be tested to a minimum test pressure of 250 kPa (36 psi).

(e) *Criteria for passing the test. A package passes the hydrostatic test if, for each test sample, there is no leakage of liquid from the package.*

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991; Amdt. 178-99, 58 FR 51534, Oct. 1, 1993; Amdt. 178-102, 59 FR 28494, June 2, 1994]

§178.606 Stacking test.

(a) *General. All packaging design types other than bags must be subjected to a stacking test.*

(b) Number of test samples. Three test samples are required for each different packaging. For periodic retesting of packagings constructed of stainless steel, monel, or nickel, only one test sample is required. Exceptions for the number of aluminum and steel sample packagings used in conducting the stacking test are subject to the approval of the Associate Administrator for Hazardous Materials Safety. Notwithstanding the provisions of §178.602(a) of this subpart, combination packagings may be subjected to the stacking test without their inner packagings, except where this would invalidate the results of the test.

(c) Test method-(1) Design qualification testing. The test sample must be subjected to a force applied to the top surface of the test sample equivalent to the total weight of identical packages which might be stacked on it during transport; where the contents of the test sample are non-hazardous liquids with specific gravities different from that of the liquid to be transported, the force must be calculated based on the specific gravity that will be marked on the packaging. The minimum height of the stack, including the test sample, must be 3.0 m (10 feet). The duration of the test must be 24 hours, except that plastic drums, jerricans, and composite packaging 6HH, intended for liquids, shall be subjected to the stacking test for a period of 28 days at a temperature of not less than 40 ^{o}C (104 ^{o}F). Alternative test methods which yield equivalent results may be used if approved by the Associate Administrator for Hazardous Materials Safety. In guided load tests, stacking stability must be assessed after completion of the test by placing two filled packagings of the same type on the test sample. The stacked packages must maintain their position for one hour. Plastic packagings must be cooled to ambient temperature before this stacking stability assessment.

(2) Periodic retesting. The test sample must be tested in accordance with:

(i) Section 178.606(c)(1) of this subpart; or

(ii) The packaging may be tested using a dynamic compression testing machine. The test must be conducted at room temperature on an empty, unsealed packaging. The test sample must be centered on the bottom platen of the testing machine. The top platen must be lowered until it comes in contact with the test sample. Compression must be applied end to end. The speed of the compression tester must be one-half inch plus or minus one-fourth inch per minute. An initial preload of 50 pounds must be applied to ensure a definite contact between the test sample and the platens. The distance between the platens at this time must be recorded as zero deformation. The force A to then be applied must be calculated using the formula:

Liquids: $A = (n - 1) [w + (s \times v \times 8.3 \times .98)] \times 1.5$;

Solids: $A = (n - 1) [w + (s \times v \times 8.3 \times .95)] \times 1.5$

Where:

A = applied load in pounds.
n = minimum number of containers that, when stacked, reach a height of 3 m.
s = specific gravity of lading.
w = maximum weight of one empty container in pounds.
v = actual capacity of container (rated capacity + outage) in gallons.

And:

8.3 corresponds to the weight in pounds of 1.0 gallon of water.
1.5 is a compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing.

(d) *Criteria for passing the test. No test sample may leak. In composite packagings or combination packagings, there must be no leakage of the filling substance from the inner receptacle, or inner packaging. No test sample may show any deterioration which could adversely affect transportation safety or any distortion likely to reduce its strength, cause instability in stacks of packages, or cause damage to inner packagings likely to reduce safety in transportation. For the dynamic compression test, a container passes the test if, after application of the required load, there is no buckling of the sidewalls sufficient to cause damage to its expected contents; in no case may the maximum deflection exceed one inch.*

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991; 57 FR 45465, Oct. 1, 1992; Amdt. 178-102, 59 FR 28494, June 2, 1994; Amdt. 178-106, 59 FR 67522, Dec. 29, 1994]

§178.607 Cooperage test for bung-type wooden barrels.

(a) *Number of samples. One barrel is required for each different packaging.*

(b) Method of testing. Remove all hoops above the bilge of an empty barrel at least two days old.

(c) Criteria for passing the test. A packaging passes the cooperage test only if the diameter of the cross-section of the upper part of the barrel does not increase by more than 10 percent.

§178.608 Vibration standard.

(a) Each packaging must be capable of withstanding, without rupture or leakage, the vibration test procedure outlined in this section.

(b) Test method. (1) Three sample packagings, selected at random, must be filled and closed as for shipment.

(2) The three samples must be placed on a vibrating platform that has a vertical or rotary double-amplitude (peak-to-peak displacement) of one inch. The packages should be constrained horizontally to prevent them from falling off the platform, but must be left free to move vertically, bounce and rotate.

(3) The test must be performed for one hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material of approximately 1.6 mm (0.063 inch) thickness (such as steel strapping or paperboard)

can be passed between the bottom of any package and the platform.
(4) Immediately following the period of vibration, each package must be removed from the platform, turned on its side and observed for any evidence of leakage.
(5) Other methods, at least equally effective, may be used, if approved by the Associate Administrator for Hazardous Materials Safety.
(c) *Criteria for passing the test. A packaging passes the vibration test if there is no rupture or leakage from any of the packages. No test sample should show any deterioration which could adversely affect transportation safety or any distortion liable to reduce packaging strength.*

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended at 56 FR 66286, Dec. 20, 1991]

§178.609 Test requirements for packagings for infectious substances (etiologic agents).

(a) Samples of each packaging must be prepared for testing as described in paragraph (b) of this section and then subjected to the tests in paragraphs (d) through (i) of this section.

(b) Samples of each packaging must be prepared as for transport except that a liquid or solid infectious substance should be replaced by water or, where conditioning at -18 ^{o}C (0 ^{o}F) is specified, by water/antifreeze. Each primary receptacle must be filled to 98 percent capacity. Packagings for live animals should be tested with the live animal being replaced by an appropriate dummy of similar mass.

(c) Packagings prepared as for transport must be subjected to the tests in table I of this paragraph, which, for test purposes, categorizes packagings according to their material characteristics. For outer packagings, the headings in table I relate to fiberboard or similar materials whose performance may be rapidly affected by moisture; plastics, other than expanded plastics or film, which may embrittle at low temperature; and other materials such as metal whose performance is not significantly affected by moisture or temperature. Inner packagings may be of plastics, other than expanded plastics or film. Where a primary receptacle and a secondary packaging of an inner packaging are made of different materials, the material of the primary receptacle determines the appropriate test.

Table I-Tests Required

Material of					Tests required				
Outer packaging			Inner packaging		Refer to para. (d)				Refer to para. (h)
Fiberboard	Plastics	Other	Plastics	Other	(d)	(e)	(f)	(g)	-
X	-	-	X	-	-	X	X	When dry ice is used	X

X	-	-	-	X	-	X	-	-	X
-	X	-	X	-	-	-	X	-	X
-	X	-	-	X	-	-	X	-	X
-	-	X	X	-	-	-	X	-	X
-	-	X	-	X	X	-	-	-	X

(d) Samples must be subjected to free-fall drops onto a rigid, nonresilient, flat, horizontal surface from a height of 9 m (30 feet).

The drops must be performed as follows:

(1) Where the samples are in the shape of a box, five must be dropped in sequence:

(i) Flat on the bottom;

(ii) Flat on the top;

(iii) Flat on the long side;

(iv) Flat on the short side; and

(v) On a corner.

(2) Where the samples are in the shape of a drum, three must be dropped in sequence:

(i) Diagonally on the top chime, with the center of gravity directly above the point of impact;

(ii) Diagonally on the base chime; and

(iii) Flat on the side.

(3) While the sample should be released in the required orientation, it is accepted that for aerodynamic reasons the impact may not take place in that orientation.

(4) Following the appropriate drop sequence, there must be no leakage from the primary receptacle(s) which should remain protected by absorbent material in the secondary packaging.

(e) The sample must be fully immersed in water for a period of at least 5 minutes and then allowed to drain for not more than 30 minutes at 23 ^{o}C (73 ^{o}F) and 50 + 2 percent relative humidity. It should then be subjected to the test described in paragraph (d) of this section.

(f) The sample must be conditioned in an atmosphere of -18 ^{o}C (0 ^{o}F) or less for a period of at least 24 hours and within 15 minutes of removal from that atmosphere be subjected to the test described in paragraph (d) of this section. Where the sample contains dry ice, the conditioning period may be reduced to 4 hours.

(g) Where packaging is intended to contain dry ice, a test additional to that specified in paragraph (d) or (e) or (f) of this section must be carried out. One sample must be stored so that all the dry ice dissipates and then be subjected to the test described in paragraph (d) of this section.

(h) Packagings with a gross mass of 7 kg (15 pounds) or less should be subjected to the tests described in paragraph (h)(1) of this section and packagings with a gross mass exceeding 7 kg (15 pounds) to the tests in paragraph (h)(2) of this section.

(1) Samples must be placed on a level hard surface. A cylindrical steel rod with a mass of at least 7 kg (15 pounds), a diameter not exceeding 38 mm (1.5 inches) and

the impact end edges a radius not exceeding 6 mm (0.2 inches), must be dropped in a vertical free fall from a height of 1 m (3 feet), measured from the impact end of the impact surface of the sample. One sample must be placed on its base. A second sample must be placed in an orientation perpendicular to that used for the first. In each instance the steel rod must be aimed to impact the primary receptacle. Following each impact, penetration of the secondary packaging is acceptable, provided that there is no leakage from the primary receptacle(s).

(2) Samples must be dropped on to the end of a cylindrical steel rod. The rod must be set vertically in a level hard surface. It must have a diameter of 38 mm (1.5 inches) and the edges of the upper end a radius not exceeding 6 mm (0.2 inches). The rod must protrude from the surface a distance at least equal to that between the primary receptacle(s) and the outer surface of the outer packaging with a minimum of 200 mm (7.9 inches). One sample must be dropped in a vertical free fall from a height of 1 m (3 feet), measured from the top of the steel rod. A second sample must be dropped from the same height in an orientation perpendicular to that used for the first. In each instance the packaging should be so orientated that the steel rod must be aimed to impact the primary receptacle(s). Following each impact, penetration of the secondary packaging is acceptable, provided that there is not leakage from the primary receptacle(s).

(i) Packagings subject to this section are not subject to §178.503 or any other requirements of this subpart, except §178.608.

[Amdt. 178-97, 55 FR 52723, Dec. 21, 1990, as amended by Amdt. 178-111, 60 FR 48787, Sept. 20, 1995]

[CFR] PART 178 SUBPART N - Intermediate Bulk Container Performance-Oriented Standards

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART N]

Subpart N - Intermediate Bulk Container Performance-Oriented Standards

Source: Amdt. 178-103, 59 FR 38068, July 26, 1994, unless otherwise noted.

§178.700 Purpose, scope and definitions.

(a) This subpart prescribes requirements applying to intermediate bulk containers intended for the transportation of hazardous materials. Standards for these packagings are based on the UN Recommendations.

(b) Terms used in this subpart are defined in §171.8 of this subchapter and in paragraph (c) of this section.
(c) The following definitions pertain to the intermediate bulk container standards in this subpart.
(1) *Body means the receptacle proper (including openings and their closures, but not including service equipment), that has a volumetric capacity of not more than three cubic meters (3,000 liters, 793 gallons, or 106 cubic feet) and not less than 0.45 cubic meters (450 liters, 119 gallons, or 15.9 cubic feet) or a maximum net mass of not less than 400 kilograms (882) pounds.*
(2) Service equipment means filling and discharge, pressure relief, safety, heating and heat-insulating devices and measuring instruments.
(3) Structural equipment means the reinforcing, fastening, handling, protective or stabilizing members of the body or stacking load bearing structural members (such as metal cages).
(4) Maximum permissible gross mass means the mass of the body, its service equipment, structural equipment and the maximum net mass (see §171.8 of this subchapter).

[Amdt. 178-103, 59 FR 38068, July 26, 1994, as amended by Amdt. 178-108, 60 FR 40038, Aug. 4, 1995]

§178.702 Intermediate bulk container identification codes.

(a) Intermediate bulk container code designations consist of: two numerals specified in paragraph (a)(1) of this section; followed by the capital letter(s) specified in paragraph (a)(2) of this section; followed, when specified in an individual section, by a numeral indicating the category of intermediate bulk container.

(1) Intermediate bulk container code number designations are as follows:

Type	For solids, discharged		For liquids
-	by gravity	Under pressure of more than 10 kPa (1.45 psi)	-
Rigid	11	21	31
Flexible	13	-	-

(2) Intermediate bulk container code letter designations are as follows:

"A" means steel (all types and surface treatments).
"B" means aluminum.
"C" means natural wood.

"D" means plywood.
"F" means reconstituted wood.
"G" means fiberboard.
"H" means plastic.
"L" means textile.
"M" means paper, multiwall.
"N" means metal (other than steel or aluminum).

(b) For composite intermediate bulk containers, two capital letters are used in sequence following the numeral indicating intermediate bulk container design type. The first letter indicates the material of the intermediate bulk container inner receptacle. The second letter indicates the material of the outer intermediate bulk container. For example, 31HA1 is a composite intermediate bulk container with a plastic inner receptacle and a steel outer packaging.

§178.703 Marking of intermediate bulk containers.

(a) The manufacturer shall:
(1) Mark every intermediate bulk container in a durable and clearly visible manner (applied in a single line or in multiple lines provided the correct sequence is followed) with the following information in the sequence presented:
(i) The United Nations symbol as illustrated in §178.503(d)(1). For metal intermediate bulk containers on which the marking is stamped or embossed, the capital letters `UN' may be applied instead of the symbol.
(ii) The code number designating intermediate bulk container design type according to §178.702(a) (1) and (2).
(iii) A capital letter identifying the performance standard under which the design type has been successfully tested, as follows:
(A) X-for intermediate bulk containers meeting Packing Group I, II and III tests;
(B) Y-for intermediate bulk containers meeting Packing Group II and III tests; and
(C) Z-for intermediate bulk containers meeting only Packing Group III tests.
(iv) The month (designated numerically) and year (last two digits) of manufacture.
(v) The country authorizing the allocation of the mark. The letters `USA' indicate that the intermediate bulk container is manufactured and marked in the United States in compliance with the provisions of this subchapter.
(vi) The name and address or symbol of the manufacturer or the approval agency certifying compliance with subparts N and O of this part. Symbols, if used, must be registered with the Associate Administrator for Hazardous Materials Safety.
(vii) The stacking test load in kilograms (kg). For intermediate bulk containers not designed for stacking, the figure "0" must be shown.
(viii) The maximum permissible gross mass or, for flexible intermediate bulk containers, the maximum net mass, in kg.
(2) The following are examples of symbols and required markings:

(i) For a metal intermediate bulk container containing solids discharged by gravity made from steel:

11A/Y/02 92/USA/ABC/5500/1500

(ii) For a flexible intermediate bulk container containing solids discharged by gravity and made from woven plastic with a liner:

13H3/Z/03 92/USA/ABC/0/1500

(iii) For a rigid plastic intermediate bulk container containing liquids, made from plastic with structural equipment withstanding the stack load and with a manufacturer's symbol in place of the manufacturer's name and address:

31H1/Y/04 93/USA/M9399/10800/1200

(iv) For a composite intermediate bulk container containing liquids, with a rigid plastic inner receptacle and an outer steel body and with the symbol of a DOT approved third-party test laboratory:

31HA1/Y/05 93/USA/+ZT1235/10800/1200

(b) *Additional marking. In addition to markings required in paragraph (a) of this section, each intermediate bulk container must be marked as follows in a place near the markings required in paragraph (a) of this section that is readily accessible for inspection. Where units of measure are used, the metric unit indicated (e.g., 450 liters) must also appear.*

(1) For each rigid plastic and composite intermediate bulk container, the following markings must be included:

(i) Rated capacity in liters of water at 20 °C (68 °F);
(ii) Tare mass in kilograms;
(iii) Gauge test pressure in kPa;
(iv) Date of last leakproofness test, if applicable (month and year); and
(v) Date of last inspection (month and year).

(2) For each metal intermediate bulk container, the following markings must be included on a metal corrosion-resistant plate:

(i) Rated capacity in liters of water at 20 °C (68 °F);
(ii) Tare mass in kilograms;
(iii) Date of last leakproofness test, if applicable (month and year);
(iv) Date of last inspection (month and year);
(v) Maximum loading/discharge pressure, in kPa, if applicable;
(vi) Body material and its minimum thickness in mm; and
(vii) Serial number assigned by the manufacturer.

(3) Markings required by paragraph (b)(1) or (b)(2) of this section may be preceded by the narrative description of the marking, e.g. "Tare Mass: * * *" where the "* * *" are replaced with the tare mass in kilograms of the intermediate bulk container.

(4) For each fiberboard and wooden intermediate bulk container, the tare mass in kg must be shown.

(5) Each flexible intermediate bulk container may be marked with a pictogram displaying recommended lifting methods.

(6) For each composite intermediate bulk container, the inner receptacle must be marked with at least the following information:

(i) The code number designating the intermediate bulk container design type, the name and address or symbol of the manufacturer, the date of manufacture and the country authorizing the allocation of the mark as specified in paragraph (a) of this section;

(ii) When a composite intermediate bulk container is designed in such a manner that the outer casing is intended to be dismantled for transport when empty (such as, for the return of the intermediate bulk container for reuse to the original consignor), each of the parts intended to be detached when so dismantled must be marked with the month and year of manufacture and the name or symbol of the manufacturer.

[Amdt. 178-103, 59 FR 38068, July 26, 1994, as amended by Amdt. 178-119, 62 FR 24743, May 6, 1997; 64 FR 10782, Mar. 5, 1999]

§178.704 General intermediate bulk container standards.

(a) Each intermediate bulk container must be resistant to, or protected from, deterioration due to exposure to the external environment. Intermediate bulk containers intended for solid hazardous materials must be sift-proof and water-resistant.

(b) All service equipment must be so positioned or protected as to minimize potential loss of contents resulting from damage during intermediate bulk container handling and transportation.

(c) Each intermediate bulk container, including attachments, and service and structural equipment, must be designed to withstand, without loss of hazardous materials, the internal pressure of the contents and the stresses of normal handling and transport. An intermediate bulk container intended for stacking must be designed for stacking. Any lifting or securing features of an intermediate bulk container must be of sufficient strength to withstand the normal conditions of handling and transportation without gross distortion or failure and must be positioned so as to cause no undue stress in any part of the intermediate bulk container.

(d) An intermediate bulk container consisting of a packaging within a framework must be so constructed that:

(1) The body is not damaged by the framework;

(2) The body is retained within the framework at all times; and

(3) The service and structural equipment are fixed in such a way that they cannot be damaged if the connections between body and frame allow relative expansion or movement.

(e) Bottom discharge valves must be secured in the closed position and the discharge system suitably protected from damage. Valves having lever closures must be secured against accidental opening. The open or closed position of each valve must be readily apparent. For each intermediate bulk container containing a liquid, a secondary means of sealing the discharge aperture must also be provided, e.g., by a blank flange or equivalent device.

(f) Intermediate bulk container design types must be constructed in such a way as to be bottom-lifted or top-lifted as specified in §§178.811 and 178.812.

§178.705 Standards for metal intermediate bulk containers.

(a) The provisions in this section apply to metal intermediate bulk containers intended to contain liquids and solids. Metal intermediate bulk container types are designated:

(1) 11A, 11B, 11N for solids that are loaded or discharged by gravity.

(2) 21A, 21B, 21N for solids that are loaded or discharged at a gauge pressure greater than 10 kPa (1.45 psig).

(3) 31A, 31B, 31N for liquids or solids.

(b) Definitions for metal intermediate bulk containers:

(1) *Metal intermediate bulk container means an intermediate bulk container with a metal body, together with appropriate service and structural equipment.*

(2) Protected means providing the intermediate bulk container body with additional external protection against impact and abrasion. For example, a multi-layer (sandwich) or double wall construction or a frame with a metal lattice-work casing.

(c) Construction requirements for metal intermediate bulk containers are as follows:

(1) *Body. The body must be made of ductile metal materials. Welds must be made so as to maintain design type integrity of the receptacle under conditions normally incident to transportation.*

(i) The use of dissimilar metals must not result in deterioration that could affect the integrity of the body.
(ii) Aluminum intermediate bulk containers intended to contain flammable liquids must have no movable parts, such as covers and closures, made of unprotected steel liable to rust, which might cause a dangerous reaction from friction or percussive contact with the aluminum.
(iii) Metals used in fabricating the body of a metal intermediate bulk container must meet the following requirements:
(A) For steel, the percentage elongation at fracture must not be less than 10,000/Rm with a minimum of 20 percent; where Rm = minimum tensile strength of the steel to be used, in N/mm^2; if U.S. Standard units of pounds per square inch are used for tensile strength then the ratio becomes 10,000 x (145/Rm).
(B) For aluminum, the percentage elongation at fracture must not be less than 10,000/(6Rm) with an absolute minimum of eight percent; if U.S. Standard units of pounds per square inch are used for tensile strength then the ratio becomes 10,000 x 145 / (6Rm).
(C) Specimens used to determine the elongation at fracture must be taken transversely to the direction of rolling and be so secured that:

Lo = 5d

or

Lo = 5.65 |A

where:

Lo = gauge length of the specimen before the test
d = diameter
A = cross-sectional area of test specimen.

(iv) Minimum wall thickness:
(A) For a reference steel having a product of Rm x Ao = 10,000, where Ao = minimum elongation (as a percentage) of the reference steel to be used on fracture under tensile stress, (Rm x Ao = 10,000 x 145; if tensile strength is in U.S. Standard units of pounds per square inch) the wall thickness must not be less than:

Capacity in liters	Wall thickness in mm (inches)			
-	Types 11A, 11B, 11N		Types 21A, 21B, 21N, 31A, 31B, 31N	
-	Unprotected	Protected	Unprotected	Protected

>450 and :1000	2.0 (0.079)	1.5 (0.059)	2.5 (0.098)	2.0 (0.079)
>1000 and :2000	2.5 (0.098)	2.0 (0.079)	3.0 (0.118)	2.5 (0.098)
>2000 and :3000	3.0 (0.118)	2.5 (0.098)	4.0 (0.157)	3.0 (0.118)

[1]Where: gallons = liters x 0.264.

(B) For metals other than the reference steel described in paragraph (c)(1)(iii)(A) of this section, the minimum wall thickness is the greater of 1.5 mm (0.059 inches) or as determined by use of the following equivalence formula:

Formula for Metric Units

$$e_1 = \frac{21.4 \times e_0}{\sqrt[3]{Rm_1 \times A_1}}$$

Formula for U.S. Standard Units

$$e_1 = \frac{21.4 \times e_0}{\sqrt[3]{(Rm_1 \times A_1)/145}}$$

where:

e_1 = required equivalent wall thickness of the metal to be used (in mm or if e_o is in inches, use formula for U.S. Standard units).

e_o = required minimum wall thickness for the reference steel (in mm or if e_o is in inches, use formula for U.S. Standard units).

Rm_1 = guaranteed minimum tensile strength of the metal to be used (in N/mm^2 or for U.S. Standard units, use pounds per square inch).

A_1 = minimum elongation (as a percentage) of the metal to be used on fracture under tensile stress (see paragraph (c)(1) of this section).

(2) Pressure relief. The following pressure relief requirements apply to intermediate bulk containers intended for liquids:

(i) Intermediate bulk containers must be capable of releasing a sufficient amount of vapor in the event of fire engulfment to ensure that no rupture of the body will occur due to pressure build-up. This can be achieved by spring-loaded or frangible pressure relief devices or by other means of construction.

(ii) The start-to-discharge pressure may not be higher than 65 kPa (9 psig) and no lower than the vapor pressure of the hazardous material plus the partial pressure of the air or other inert gases, measured in the intermediate bulk container at 55 °C (131 °F), determined on the basis of a maximum degree of filling as specified in §173.35(d) of this subchapter. This does not apply to fusible devices unless such devices are the only source of pressure relief for the IBC. Pressure relief devices must be fitted in the vapor space.

[Amdt. 178-103, 59 FR 38068, July 26, 1994, as amended by Amdt. 178-108, 60 FR 40038, Aug. 4, 1995; Amdt. 178-117, 61 FR 50629, Sept. 26, 1996]

§178.706 Standards for rigid plastic intermediate bulk containers.

(a) The provisions in this section apply to rigid plastic intermediate bulk containers intended to contain solids or liquids. Rigid plastic intermediate bulk container types are designated:

(1) 11H1 fitted with structural equipment designed to withstand the whole load when intermediate bulk containers are stacked, for solids which are loaded or discharged by gravity.

(2) 11H2 freestanding, for solids which are loaded or discharged by gravity.

(3) 21H1 fitted with structural equipment designed to withstand the whole load when intermediate bulk containers are stacked, for solids which are loaded or discharged under pressure.

(4) 21H2 freestanding, for solids which are loaded or discharged under pressure.

(5) 31H1 fitted with structural equipment designed to withstand the whole load when intermediate bulk containers are stacked, for liquids.

(6) 31H2 freestanding, for liquids.

(b) Rigid plastic intermediate bulk containers consist of a rigid plastic body, which may have structural equipment, together with appropriate service equipment.

(c) Rigid plastic intermediate bulk containers must be manufactured from plastic material of known specifications and be of a strength relative to its capacity and to the service it is required to perform. In addition to conformance to §173.24 of this subchapter, plastic materials must be resistant to aging and to degradation caused by ultraviolet radiation.

(1) If protection against ultraviolet radiation is necessary, it must be provided by the addition of a pigment or inhibiter such as carbon black. These additives must be compatible with the contents and remain effective throughout the life of the intermediate bulk container body. Where use is made of carbon black, pigments or inhibitors, other than those used in the manufacture of the tested design type, retesting may be omitted if changes in the carbon black content, the pigment content or the inhibitor content do not adversely affect the physical properties of the material of construction.

(2) Additives may be included in the composition of the plastic material to improve the resistance to aging or to serve other purposes, provided they do not adversely affect the physical or chemical properties of the material of construction.

(3) No used material other than production residues or regrind from the same manufacturing process may be used in the manufacture of rigid plastic intermediate bulk containers.

(4) Rigid plastic intermediate bulk containers intended for the transportation of liquids must be capable of releasing a sufficient amount of vapor to prevent the body of the intermediate bulk container from rupturing if it is subjected to an internal pressure in excess of that for which it was hydraulically tested. This may be achieved by spring-loaded or frangible pressure relief devices or by other means of construction.

§178.707 Standards for composite intermediate bulk containers.

(a) The provisions in this section apply to:

(1) Composite intermediate bulk containers intended to contain solids and liquids. Composite intermediate bulk container types are designated:

(i) 11HZ1 Composite intermediate bulk containers with a rigid plastic inner receptacle for solids loaded or discharged by gravity.

(ii) 11HZ2 Composite intermediate bulk containers with a flexible plastic inner receptacle for solids loaded or discharged by gravity.

(iii) 21HZ1 Composite intermediate bulk containers with a rigid plastic inner receptacle for solids loaded or discharged under pressure.

(iv) 21HZ2 Composite intermediate bulk containers with a flexible plastic inner receptacle for solids loaded or discharged under pressure.

(v) 31HZ1 Composite intermediate bulk containers with a rigid plastic inner receptacle for liquids.

(vi) 31HZ2 Composite intermediate bulk containers with a flexible plastic inner receptacle for liquids.

(2) The marking code in paragraph (a)(1) of this section must be completed by replacing the letter Z by a capital letter in accordance with §178.702(a)(2) to indicate the material used for the outer packaging.

(b) Definitions for composite intermediate bulk container types:

(1) A *composite intermediate bulk container is an intermediate bulk container which consists of a rigid outer packaging enclosing a plastic inner receptacle together with any service or other structural equipment. The outer packaging of a composite intermediate bulk container is designed to bear the entire stacking load. The inner receptacle and outer packaging form an integral packaging and are filled, stored, transported, and emptied as a unit.*

(2) The term plastic means polymeric materials (i.e., plastic or rubber).

(3) A "rigid" inner receptacle is an inner receptacle which retains its general shape when empty without closures in place and without benefit of the outer casing. Any inner receptacle that is not "rigid" is considered to be "flexible."

(c) Construction requirements for composite intermediate bulk containers with plastic inner receptacles are as follows:

(1) The outer packaging must consist of rigid material formed so as to protect the inner receptacle from physical damage during handling and transportation, but is not required to perform the secondary containment function. It includes the base pallet where appropriate. The inner receptacle is not intended to perform a containment function

without the outer packaging.
(2) A composite intermediate bulk container with a fully enclosing outer packaging must be designed to permit assessment of the integrity of the inner container following the leakproofness and hydraulic tests. The outer packaging of 31HZ2 composite intermediate bulk containers must enclose the inner receptacles on all sides.
(3) The inner receptacle must be manufactured from plastic material of known specifications and be of a strength relative to its capacity and to the service it is required to perform. In addition to conformance with the requirements of §173.24 of this subchapter, the material must be resistant to aging and to degradation caused by ultraviolet radiation. The inner receptacle of 31HZ2 composite intermediate bulk containers must consist of at least three plies of film.
(i) If necessary, protection against ultraviolet radiation must be provided by the addition of pigments or inhibitors such as carbon black. These additives must be compatible with the contents and remain effective throughout the life of the inner receptacle. Where use is made of carbon black, pigments, or inhibitors, other than those used in the manufacture of the tested design type, retesting may be omitted if the carbon black content, the pigment content, or the inhibitor content do not adversely affect the physical properties of the material of construction.
(ii) Additives may be included in the composition of the plastic material of the inner receptacle to improve resistance to aging, provided they do not adversely affect the physical or chemical properties of the material.
(iii) No used material other than production residues or regrind from the same manufacturing process may be used in the manufacture of inner receptacles.
(iv) Composite intermediate bulk containers intended for the transportation of liquids must be capable of releasing a sufficient amount of vapor to prevent the body of the intermediate bulk container from rupturing if it is subjected to an internal pressure in excess of that for which it was hydraulically tested. This may be achieved by spring-loaded or frangible pressure relief devices or by other means of construction.
(4) The strength of the construction material comprising the outer packaging and the manner of construction must be appropriate to the capacity of the composite intermediate bulk container and its intended use. The outer packaging must be free of any projection that might damage the inner receptacle.
(i) Outer packagings of natural wood must be constructed of well seasoned wood that is commercially dry and free from defects that would materially lessen the strength of any part of the outer packaging. The tops and bottoms may be made of water-resistant reconstituted wood such as hardboard or particle board. Materials other than natural wood may be used for construction of structural equipment of the outer packaging.
(ii) Outer packagings of plywood must be made of well-seasoned, rotary cut, sliced, or sawn veneer, commercially dry and free from defects that would materially lessen the strength of the casing. All adjacent plies must be glued with water-resistant adhesive. Materials other than plywood may be used for construction of structural equipment of the outer packaging. Outer packagings must be firmly nailed or secured to corner posts or ends or be assembled by equally suitable devices.
(iii) Outer packagings of reconstituted wood must be constructed of water-resistant

reconstituted wood such as hardboard or particle board. Materials other than reconstituted wood may be used for the construction of structural equipment of reconstituted wood outer packaging.
(iv) Fiberboard outer packagings must be constructed of strong, solid, or double-faced corrugated fiberboard (single or multiwall).
(A) Water resistance of the outer surface must be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 grams per square meter (0.0316 pounds per square foot-see ISO International Standard 535-1976 (E)). Fiberboard must have proper bending qualities. Fiberboard must be cut, creased without cutting through any thickness of fiberboard, and slotted so as to permit assembly without cracking, surface breaks, or undue bending. The fluting of corrugated fiberboard must be firmly glued to the facings.
(B) The ends of fiberboard outer packagings may have a wooden frame or be constructed entirely of wood. Wooden battens may be used for reinforcements.
(C) Manufacturers' joints in the bodies of outer packagings must be taped, lapped and glued, or lapped and stitched with metal staples.
(D) Lapped joints must have an appropriate overlap.
(E) Where closing is effected by gluing or taping, a water-resistant adhesive must be used.
(F) All closures must be sift-proof.
(v) Outer packagings of plastic materials must be constructed in accordance with the relevant provisions of paragraph (c)(3) of this section.
(5) Any integral pallet base forming part of an intermediate bulk container, or any detachable pallet, must be suitable for the mechanical handling of an intermediate bulk container filled to its maximum permissible gross mass.
(i) The pallet or integral base must be designed to avoid protrusions that may cause damage to the intermediate bulk container in handling.
(ii) The outer packaging must be secured to any detachable pallet to ensure stability in handling and transportation. Where a detachable pallet is used, its top surface must be free from sharp protrusions that might damage the intermediate bulk container.
(iii) Strengthening devices, such as timber supports to increase stacking performance, may be used but must be external to the inner receptacle.
(iv) The load-bearing surfaces of intermediate bulk containers intended for stacking must be designed to distribute loads in a stable manner. An intermediate bulk container intended for stacking must be designed so that loads are not supported by the inner receptacle.
(6) Intermediate IBCs of type 31HZ2 must be limited to a capacity of not more than 1,250 liters.

[Amdt. 178-103, 59 FR 38068, July 26, 1994, as amended by Amdt. 178-119, 62 FR 24743, May 6, 1997]

§178.708 Standards for fiberboard intermediate bulk containers.

(a) The provisions of this section apply to fiberboard intermediate bulk containers intended to contain solids that are loaded or discharged by gravity. Fiberboard intermediate bulk containers are designated: 11G.

(b) Definitions for fiberboard intermediate bulk container types:

(1) *Fiberboard intermediate bulk containers consist of a fiberboard body with or without separate top and bottom caps, appropriate service and structural equipment, and if necessary an inner liner (but no inner packaging).*

(2) Liner means a separate tube or bag, including the closures of its openings, inserted in the body but not forming an integral part of it.

(c) Construction requirements for fiberboard intermediate bulk containers are as follows:

(1) Top lifting devices are prohibited in fiberboard intermediate bulk containers.

(2) Fiberboard intermediate bulk containers must be constructed of strong, solid or double-faced corrugated fiberboard (single or multiwall) that is appropriate to the capacity of the outer packaging and its intended use. Water resistance of the outer surface must be such that the increase in mass, as determined in a test carried out over a period of 30 minutes by the Cobb method of determining water absorption, is not greater than 155 grams per square meter (0.0316 pounds per square foot see ISO 535-1976(E)). Fiberboard must have proper bending qualities. Fiberboard must be cut, creased without cutting through any thickness of fiberboard, and slotted so as to permit assembly without cracking, surface breaks, or undue bending. The fluting of corrugated fiberboard must be firmly glued to the facings.

(i) The walls, including top and bottom, must have a minimum puncture resistance of 15 Joules (11 foot-pounds of energy) measured according to ISO 3036, incorporated by reference in §171.7 of this subchapter.

(ii) Manufacturers' joints in the bodies of intermediate bulk containers must be made with an appropriate overlap and be taped, glued, stitched with metal staples or fastened by other means at least equally effective. Where joints are made by gluing or taping, a water-resistant adhesive must be used. Metal staples must pass completely through all pieces to be fastened and be formed or protected so that any inner liner cannot be abraded or punctured by them.

(3) The strength of the material used and the construction of the liner must be appropriate to the capacity of the intermediate bulk container and the intended use. Joints and closures must be sift-proof and capable of withstanding pressures and impacts liable to occur under normal conditions of handling and transport.

(4) Any integral pallet base forming part of an intermediate bulk container, or any detachable pallet, must be suitable for the mechanical handling of an intermediate bulk container filled to its maximum permissible gross mass.

(i) The pallet or integral base must be designed to avoid protrusions that may cause damage to the intermediate bulk container in handling.

(ii) The outer packaging must be secured to any detachable pallet to ensure stability in handling and transport. Where a detachable pallet is used, its top surface must be free from sharp protrusions that might damage the intermediate bulk container.

(iii) Strengthening devices, such as timber supports to increase stacking performance, may be used but must be external to the inner liner.

(iv) The load-bearing surfaces of intermediate bulk containers intended for stacking must be designed to distribute loads in a stable manner.

§178.709 Standards for wooden intermediate bulk containers.

(a) The provisions in this section apply to wooden intermediate bulk containers intended to contain solids that are loaded or discharged by gravity. Wooden intermediate bulk container types are designated:

(1) 11C Natural wood with inner liner.

(2) 11D Plywood with inner liner.

(3) 11F Reconstituted wood with inner liner.

(b) Definitions for wooden intermediate bulk containers:

(1) *Wooden intermediate bulk containers consist of a rigid or collapsible wooden body together with an inner liner (but no inner packaging) and appropriate service and structural equipment.*

(2) Liner means a separate tube or bag, including the closures of its openings, inserted in the body but not forming an integral part of it.

(c) Construction requirements for wooden intermediate bulk containers are as follows:

(1) Top lifting devices are prohibited in wooden intermediate bulk containers.

(2) The strength of the materials used and the method of construction must be appropriate to the capacity and intended use of the intermediate bulk container.

(i) Natural wood used in the construction of an intermediate bulk container must be well-seasoned, commercially dry, and free from defects that would materially lessen the strength of any part of the intermediate bulk container. Each intermediate bulk container part must consist of uncut wood or a piece equivalent in strength and integrity. Intermediate bulk container parts are equivalent to one piece when a suitable method of glued assembly is used (i.e., a Lindermann joint, tongue and groove joint, ship lap or rabbet joint, or butt joint with at least two corrugated metal fasteners at each joint, or when other methods at least equally effective are used). Materials other than natural wood may be used for the construction of structural equipment of the outer packaging.

(ii) Plywood used in construction of bodies must be at least 3-ply. Plywood must be made of well-seasoned, rotary-cut, sliced or sawn veneer, commercially dry, and free from defects that would materially lessen the strength of the body. All adjacent plies must be glued with water-resistant adhesive. Materials other than plywood may be used for the construction of structural equipment of the outer packaging.

(iii) Reconstituted wood used in construction of bodies must be water resistant reconstituted wood such as hardboard or particle board. Materials other than reconstituted wood may be used for the construction of structural equipment of the outer packaging.

(iv) Wooden intermediate bulk containers must be firmly nailed or secured to corner

posts or ends or be assembled by similar devices.
(3) The strength of the material used and the construction of the liner must be appropriate to the capacity of the intermediate bulk container and its intended use. Joints and closures must be sift-proof and capable of withstanding pressures and impacts liable to occur under normal conditions of handling and transportation.
(4) Any integral pallet base forming part of an intermediate bulk container, or any detachable pallet, must be suitable for the mechanical handling of an intermediate bulk container filled to its maximum permissible gross mass.
(i) The pallet or integral base must be designed to avoid protrusions that may cause damage to the intermediate bulk container in handling.
(ii) The outer packaging must be secured to any detachable pallet to ensure stability in handling and transportation. Where a detachable pallet is used, its top surface must be free from sharp protrusions that might damage the intermediate bulk container.
(iii) Strengthening devices, such as timber supports to increase stacking performance, may be used but must be external to the inner liner.
(iv) The load-bearing surfaces of intermediate bulk containers intended for stacking must be designed to distribute loads in a stable manner.

§178.710 Standards for flexible intermediate bulk containers.
(a) The provisions of this section apply to flexible intermediate bulk containers intended to contain solid hazardous materials. Flexible intermediate bulk container types are designated:
(1) 13H1 woven plastic without coating or liner.
(2) 13H2 woven plastic, coated.
(3) 13H3 woven plastic with liner.
(4) 13H4 woven plastic, coated and with liner.
(5) 13H5 plastic film.
(6) 13L1 textile without coating or liner.
(7) 13L2 textile, coated.
(8) 13L3 textile with liner.
(9) 13L4 textile, coated and with liner.
(10) 13M1 paper, multiwall.
(11) 13M2 paper, multiwall, water resistant.
(b) Definitions for flexible intermediate bulk containers:
(1) *Flexible intermediate bulk containers consist of a body constructed of film, woven plastic, woven fabric, paper, or combination thereof, together with any appropriate service equipment and handling devices, and if necessary, an inner coating or liner.*
(2) Woven plastic means a material made from stretched tapes or monofilaments.
(3) Handling device means any sling, loop, eye, or frame attached to the body of the intermediate bulk container or formed from a continuation of the intermediate bulk container body material.
(c) Construction requirements for flexible intermediate bulk containers are as follows:

(1) The strength of the material and the construction of the flexible intermediate bulk container must be appropriate to its capacity and its intended use.
(2) All materials used in the construction of flexible intermediate bulk containers of types 13M1 and 13M2 must, after complete immersion in water for not less than 24 hours, retain at least 85 percent of the tensile strength as measured originally on the material conditioned to equilibrium at 67 percent relative humidity or less.
(3) Seams must be stitched or formed by heat sealing, gluing or any equivalent method. All stitched seam-ends must be secured.
(4) In addition to conformance with the requirements of §173.24 of this subchapter, flexible intermediate bulk containers must be resistant to aging and degradation caused by ultraviolet radiation.
(5) For plastic flexible intermediate bulk containers, if necessary, protection against ultraviolet radiation must be provided by the addition of pigments or inhibitors such as carbon black. These additives must be compatible with the contents and remain effective throughout the life of the container. Where use is made of carbon black, pigments, or inhibitors, other than those used in the manufacture of the tested design type, retesting may be omitted if the carbon black content, the pigment content or the inhibitor content does not adversely affect the physical properties of the material of construction. Additives may be included in the composition of the plastic material to improve resistance to aging, provided they do not adversely affect the physical or chemical properties of the material.
(6) No used material other than production residues or regrind from the same manufacturing process may be used in the manufacture of plastic flexible intermediate bulk containers. This does not preclude the re-use of component parts such as fittings and pallet bases, provided such components have not in any way been damaged in previous use.
(7) When flexible intermediate bulk containers are filled, the ratio of height to width may not be more than 2:1.

[Amdt. 178-103, 59 FR 38068, July 26, 1994, as amended by Amdt. 178-108, 60 FR 40038, Aug. 4, 1995]

[CFR] PART 178 SUBPART O - Testing of Intermediate Bulk Containers

[TITLE 49] [SUBTITLE B] [PART 178] [SUBPART O]

Subpart O - Testing of Intermediate Bulk Containers

Source: Amdt. 178-103, 59 FR 38074, July 26, 1994, unless otherwise noted.

§178.800 Purpose and scope.
This subpart prescribes certain testing requirements for intermediate bulk containers identified in subpart N of this part.

§178.801 General requirements.
(a) *General. The test procedures prescribed in this subpart are intended to ensure that intermediate bulk containers containing hazardous materials can withstand normal conditions of transportation and are considered minimum requirements. Each packaging must be manufactured and assembled so as to be capable of successfully passing the prescribed tests and of conforming to the requirements of §173.24 of this subchapter at all times while in transportation.*
(b) Responsibility. It is the responsibility of the intermediate bulk container manufacturer to assure that each intermediate bulk container is capable of passing the prescribed tests. To the extent that an intermediate bulk container assembly function, including final closure, is performed by the person who offers a hazardous material for transportation, that person is responsible for performing the function in accordance with §§173.22 and 178.2 of this subchapter.
(c) Definitions. For the purpose of this subpart:
(1) Intermediate bulk container design type refers to intermediate bulk container which does not differ in structural design, size, material of construction, wall thickness, manner of construction and representative service equipment.
(2) Design qualification testing is the performance of the drop, leakproofness, hydrostatic pressure, stacking, bottom-lift or top-lift, tear, topple, righting and vibration tests, as applicable, prescribed in this subpart, for each different intermediate bulk container design type, at the start of production of that packaging.
(3) Periodic design requalification test is the performance of the applicable tests specified in paragraph (c)(2) of this section on an intermediate bulk container design type, in order to requalify the design for continued production at the frequency specified in paragraph (e) of this section.
(4) Production inspection is the inspection that must initially be conducted on each newly manufactured intermediate bulk container.
(5) Production testing is the performance of the leakproofness test in accordance with paragraph (f) of this section on each intermediate bulk container intended to contain solids discharged by pressure or intended to contain liquids.
(6) Periodic retest and inspection is performance of the applicable test and inspections on each intermediate bulk container at the frequency specified in §180.352 of this subchapter.
(7) Different intermediate bulk container design type is one that differs from a previously qualified intermediate bulk container design type in structural design, size, material of construction, wall thickness, or manner of construction, but does not include:
(i) A packaging which differs in surface treatment;

(ii) A rigid plastic intermediate bulk container or composite intermediate bulk container which differs with regard to additives used to comply with §§178.706(c), 178.707(c) or 178.710(c);
(iii) A packaging which differs only in its lesser external dimensions (i.e., height, width, length) provided materials of construction and material thicknesses or fabric weight remain the same;
(iv) A packaging which differs in service equipment.
(d) *Design qualification testing. The packaging manufacturer shall achieve successful test results for the design qualification testing at the start of production of each new or different intermediate bulk container design type. The service equipment selected for this design qualification testing shall be representative of the type of service equipment that will be fitted to any finished intermediate bulk container body under the design. Application of the certification mark by the manufacturer shall constitute certification that the intermediate bulk container design type passed the prescribed tests in this subpart.*
(e) Periodic design requalification testing. (1) Periodic design requalification must be conducted on each qualified intermediate bulk container design type if the manufacturer is to maintain authorization for continued production. The intermediate bulk container manufacturer shall achieve successful test results for the periodic design requalification at sufficient frequency to ensure each packaging produced by the manufacturer is capable of passing the design qualification tests. Design requalification tests must be conducted at least once every 12 months.
(2) Changes in the frequency of design requalification testing specified in paragraph (e)(1) of this section are authorized if approved by the Associate Administrator for Hazardous Materials Safety. These requests must be based on:
(i) Detailed quality assurance programs that assure that proposed decreases in test frequency maintain the integrity of originally tested intermediate bulk container design types; and
(ii) Demonstrations that each intermediate bulk container produced is capable of withstanding higher standards (e.g., increased drop height, hydrostatic pressure, wall thickness, fabric weight).
(f) *Production testing and inspection. (1) Production testing consists of the leakproofness test prescribed in §178.813 of this subpart and must be performed on each intermediate bulk container intended to contain solids discharged by pressure or intended to contain liquids. For this test:*
(i) The intermediate bulk container need not have its closures fitted.
(ii) The inner receptacle of a composite intermediate bulk container may be tested without the outer intermediate bulk container body, provided the test results are not affected.
(2) Applicable inspection requirements in §180.352 of this subchapter must be performed on each intermediate bulk container initially after production.
(g) *Test samples. The intermediate bulk container manufacturer shall conduct the design qualification and periodic design requalification tests prescribed in this subpart using random samples of intermediate bulk containers, according to the appropriate test section.*

(h) Selective testing of intermediate bulk containers. Variation of a tested intermediate bulk container design type is permitted without further testing, provided selective testing demonstrates an equivalent or greater level of safety than the design type tested and which has been approved by the Associate Administrator for Hazardous Materials Safety.
(i) Approval of equivalent packagings. An intermediate bulk container which differs from the standards in subpart N of this part, or which is tested using methods other than those specified in this subpart, may be used if approved by the Associate Administrator for Hazardous Materials Safety. Such intermediate bulk containers must be shown to be equally effective, and testing methods used must be equivalent.
(j) Proof of compliance. Notwithstanding the periodic design requalification testing intervals specified in paragraph (e) of this section, the Associate Administrator for Hazardous Materials Safety, or a designated representative, may at any time require demonstration of compliance by a manufacturer, through testing in accordance with this subpart, that packagings meet the requirements of this subpart. As required by the Associate Administrator for Hazardous Materials Safety, or a designated representative, the manufacturer shall either:
(1) Conduct performance tests or have tests conducted by an independent testing facility, in accordance with this subpart; or
(2) Make a sample intermediate bulk container available to the Associate Administrator for Hazardous Materials Safety, or a designated representative, for testing in accordance with this subpart.
(k) *Coatings. If an inner treatment or coating of an intermediate bulk container is required for safety reasons, the manufacturer shall design the intermediate bulk container so that the treatment or coating retains its protective properties even after withstanding the tests prescribed by this subpart.*
(l) Record retention. (1) The person who certifies an intermediate bulk container design type shall keep records of design qualification tests for each intermediate bulk container design type and for each periodic design requalification as specified in this part. These records must be maintained at each location where the intermediate bulk container is manufactured and at each location where design qualification and periodic design requalification testing is performed. These records must be maintained for as long as intermediate bulk containers are manufactured in accordance with each qualified design type and for at least 2.5 years thereafter. These records must include the following information: name and address of test facility; name and address of the person certifying the intermediate bulk container; a unique test report identification; date of test report; manufacturer of the intermediate bulk container; description of the intermediate bulk container design type (e.g., dimensions, materials, closures, thickness, representative service equipment, etc.); maximum intermediate bulk container capacity; characteristics of test contents; test descriptions and results (including drop heights, hydrostatic pressures, tear propagation length, etc.). Each test report must be signed with the name of the person conducting the test, and name of the person responsible for testing.
(2) The person who certifies each intermediate bulk container must make all records of

design qualification tests and periodic design requalification tests available for inspection by a representative of the Department upon request.

[Amdt. 178-103, 59 FR 38074, July 26, 1994, as amended by Amdt. 178-108, 60 FR 40038, Aug. 4, 1995]

§178.802 Preparation of fiberboard intermediate bulk containers for testing.

(a) Fiberboard intermediate bulk containers and composite intermediate bulk containers with fiberboard outer packagings must be conditioned for at least 24 hours in an atmosphere maintained:

(1) At 50 percent + 2 percent relative humidity, and at a temperature of 23^{o} + 2 ^{o}C (73 ^{o}F + 4 ^{o}F); or

(2) At 65 percent + 2 percent relative humidity, and at a temperature of 20^{o} + 2 ^{o}C (68 ^{o}F + 4 ^{o}F), or 27 ^{o}C + 2 ^{o}C (81 ^{o}F + 4 ^{o}F).

(b) Average values for temperature and humidity must fall within the limits in paragraph (a) of this section. Short-term fluctuations and measurement limitations may cause individual measurements to vary by up to + 5 percent relative humidity without significant impairment of test reproducibility.

(c) For purposes of periodic design requalification only, fiberboard intermediate bulk containers or composite intermediate bulk containers with fiberboard outer packagings may be at ambient conditions.

§178.803 Testing and certification of intermediate bulk containers.

Tests required for the certification of each intermediate bulk container design type are specified in the following table. The letter X indicates that one intermediate bulk container (except where noted) of each design type must be subjected to the tests in the order presented:

Performance test	Intermediate Bulk Container (IBC) type					
-	Metal IBCs	Rigid plastic IBCs	Composite IBCs	Fiber-board IBCs	Wooden IBCs	Flexible IBCs
Vibration	[6] X	[6] X	[6] X	[6] X	[6] X	[1].5 X
Bottom lift	[2] X	X	X	X	X	-
Top lift	[2] X	[2] X	[2] X	-	-	[2],5 X
Stacking	[7] X	[7] X	[7] X	[7] X	[7] X	[5] X
Leakproofness	[3] X	[3] X	[3] X	-	-	-
Hydrostatic	[3] X	[3] X	[3] X	-	-	-
Drop	[4] X	[4] X	[4] X	[4] X	[4] X	[5] X
Topple	-	-	-	-	-	[5] X

Righting	-	-	-	-	-	[2,5] X
Tear	-	-	-	-	-	[5] X

[1]Flexible intermediate bulk containers must be capable of withstanding the vibration test.

[2]This test must be performed only if intermediate bulk containers are designed to be handled this way. For metal intermediate bulk containers, at least one of the bottom lift or top lift tests must be performed.

[3]The leakproofness and hydrostatic pressure tests are required only for intermediate bulk containers intended to contain liquids or intended to contain solids loaded or discharged under pressure.

[4]Another intermediate bulk container of the same design type may be used for the drop test set forth in §178.810 of this subchapter.

[5]Another different flexible intermediate bulk container of the same design type may be used for each test.

[6]The vibration test may be performed in another order for intermediate bulk containers manufactured and tested under provisions of an exemption before October 1, 1994 and for non-DOT specification portable tanks tested before October 1, 1994, intended for export.

[7]This test must be performed only if the intermediate bulk container is designed to be stacked.

[Amdt. 178-108, 60 FR 40039, Aug. 4, 1995, as amended at 64 FR 51919, Sept. 27, 1999]

§178.810 Drop test.

(a) *General. The drop test must be conducted for the qualification of all intermediate bulk container design types and performed periodically as specified in §178.801(e) of this subpart.*

(b) Special preparation for the drop test. (1) Metal, rigid plastic, and composite intermediate bulk containers intended to contain solids must be filled to not less than 95 percent of their capacity, or if intended to contain liquids, to not less than 98 percent of their capacity. Pressure relief devices must be removed and their apertures plugged or rendered inoperative.

(2) Fiberboard, wooden, and flexible intermediate bulk containers must be filled with a solid material to not less than 95 percent of their capacity.

(3) Rigid plastic intermediate bulk containers and composite intermediate bulk containers with plastic inner receptacles must be conditioned for testing by reducing the temperature of the packaging and its contents to -18 °C (0 °F) or lower. Test liquids must be kept in the liquid state. Anti-freeze should be used, if necessary.

(c) *Test method. Samples of all intermediate bulk container design types must be* *dropped onto a rigid, non-resilient, smooth, flat and horizontal surface. The point of impact must be the most vulnerable part of the base of the intermediate bulk container being tested. Following the drop, the intermediate bulk container must be restored to the upright position for observation.*

(d) Drop height. (1) For all intermediate bulk containers, drop heights are specified as follows:

(i) Packing Group I: 1.8 m (5.9 feet).

(ii) Packing Group II: 1.2 m (3.9 feet).

(iii) Packing Group III: 0.8 m (2.6 feet).

(2) Drop tests are to be performed with the solid or liquid to be transported or with a non-hazardous material having essentially the same physical characteristics.

(3) The specific gravity and viscosity of a substituted non-hazardous material used in the drop test for liquids must be similar to the hazardous material intended for transportation. Water also may be used for the liquid drop test under the following conditions:

(i) Where the substances to be carried have a specific gravity not exceeding 1.2, the drop heights must be those specified in paragraph (d)(1) of this section for each intermediate bulk container design type; and

(ii) Where the substances to be carried have a specific gravity exceeding 1.2, the drop heights must be as follows:

(A) Packing Group I: SG x 1.5 m (4.9 feet).

(B) Packing Group II: SG x 1.0 m (3.3 feet).

(C) Packing Group III: SG x 0.67 m (2.2 feet).

(e) *Criteria for passing the test. For all intermediate bulk container design types there may be no loss of contents. A slight discharge from a closure upon impact is not considered to be a failure of the intermediate bulk container provided that no further leakage occurs. A slight discharge (e.g., from closures or stitch holes) upon impact is not considered a failure of the flexible intermediate bulk container provided that no further leakage occurs after the intermediate bulk container has been raised clear of the ground.*

§178.811 Bottom lift test.

(a) General. The bottom lift test must be conducted for the qualification of all intermediate bulk container design types designed to be lifted from the base.

(b) Special preparation for the bottom lift test. The intermediate bulk container must be loaded to 1.25 times its maximum permissible gross mass, the load being evenly distributed.

(c) Test method. All intermediate bulk container design types must be raised and lowered twice by a lift truck with the forks centrally positioned and spaced at three quarters of the dimension of the side of entry (unless the points of entry are fixed). The forks must penetrate to three quarters of the direction of entry. The test must be repeated from each possible direction of entry.

(d) Criteria for passing the test. For all intermediate bulk container design types designed to be lifted from the base, there may be no permanent deformation which renders the intermediate bulk container unsafe for transportation and no loss of contents.

§178.812 Top lift test.

(a) General. The top lift test must be conducted for the qualification of all intermediate bulk container design types designed to be lifted from the top or, for flexible intermediate bulk containers, from the side.

(b) Special preparation for the top lift test. (1) Metal, rigid plastic, and composite intermediate bulk container design types must be loaded to twice the maximum permissible gross mass.

(2) Flexible intermediate bulk container design types must be filled to six times the maximum net mass, the load being evenly distributed.

(c) *Test method. (1) A metal or flexible intermediate bulk container must be lifted in the manner for which it is designed until clear of the floor and maintained in that position for a period of five minutes. For flexible intermediate bulk container design types, other methods of top lift testing and preparation at least equally effective may be used (see §178.801(i)).*

(2) Rigid plastic and composite intermediate bulk container design types must be:

(i) Lifted by each pair of diagonally opposite lifting devices, so that the hoisting forces are applied vertically, for a period of five minutes; and

(ii) Lifted by each pair of diagonally opposite lifting devices, so that the hoisting forces are applied towards the center at 45^{o} to the vertical, for a period of five minutes.

(d) *Criteria for passing the test. For all intermediate bulk container design types designed to be lifted from the top, there may be no permanent deformation which renders the intermediate bulk container, including the base pallets when applicable, unsafe for transportation, and no loss of contents.*

§178.813 Leakproofness test.

(a) General. The leakproofness test must be conducted for the qualification of all intermediate bulk container design types and on all production units intended to contain liquids or intended to contain solids that are loaded or discharged under pressure.

(b) Special preparation for the leakproofness test. Vented closures must either be replaced by similar non-vented closures or the vent must be sealed. For metal intermediate bulk container design types, the initial test must be carried out before the fitting of any thermal insulation equipment. The inner receptacle of a composite intermediate bulk container may be tested without the outer packaging provided the test results are not affected.

(c) Test method and pressure applied. The leakproofness test must be carried out for a

suitable length of time using air at a gauge pressure of not less than 20 kPa (2.9 psig). Leakproofness of intermediate bulk container design types must be determined by coating the seams and joints with a heavy oil, a soap solution and water, or other methods suitable for the purpose of detecting leaks. Other methods, if at least equally effective, may be used in accordance with appendix B of this part, or if approved by the Associate Administrator for Hazardous Materials Safety, as provided in §178.801(i)).
(d) Criterion for passing the test. For all intermediate bulk container design types intended to contain liquids or intended to contain solids that are loaded or discharged under pressure, there may be no leakage of air from the intermediate bulk container.

[Amdt. 178-103, 59 FR 38074, July 26, 1994, as amended at 64 FR 10782, Mar. 5, 1999]

§178.814 Hydrostatic pressure test.

(a) *General. The hydrostatic pressure test must be conducted for the qualification of all metal, rigid plastic, and composite intermediate bulk container design types intended to contain liquids or intended to contain solids loaded or discharged under pressure.*

(b) Special preparation for the hydrostatic pressure test. For metal intermediate bulk containers, the test must be carried out before the fitting of any thermal insulation equipment. For all intermediate bulk containers, pressure relief devices and vented closures must be removed and their apertures plugged or rendered inoperative.

(c) Test method. Hydrostatic gauge pressure must be measured at the top of the intermediate bulk container. The test must be carried out for a period of at least 10 minutes applying a hydrostatic gauge pressure not less than that indicated in paragraph (d) of this section. The intermediate bulk containers may not be mechanically restrained during the test.

(d) Hydrostatic gauge pressure applied. (1) For metal intermediate bulk container design types, 31A, 31B, 31N: 65 kPa gauge pressure (9.4 psig).

(2) For metal intermediate bulk container design types 21A, 21B, 21N, 31A, 31B, 31N: 200 kPa (29 psig). For metal intermediate bulk container design types 31A, 31B and 31N, the tests in paragraphs (d)(1) and (d)(2) of this section must be conducted consecutively.

(3) For metal intermediate bulk containers design types 21A, 21B, and 21N, for Packing Group I solids: 250 kPa (36 psig) gauge pressure.

(4) For rigid plastic intermediate bulk container design types 21H1 and 21H2 and composite intermediate bulk container design types 21HZ1 and 21HZ2: 75 kPa (11 psig).

(5) For rigid plastic intermediate bulk container design types 31H1 and 31H2 and composite intermediate bulk container design types 31HZ1 and 31HZ2: whichever is the greater of:

(i) The pressure determined by any one of the following methods:

(A) The gauge pressure (pressure in the intermediate bulk container above ambient atmospheric pressure) measured in the intermediate bulk container at 55 ^{o}C (131 ^{o}F) multiplied by a safety factor of 1.5. This pressure must be determined on the basis of the intermediate bulk container being filled and closed to no more than 98 percent capacity at 15 ^{o}C (60 ^{o}F);

(B) If absolute pressure (vapor pressure of the hazardous material plus atmospheric pressure) is used, 1.5 multiplied by the vapor pressure of the hazardous material at 55 ^{o}C (131 ^{o}F) minus 100 kPa (14.5 psi). If this method is chosen, the hydrostatic test pressure applied must be at least 100 kPa gauge pressure (14.5 psig); or

(C) If absolute pressure (vapor pressure of the hazardous material plus atmospheric pressure) is used, 1.75 multiplied by the vapor pressure of the hazardous material at 50 ^{o}C (122 ^{o}F) minus 100 kPa (14.5 psi). If this method is chosen, the hydrostatic test pressure applied must be at least 100 kPa gauge pressure (14.5 psig); or

(ii) Twice the greater of: (A) The static pressure of the hazardous material on the bottom of the intermediate bulk container filled to 98 percent capacity; or

(B) The static pressure of water on the bottom of the intermediate bulk container filled to 98 percent capacity.

(e) *Criteria for passing the test(s). (1) For metal intermediate bulk containers, subjected to the 65 kPa (9.4 psig) test pressure specified in paragraph (d)(1) of this section, there may be no leakage or permanent deformation that would make the intermediate bulk container unsafe for transportation.*

(2) For metal intermediate bulk containers intended to contain liquids, when subjected to the 200 kPa (29 psig) and the 250 kPa (36 psig) test pressures specified in paragraphs (d)(2) and (d)(3) of this section, respectively, there may be no leakage.

(3) For rigid plastic intermediate bulk container types 21H1, 21H2, 31H1, and 31H2, and composite intermediate bulk container types 21HZ1, 21HZ2, 31HZ1, and 31HZ2, there may be no leakage and no permanent deformation which renders the intermediate bulk container unsafe for transportation.

§178.815 Stacking test.

(a) *General. The stacking test must be conducted for the qualification of all intermediate bulk container design types intended to be stacked.*

(b) Special preparation for the stacking test. (1) All intermediate bulk containers except flexible intermediate bulk container design types must be loaded to their maximum permissible gross mass.

(2) The flexible intermediate bulk container must be filled to not less than 95 percent of its capacity and to its maximum net mass, with the load being evenly distributed.

(c) *Test method. (1) All intermediate bulk containers must be placed on their base on level, hard ground and subjected to a uniformly distributed superimposed test load for a period of at least five minutes (see paragraph (d) of this section).*

(2) Fiberboard, wooden, and composite intermediate bulk containers with outer packagings constructed of other than plastic materials must be subjected to the test for 24 hours.

(3) Rigid plastic intermediate bulk container types and composite intermediate bulk container types with plastic outer packagings (11HH1, 11HH2, 21HH1, 21HH2, 31HH1 and 31HH2) which bear the stacking load must be subjected to the test for 28 days at 40 °C (104 °F).
(4) For all intermediate bulk containers, the load must be applied by one of the following methods:
(i) One or more intermediate bulk containers of the same type loaded to their maximum permissible gross mass and stacked on the test intermediate bulk container; or
(ii) The calculated superimposed test load weight loaded on either a flat plate or a reproduction of the base of the intermediate bulk container, which is stacked on the test intermediate bulk container.
(d) *Calculation of superimposed test load. For all intermediate bulk containers, the load to be placed on the intermediate bulk container must be 1.8 times the combined maximum permissible gross mass of the number of similar intermediate bulk containers that may be stacked on top of the intermediate bulk container during transportation.*
(e) Criteria for passing the test. (1) For metal, rigid plastic, and composite intermediate bulk containers there may be no permanent deformation which renders the intermediate bulk container unsafe for transportation and no loss of contents.
(2) For fiberboard and wooden intermediate bulk containers there may be no loss of contents and no permanent deformation which renders the whole intermediate bulk container, including the base pallet, unsafe for transportation.
(3) For flexible intermediate bulk containers, there may be no deterioration which renders the intermediate bulk container unsafe for transportation and no loss of contents.

[Amdt. 178-103, 59 FR 38074, July 26, 1994, as amended by Amdt. 178-119, 62 FR 24743, May 6, 1997]

§178.816 Topple test.

(a) *General. The topple test must be conducted for the qualification of all flexible intermediate bulk container design types.*

(b) Special preparation for the topple test. The flexible intermediate bulk container must be filled to not less than 95 percent of its capacity and to its maximum net mass, with the load being evenly distributed.

(c) Test method. A flexible intermediate bulk container must be toppled onto any part of its top upon a rigid, non-resilient, smooth, flat, and horizontal surface.

(d) Topple height. For all flexible intermediate bulk containers, the topple height is specified as follows:

(1) Packing Group I: 1.8 m (5.9 feet).
(2) Packing Group II: 1.2 m (3.9 feet).
(3) Packing Group III: 0.8 m (2.6 feet).

(e) *Criteria for passing the test. For all flexible intermediate bulk containers, there* *may be no loss of contents. A slight discharge (e.g., from closures or stitch holes) upon impact is not considered to be a failure, provided no further leakage occurs.*

§178.817 Righting test.

(a) General. The righting test must be conducted for the qualification of all flexible intermediate bulk containers designed to be lifted from the top or side.
(b) Special preparation for the righting test. The flexible intermediate bulk container must be filled to not less than 95 percent of its capacity and to its maximum net mass, with the load being evenly distributed.
(c) Test method. The flexible intermediate bulk container, lying on its side, must be lifted at a speed of at least 0.1 m/second (0.33 ft/s) to an upright position, clear of the floor, by one lifting device, or by two lifting devices when four are provided.
(d) Criterion for passing the test. For all flexible intermediate bulk containers, there may be no damage to the intermediate bulk container or its lifting devices which renders the intermediate bulk container unsafe for transportation or handling.

§178.818 Tear test.

(a) General. The tear test must be conducted for the qualification of all flexible intermediate bulk container design types.
(b) Special preparation for the tear test. The flexible intermediate bulk container must be filled to not less than 95 percent of its capacity and to its maximum net mass, the load being evenly distributed.
(c) Test method. Once the intermediate bulk container is placed on the ground, a 100-mm (4-inch) knife score, completely penetrating the wall of a wide face, is made at a 45^{o} angle to the principal axis of the intermediate bulk container, halfway between the bottom surface and the top level of the contents. The intermediate bulk container must then be subjected to a uniformly distributed superimposed load equivalent to twice the maximum net mass. The load must be applied for at least five minutes. An intermediate bulk container which is designed to be lifted from the top or the side must, after removal of the superimposed load, be lifted clear of the floor and maintained in that position for a period of five minutes.
(d) Criterion for passing the test. The intermediate bulk container passes the tear test if the cut does not propagate more than 25 percent of its original length.

§178.819 Vibration test.

(a) General. The vibration test must be conducted for the qualification of all rigid intermediate bulk container design types. Flexible intermediate bulk container design types must be capable of withstanding the vibration test.

(b) Test method. (1) A sample intermediate bulk container, selected at random, must be filled and closed as for shipment.
(2) The sample intermediate bulk container must be placed on a vibrating platform that has a vertical double-amplitude (peak-to-peak displacement) of one inch. The intermediate bulk container must be constrained horizontally to prevent it from falling off the platform, but must be left free to move vertically and bounce.
(3) The test must be performed for one hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material of approximately 1.6-mm (0.063-inch) thickness (such as steel strapping or paperboard) can be passed between the bottom of the intermediate bulk container and the platform. Other methods at least equally effective may be used (see §178.801(i)).
(c) *Criteria for passing the test. An intermediate bulk container passes the vibration test if there is no rupture or leakage.*

[Amdt. 178-103, 59 FR 38074, July 26, 1994, as amended by Amdt. 178-108, 60 FR 40038, Aug. 4, 1995; Amdt. 178-110, 60 FR 49111, Sept. 21, 1995]

Pt. 178, App. A

Appendix A to Part 178-Specifications for Steel

Table 1

[Open-hearth, basic oxygen, or electric steel of uniform quality. The following chemical composition limits are based on ladle analysis:]

Designation	Chemical composition, percent-ladle analysis		
-	Grade 1	Grade 2[2]	Grade 3[45]
Carbon	0.10/0.20	0.24 maximum	0.22 maximum.
Manganese	1.10/1.60	0.50/1.00	1.25 maximum.
Phosphorus, maximum	0.04	0.04	0.045.[6]
Sulfur, maximum	0.05	0.05	0.05.
Silicon	0.15/0.30	0.30 maximum	-
Copper, maximum	0.40	-	-
Columbium	-	0.01/0.04	-
Heat treatment authorized	([3])	([3])	([3]).
Maximum stress (p.s.i.)	35,000	35,000	35,000.

[1]Addition of other elements to obtain alloying effect is not authorized.

[2]Ferritic grain size 6 or finer according to ASTM E112-63.

[3]Any suitable heat treatment in excess of 1,100 ^{o}F., except that liquid quenching is not permitted.

[4]Other alloying elements may be added and shall be reported.

[5]For compositions with a maximum carbon content of 0.15 percent of ladle analysis, the maximum limit for manganese on ladle analysis may be 1.40 percent.

[6]Rephosphorized Grade 3 steels containing no more than 0.15 percent phosphorus are permitted if carbon content does not exceed 0.15 percent and manganese does not

exceed 1 percent.

Check Analysis Tolerances

[A heat of steel made under any of the above grades, the ladle analysis of which is slightly out of the specified range is acceptable if the check analysis is within the following variations:]

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
-	-	Under minimum limit	Over maximum limit
Carbon	To 0.15 inclusive	0.02	0.03
-	Over 0.15 to 0.40 inclusive	0.03	0.04
Manganese	To 0.60 inclusive	0.03	0.03
-	Over 0.60 to 1.15 inclusive	0.04	0.04
-	Over 1.15 to 2.50 inclusive	0.05	0.05
Phosphorus[7]	All ranges	-	0.01
Sulfur	All ranges	-	0.01
Silicon	To 0.30 inclusive	0.02	0.03
-	Over 0.30 to 1.00 inclusive	0.05	0.05
Copper	To 1.00 inclusive	0.03	0.03
-	Over 1.00 to 2.00 inclusive	0.05	0.05
Nickel	To 1.00 inclusive	0.03	0.03
-	Over 1.00 to 2.00 inclusive	0.05	0.05
Chromium	To 0.90 inclusive	0.03	0.03
-	Over 0.90 to 2.10 inclusive	0.05	0.05
Molybdenum	To 0.20 inclusive	0.01	0.01
-	Over 0.20 to 0.40 inclusive	0.02	0.02
Zirconium	All ranges	0.01	0.05
Columbium	To 0.04 inclusive	0.005	0.01
Aluminum	Over 0.10 to 0.20 inclusive	0.04	0.04
-	Over 0.20 to 0.30 inclusive	0.05	0.05

[7]Rephosphorized steels not subject to check analysis for phosphorus.

[Amdt. 178-3, 34 FR 12283, July 25, 1969; 34 FR 12593, Aug. 1, 1969, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980; Amdt. 178-97, 55 FR 52728, Dec. 21, 1990]

Pt. 178, App. B

to Part 178-Alternative Leakproofness Test Methods

In addition to the method prescribed in §178.604 of this subchapter, the following leakproofness test methods are authorized:

(1) *Helium test. The packaging must be filled with at least 1 L inert helium gas, air tight closed, and placed in a testing chamber. The testing chamber must be evacuated down to a pressure of 5 kPa which equals an over-pressure inside the packaging of 95 kPa. The air in the testing chamber must be analyzed for traces of helium gas by means*

of a mass spectrograph. The test must be conducted for a period of time sufficient to evacuate the chamber and to determine if there is leakage into or out of the packaging. If helium gas is detected, the leaking packaging must be automatically separated from non-leaking drums and the leaking area determined according to the method prescribed in §178.604(d) of this subchapter. A packaging passes the test if there is no leakage of helium.

(2) Pressure differential test. The packaging shall be restrained while either pressure or a vacuum is applied internally. The packaging must be pressurized to the pressure required by §178.604(e) of this subchapter for the appropriate packing group. The method of restraint must not affect the results of the test. The test must be conducted for a period of time sufficient to appropriately pressurize or evacuate the interior of the packaging and to determine if there is leakage into or out of the packaging. A packaging passes the pressure differential test if there is no change in measured internal pressure.

(3) Solution over seams. The packaging must be restrained while an internal air pressure is applied; the method of restraint may not affect the results of the test. The exterior surface of all seams and welds must be coated with a solution of soap suds or a water and oil mixture. The test must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging.

(4) Solution over partial seams test. For other than design qualification testing, the following test may be used for metal drums: The packaging must be restrained while an internal air pressure of 48 kPa (7.0 psig) is applied; the method of restraint may not affect the results of the test. The packaging must be coated with a soap solution over the entire side seam and a distance of not less than eight inches on each side of the side seam along the chime seam(s). The test must be conducted for a period of time sufficient to pressurize the interior of the packaging to the specified air pressure and to determine if there is leakage of air from the packaging. A packaging passes the test if there is no leakage of air from the packaging. Chime cuts must be made on the initial drum at the beginning of each production run and on the initial drum after any adjustment to the chime seamer. Chime cuts must be maintained on file in date order for not less than six months and be made available to a representative of the Department of Transportation on request.

[Amdt. 178-97, 55 FR 52728, Dec. 21, 1990, as amended at 56 FR 66287, Dec. 20, 1991; 57 FR 45466, Oct. 1, 1992]

Pt. 178, App. C

to Part 178-Nominal and Minimum Thicknesses of Steel Drums and Jerricans

For each listed packaging capacity, the following table compares the ISO Standard 3574 nominal thickness with the corresponding ISO Standard 3574 minimum thickness.

Maximum capacity (L)	ISO nominal (mm)	Corresponding ISO

		minimum (mm)
20	0.7	0.63
30	0.8	0.73
40	0.8	0.73
60	1.0	0.92
120	1.0	0.92
220	1.0	0.92
450	1.9	1.77

[Amdt. 178-106, 59 FR 67522, Dec. 29, 1994]

Pt. 179