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Part II

**Department of
Transportation**

**Research and Special Programs
Administration**

**49 CFR Part 107, et al.
Hazardous Materials: Requirement for
DOT Specification Cylinders; Proposed
Rule**

DEPARTMENT OF TRANSPORTATION

Research and Special Programs Administration

49 CFR Parts 107, 171, 172, 173, 177, 178, and 180

[Docket No. RSPA-98-3684(HM-220)]

RIN 2137-AA92

Hazardous Materials: Requirements for DOT Specification Cylinders

AGENCY: Research and Special Programs Administration (RSPA) DOT.

ACTION: Notice of proposed rulemaking (NPRM) and public meeting.

SUMMARY: RSPA proposes to amend certain requirements in the Hazardous Materials Regulations (HMR) to establish four new DOT cylinder specifications and to revise the requirements for maintenance, requalification, and repair of all DOT specification cylinders. In addition, RSPA proposes to: revise the requirements for approval of cylinder requalifiers, independent inspection agencies, and nondomestic chemical analysis and tests; revise the cylinder requalification, maintenance and repair requirements; and to revise the requirements for hazardous materials that are authorized to be offered for transportation in cylinders. Finally, this NPRM incorporates a proposal to remove from use aluminum alloy 6351-T6 that was published in an advance notice under Docket HM-176A and terminates that docket (RIN: 2131-AB51).

This action is being taken to—simplify the HMR for construction of cylinders; provide for flexibility in the design, construction and use of cylinders; recognize recent advances in cylinder manufacturing and requalification technologies; promote safety through simplification of the regulations; reduce the need for exemptions; and facilitate international commerce. The intended effect of this action is to enhance the safe transportation of hazardous materials in cylinders.

DATES: Comment Date: Comments must be received on or before January 28, 1999.

Public Meeting Date: A public meeting will be held on December 8, 1998; from 9:30 am to 4:00 pm. An additional meeting may be scheduled if there is substantial interest.

ADDRESSES: *Written Comments:* Address comments to the Dockets Management System, U.S. Department of Transportation, PL 401, 400 Seventh St.,

SW, Washington, DC 20590-0001. Comments should identify the docket number, RSPA 98-3684(HM-220), and should be submitted in two copies. Persons wishing to receive confirmation of receipt of their comments should include a self-addressed stamped postcard. The Dockets Management System is located on the Plaza Level of the Nassif Building, at the above address.

Public dockets may be reviewed between the hours of 10:00 a.m. to 5:00 p.m., Monday thru Friday, excluding Federal holidays. In addition, comments can be reviewed by accessing the DOT Homepage (<http://www.dot.gov>). Comments may also be submitted by E-mail to "rules@rspa.dot.gov". In every case, the comment should refer to the Docket number set forth above.

Public Meeting: The public meeting will be held in Room 3200-3204 at the U.S. Department of Transportation's Nassif Building, 400 7th Street SW, Washington DC, 20590.

FOR FURTHER INFORMATION CONTACT: Cheryl Freeman, telephone number (202) 366-4545, Office of Hazardous Materials Technology, or Ryan Posten, telephone number (202) 366-8553, Office of Hazardous Materials Standards, Research and Special Programs Administration, U.S. Department of Transportation, Washington, DC 20590-0001.

SUPPLEMENTARY INFORMATION:**I. Background**

Federal hazardous material transportation law (Federal hazmat law), 49 U.S.C. 5101-5127, authorizes the Secretary of Transportation to regulate the manufacture and continuing qualification of packagings used to transport hazardous materials in commerce, or packagings certified under Federal hazmat law for the transportation of hazardous materials in commerce. The HMR, 49 CFR parts 171-180, contain requirements for the manufacture, use, and requalification of cylinders subject to Federal hazmat law, including defining materials and methods of construction, the frequency and manner of inspection and testing, standards for cylinder rejection and condemnation, cylinder marking and recordkeeping, authorizations for packaging hazardous materials in cylinders, filling, loading, unloading, and carriage in transportation.

Historically, Federal authority to regulate the transportation of compressed gases was given to the former Interstate Commerce Commission (ICC) through the Transportation of Explosives Act, 35 Stat. 1135, section 233 (March 4, 1909),

which was later amended in 1921, at 41 Stat. 1445, §233. In 1911 the ICC adopted a series of "Shipping Container Specifications," among which the ICC 3 specification for seamless steel cylinders was codified. That same year, the ICC 4 specification for a lap-welded cylinder for anhydrous ammonia was also published. As the welding process improved, from the riveted/brazed welds to resistance welding and then butt welding by the metal-arc process, the ICC 4 Specification series was expanded to include the 4BA, the 4BW, and others. By 1914, two other cylinder specifications were codified: the ICC 7 specification for steel cylinders for low pressure, nonliquefied gas, (which have carried over to the present regulations, but not as specification 7) and the ICC 8 specification for acetylene gas cylinders, which still exists today with minor changes.

In 1930, the ICC implemented regulations for periodic inspection and testing of cylinders; the regulations, as amended, were first published in the **Federal Register** on December 12, 1940 (5 FR 4908). During the 1930's and 1940's, the Compressed Gas Association (CGA) developed and refined the water jacket test method for determining the serviceability of a cylinder. During World War II, there was a shortage of high pressure gas cylinders. Because of CGA's work on steel wall stress limitations, the ICC granted "temporary" regulatory relief to increase the gas carrying capacity of existing cylinders by allowing the cylinders to be filled 10% over their marked service pressures, and by marking those cylinders with a plus, "+", mark. Ten years later, the regulations were codified into the Code of Federal Regulations (15 FR 8261; Dec. 2, 1950). In 1967, pursuant to the Department of Transportation Act, Pub. L. 89-670, 80 Stat. 931, regulatory responsibility for the transportation of dangerous articles in commerce was transferred from the ICC to DOT.

Through rulemaking and the issuance of exemptions from the regulations under 49 CFR part 107, subpart B, materials other than steel (e.g., aluminum and composite cylinders) now are authorized for use. Nevertheless, apart from the substitution of the "DOT" identifier for the "ICC" identifier, many of today's basic requirements remain virtually unchanged from the time they were first incorporated into the regulations.

Over the years, RSPA has received numerous petitions for rulemaking requesting various changes to the cylinder requirements. CGA filed most of these petitions that request changes to

the cylinder specifications. In 1969, CGA submitted a petition (P-69) containing six new proposals and revising eight previously-filed petitions. Many of these 14 petitions were handled in subsequent rulemakings such as Docket HM-69 adding a DOT 39 non-reusable, non-refillable specification cylinder (August 24, 1971; 36 FR 16579), Docket HM-85 updating the DOT-4L cylinder material properties (Nov. 5, 1971; 36 FR 21287), and Docket HM-99 adding the DOT-3T specification cylinder (Aug. 15, 1973; 38 FR 21989).

In 1981, RSPA adopted a DOT 3AL specification under Docket HM-176 (46 FR 62452). This new specification for a seamless aluminum cylinder, made of definitely prescribed alloys, was based in part on the petitions received from industry and an agency initiative to consolidate and eliminate the need for seven exemptions authorizing the manufacture of seamless aluminum cylinders. In 1984, CGA petitioned (P-953) to include a welded stainless steel cylinder similar to the DOT-4BW. At that time, CGA proposed the designation "4SS" for the new stainless steel cylinder.

In 1990, CGA petitioned to add a new 3F specification for a seamless steel compressed gas cylinder designed for a high stress level similar to the DOT-3T, but with a stronger structural integrity similar to the DOT-3AA cylinder. The proposed 3FM specification provides for a greater efficiency in gas transportation.

The above-mentioned petitions were given full consideration in the development of this NPRM. In developing this NPRM, RSPA worked closely with the cylinder manufacturing and maintenance industries, and held several meetings with CGA to obtain clarification of the CGA petitions. RSPA also held public outreach meetings with industry that were announced in the **Federal Register**. The industry proposals and petitions have been refined by RSPA based on RSPA's compliance inspections and exemption program, interpretations issued by RSPA, and certain industry consensus standards and practices that have proven to be safe. RSPA believes the proposals in this NPRM are consistent with sound industry practice and incorporate modern manufacture and requalification technology.

Some of the more significant proposals contained in this NPRM are:

1. The establishment of four new cylinder specifications that are more performance-oriented and the removal of several obsolete specifications. These proposed specifications are expressed in metric units, require marking of the

cylinder with test pressure in place of service pressure, and are distinguishable by their specification designation markings.

2. The new specifications allows greater flexibility in the design and construction of metric-marked cylinders.

3. Independent inspection of all metric-marked cylinders, both seamless and welded.

4. Design qualification testing of metric-marked cylinders.

5. The requalification of metric-marked cylinders and certain nonmetric-marked cylinders using thickness and shear wave ultrasonic testing in place of the volumetric pressure test.

6. Requiring any person who performs a requalification function that requires marking an inspection or retest date on the cylinder to have approval from the Associate Administrator for Hazardous Materials Safety (herein after referred to as the Associate Administrator).

7. Standardizing the requirements for the repair and rebuilding of DOT 4 series cylinders, other than the DOT 4L.

8. Allowing a 10-year interval for requalification of DOT 3-series metric-marked cylinders used in certain types of service.

9. Allowing a 15-year interval for requalification of certain DOT 4-series metric-marked cylinders used in certain types of service.

10. Allowing, upon approval by the Associate Administrator, the application of requalification markings on cylinders by using alternative methods that produce durable legible marks.

11. Implementing valve damage protection and puncture resistance criteria for all DOT specification cylinders used for Division 2.3 or 6.1 materials in Hazard Zone B, and puncture resistance criteria for those in Hazard Zone A.

12. Discontinuing authorization for a filled cylinder with a specified service life from being offered for transportation in commerce after its service life has expired.

13. Providing filling pressures for metric-marked cylinders based on critical temperature, test pressure, and draft ISO Standard 11622.

14. Requiring that pressure relief devices on all metric-marked specification cylinders be set at no less than test pressure. Requiring that pressure relief devices on all 3-series, nonmetric-marked specification cylinders be set at no less than test pressure from the first requalification due after the effective date of the final rule.

II. New specification Standards for Metric-marked Cylinders

A. Consolidation of Cylinder Standards

As discussed above, the current cylinder requirements have their origin in the early 1900's. The regulations were developed in a piecemeal fashion, with adjustments being made to address particular situations and problems on a case-by-case basis. This NPRM represents RSPA's first comprehensive review of the cylinder requirements.

RSPA proposes to establish four new cylinder specifications for seamless and welded cylinders. These proposed cylinder specifications are more performance oriented and incorporate provisions that recognize certain domestic and international practices. Cylinders made to these specifications would be marked in metric units and would be distinguished by a unique specification marking that closely approximates the markings in draft International Standards Organization (ISO) and the European Committee for Standardization (CEN), Technical Committee, entitled ISO/TC58/SC4 "Gas Cylinders Operational Requirements," based on CEN Standard EN 1089-1, "Transportable gas cylinders—Gas cylinder identification—Part 1: Stampmarking."

The new seamless cylinder specifications are identified as DOT 3M, 3ALM, and 3FM. The welded cylinder specification is identified as the DOT 4M. Eventually, RSPA anticipates that the DOT 3M specification will replace the current DOT 3A, 3AA, 3AX, 3AAX, 3B, and 3BN specifications. The DOT 3ALM specification will replace the 3AL specifications. The DOT 3FM will replace the higher strength 3AA and the 3T specifications. The DOT 4M will replace the 4B, 4BA, 4BW, 4B240X, 4B240ET, and 4E. In future rulemakings, RSPA plans to propose new metric-marked cylinder specifications to replace the current specifications for the DOT 3E, 3HT, 4D, 4DA and 4DS; the 4L; the 8 and 8AL; and the DOT 39.

The basic specification requirements, those common to most metric-marked cylinders, are in proposed § 178.69. This section contains definitions, material of construction, duties of the inspector, and criteria for all design and production qualification tests that may be required by the individual specifications. Proposed § 178.70 contains requirements applicable to seamless cylinders. The individual specifications, containing additional requirements, are in § 178.71 for the DOT 3M, § 178.72 for the DOT 3ALM, and § 178.73 for the DOT 3FM. Proposed § 178.81 contains

requirements applicable to DOT 4M welded cylinders.

In all cases where the new proposed specifications differ, the new specification requirements will have a level of integrity that is equivalent to, or greater than, the current nonmetric specification requirements. Significant changes from current requirements are discussed further in this preamble.

B. Cylinder Filling Limits

CGA petitioned RSPA to change the test pressure from 5/3 times service pressure for currently authorized DOT specification seamless cylinders to 3/2 times service pressure for newly constructed DOT specification seamless cylinders. In effect, the CGA proposal would increase the filling limit for most of the new seamless DOT specification cylinders to that currently authorized for cylinders marked with a "+" sign (see 49 CFR 173.302(c)). In the historical and technical information provided to support its petition, CGA stated:

I. Background

In 1942 during the height of industrial production for WWII, a shortage of high pressure gas cylinders developed. The shortage was hampering the War effort. The three manufacturers of large size cylinders were also forging shells and bombs and did not have capacity to forge those and the required quantities of high pressure steel cylinders.

The War Production Board brought this concern to the Compressed Gas Association (CGA) to seek a remedy for the shortage of high pressure cylinders. One idea was to start up new production by spinning seamless tubing, which was initiated by Cueno-Press and Taylor Forge; but that would take months. An immediate "temporary" relief was conceived which was to increase gas carrying capacity by allowing an "overfill" of existing cylinders. After careful study, the increase of 10% in filling pressure (i.e., from 2015 to 2215 psi) was considered safe and technically sound because of the conservative design required by DOT Specification 3A and of the existing high pressure cylinders produced thereto.

For example: A 10% increase in wall stress at the increased filling pressure maintained the operating stress well below the yield point of the steel; and so, cyclic fatigue failure would not become a factor for the ductile, low strength steel. Furthermore, the operating stress would still be far below the ultimate tensile strength providing an adequate safety factor which related service pressure to rupture pressure; and the only way the cylinder pressure of permanent gases could reach burst pressure was by involvement in a fire.

By joint agreement between the War Production Board, Interstate Commerce Commission (ICC) and the Gas Industry, it was decided to immediately allow a "10% overfill" for the existing cylinder fleet. This was to be allowed for both *flammable* and *non-flammable* permanent gases.

To make this effective required a change in the "Regulations" covering "Charging of Cylinders with Non-liquefied Compressed Gases" because it was to be applied to existing cylinders as well as new production. Therefore, section 173.302 was changed and 178 was not changed to cover cylinder design and production. Thus, a 10% increase in the gas carrying capacity of the existing cylinder fleet and new current production was immediately achieved. This had the effect of adding 10% additional cylinders.

II. Technical Rationale for Allowing 10% Higher Fill Pressures

A. Introduction

The fleet of DOT 3 Series cylinders in use during the war years performed safely without a service failure, notably from fatigue or gas pressure rupture. Thus, the carefully considered decision to allow the charging pressure to be increased by 10% was considered to be proven safe and technically valid.

The compressed gas industry monitored performance of their cylinder fleets and concluded that the "temporary" over-filling procedure could safely become a permanent regulation. However, CGA decided to recommend certain controls to justify permanent continuation of this change which effected the design safety factor. Those controls are now contained in CFR Title 49, clause 173.302 (c) entitled "Special filling limits for Specification 3A, 3AA, 3AX, 3AAX and 3T cylinders".

The technical rationale for those controls was: * * *

(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."

Rationale: This was to guarantee that cylinder pressure from any source could never reach the cylinder design burst pressure. Therefore, lowering the ratio of service pressure to rupture pressure, was meaningless because the cylinders would be equipped with a "rupture port" which would vent the gas pressure at a pre-determined pressure and prevent the cylinder from ever reaching its "burst" pressure. * * *

(2) "That the elastic expansion shall have been determined at the time of the last test or retest by the water jacket method."

Rationale: In the 1930s and 1940s the CGA had developed and refined the water jacket test method, and developed the mathematical relationship of wall stresses as measured by the elastic expansion of individual cylinder designs. The average wall stress as determined by elastic expansion measured by the water jacket hydrostatic test was limited to a specified stress less than the permitted maximum design stress. For example, 3AA design cylinders were to be rejected if the elastic expansion exceeded a value equivalent to the strain developed at an average wall stress of 67,000 psi; whereas, the design wall stress limit in 178.37-10(b) is 70,000 psi. This 4% decrease in wall stress was selected because elastic expansion measures the average effective wall thickness and not the minimum. At the same time it was concluded that a small increase (i.e., 4%)

in the stress at isolated areas of a cylinder could be safely tolerated to allow for localized damage or thinning; and a "Maximum wall stress limitation" was set; e.g., 73,000 psi for 3AA design cylinders. This procedure of elastic expansion control was developed to further justify the permanent use of the "10% overfill" by guaranteeing that such cylinders would be controlled by limiting the loss of wall thickness so that the stress at service pressure would be below the yield point of the cylinder steel. * * *

(3) "That either the average wall stress or the maximum wall stress shall not exceed the wall stress limitations shown in the following table."

Rationale: Wall stress limitations for both average wall and isolated spots were developed for each "class of steel" used for ICC 3, DOT 3A, and DOT 3AA cylinder designs. (Much later DOT-3T was added.) These limits were selected from known physical properties of these steel classes; and were set to assure that stress at operation pressures were: (1) well below yield point and (2) that an adequate burst pressure to service pressure ratio was obtained. This clause amplifies the preceding clause 2.

(4) "That an external and internal visual examination made the time of test or retest shows the cylinder to be free from excessive corrosion, pitting, or dangerous defects."

Rationale: The body of data and service experience available within the CGA had proven that the design criterion for DOT high pressure cylinders were eminently safe; especially as regards cycle life and rupture in service. The only cause of cyclic or tensile rupture would be damage inflicted during manufacture or service. Thus, the visual inspection before and during use was considered to be an essential safety measure, which continues to be true today.

(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."

Rationale: This was to force both the cylinder manufacturer and user to take a physical act to signify their guarantee of compliance with the control methods. This also was an easily discerned mark that permitted personnel to identify which cylinders were satisfactory, safe and qualified for charging to the "10% overfill".

B. Wall Stress and Safety Factors of Series 3 DOT Cylinders

The most common high pressure cylinder in use in 1942 was the ICC-3A-2015 with size of 9" O.D. x 51" long, rated at 220 cubic feet oxygen capacity. This cylinder made of normalized intermediate manganese steel had an ultimate tensile strength of about 95,000 psi and had excellent ductility and good Charpy impact strength at -50°F. to assure safe fracture performance. The design stress at test pressure was 49,500 psi which with the 5/3 test pressure ratio allows a stress of 29,600 psi at 2015 psi service pressure. The yield point was about 69,000 psi (about 0.73 x U.T.S.). Thus the service stress was about 50% of yield stress, which level assured a long (virtually infinite) cycle life. The burst stress to service stress ratio (safety factor) was about 3.2 (95,000 ÷ 29,600). * * *

This ratio of operating stress compared to ultimate strength was obviously a conservative design. The conservatism is more obvious in view of the fact that the cylinders were seamless, forged, high quality steel pressure vessels which have no stress concentration points in the longitudinal plane of major stress. Furthermore, they were used in non-corrosive gas service and have no source to increase the contained pressure during use except by the small fluctuations in ambient temperature or a fire. The cylinders are also subjected to periodic requalification. In view of these facts/data and the excellent service record, the decision was made in 1942 to allow stress to increase about 32,600 psi at service pressure for the "10% overfill". This equates to a working stress to burst strength ratio of 2.9 (95,000 ÷ 32,600).

Thus the "10% overfill" was considered technically appropriate and eminently safe as a way to increase the oxygen carrying capacity from 220 CF to 244 CF. These cylinders have continued in service for over 50 years with a perfect safety record as regards cyclic or pressure rupture in service. The same effective stress at test pressure can be achieved by testing either at 5/3 of 2015 or 3/2 of 2215. These pressures are 3358 and 3323 which stresses the wall to 49,350 and 48,720 psi respectively. This 1.2% difference in test pressure stress would be inconsequential with respect to cylinder safety. Therefore, the test pressure in the DOT 3A, 3AA, and 3T specifications can safely be changed to 3/2 instead of 5/3 service pressure. The following paragraph describes graphic presentation of the situation with intermediate manganese normalized and chrome-moly quenched and tempered, which represents virtually 100% of the 3A and 3AA cylinders in the U.S.

* * *

It is proposed to write all the "10% overfill" into the design conditions for DOT 3A, 3AX, 3AA, 3AAX, 3F (new) and 3T. This can be accomplished by merely changing the required test pressure from 5/3 x service pressure to 3/2 x service pressure. For all intents and purposes, the cylinders would be exactly the same as discussed above. * * *

III. Conclusions

1. DOT 3A and 3AA cylinders have been in use since 1942 (54 years) with a ratio of test pressure to service pressure of 3/2. At time of manufacture or retest, the cylinders are tested at 5/3 x service pressure; but the service pressure is increased by 10% for filling.

2. The 10% overfill pressure times 3/2 results in a wall stress at test pressure only 1% less than the requirement to test at 5/3 times marked service pressure.

3. The 3/2 test pressure would result in a calculated minimum wall of barely 0.001 inch less for a current cylinder with a 0.250 wall minimum.

4. The tiny decrease in wall thickness and effect of 1% lower stress at test pressure would have no effect in overall cylinder safety.

5. The service record since 1942 (54 years) has been perfect as regards rupture under gas pressure and cyclic fatigue characteristic.

The change to 3/2 test versus 5/3 does not change any measurable characteristic which would effect these failure modes.

6. The ASME Code uses a 3/2 test pressure to working pressure ratio.

7. Europe (18 countries) uses the 3/2 test to service pressure ratio.

IV. Recommendation

The minimum prescribed test pressure shall be 3/2 times the marked service pressure for all cylinders with a marked service of 500 psi or greater for all Series 3 steel cylinders. This should also be considered for cylinders made of nickel, aluminum or stainless steel.

In considering the issue of cylinder filling limits, RSPA also reviewed technical information supplied by cylinder manufacturers and by holders of exemptions that authorize either a test pressure of 3/2 times service pressure or 10% overfill for materials not currently specified in 49 CFR 173.302(c), the hazardous materials information system data base for incidents involving "+" marked cylinders, and the work currently being done by the ISO and the United Nations Group of Experts on the Transport of Dangerous Goods. After reviewing all the available information, RSPA has concluded that from a transportation safety perspective, there is no technical reason or safety experience which would prohibit increasing the cylinder filling limits for seamless cylinders to those comparable to the levels currently authorized in 49 CFR 173.302(c). Therefore, RSPA has accepted the CGA proposal to increase the filling limits for new cylinders, in principle, but has chosen to limit the proposal for increased filling limits to metric-marked DOT Specification cylinders. Additionally, RSPA has not changed the requirements in 49 CFR 173.302(c) for the current DOT specification cylinders, but has moved them to proposed § 173.302a(b).

With regards to existing cylinders, RSPA is considering a process for accepting certain DOT specification cylinders as meeting the new metric specifications, but is still considering various conversion criteria. RSPA solicits comments from interested persons as to the interest and feasibility of developing such a conversion program and, if feasible, specific criteria for requalifying and conversion of existing cylinders.

C. Specification Markings on Metric-marked Cylinders

In the CGA submission to RSPA, it was requested that cylinders be marked in bar rather than psig. Bar is an internationally accepted metric unit for pressure in the compressed gas

industry. This change would help make marking DOT specification cylinders consistent with the practice in most European countries which are currently marking cylinders with the test pressure shown in bar.

While considering this request, RSPA reviewed its current marking requirements as well as two draft documents on the subject of cylinder marking being considered by the ISO and the CEN. The documents are ISO/DIS 13769, "Gas cylinders—Stamp marking," and CEN Standard EN 1089-1, "Transportable gas cylinders—Gas cylinder identification—Part 1: Stampmarking."

Based upon this review, RSPA proposes to change the way DOT specification cylinders are marked. The new marking scheme will change the number and sequence of marks required to be placed on DOT specification cylinders by manufacturers and is consistent with the sequence being proposed by both ISO and CEN. However, RSPA does not propose to require all of the cylinder marks contained in either the ISO or CEN documents. The proposed marking scheme will also make it easier to identify those cylinders manufactured to the proposed specifications. Additionally, the marking scheme is similar to the type of marking scheme contained in the United Nations Recommendations for the Transport of Dangerous Good for non-bulk packagings and intermediate bulk containers.

The proposed marking sequence, with each element separated by a slash mark, is as follows:

DOT Specification
Country of origin
Manufacturer's identification
Serial number
Stamp for non-destructive testing (if applicable)
Minimum wall thickness
Water capacity (liters)
Test pressure (bar)
Identification of alloy
Tare weight (kg)
Identification of inspection agency
Test date
REE (if applicable)

The most significant change is the marking of the new specification cylinders with test pressure instead of service pressure. DOT specification cylinders have always been designed to test pressure rather than service pressure. Specifically, the stress formulas used to determine the minimum wall thickness of DOT specification cylinders are calculated at the minimum test pressure.

Additionally, as currently authorized in 49 CFR 173.302(c), many cylinders used to transport compressed gases which are not liquefied, dissolved, toxic or flammable are filled to a pressure 10% in excess of their marked service pressure and 49 CFR 173.304(f) specifies, with limited exceptions, that the pressure in the container at 130°F shall not exceed 5/4 times the marked service pressure. While marking the test pressure rather than the service pressure will require the training of persons who fill cylinders, it should not have any adverse safety effects since inadvertently filling a cylinder to the marked test pressure, in bar, would result in the cylinder being filled to a lower pressure than the currently marked service pressure in psig. Further, most cylinders are filled by a person who uses a filling table that shows the values already adjusted for changes in temperature and elevation. RSPA envisions that cylinders marked with test pressure will also be filled by using filling tables.

III. Independent Inspection—New DOT Specification Cylinders

A DOT specification cylinder is, and has been for the past sixty years, a widely recognized standard for the safe transportation of compressed gases. This wide acceptance has resulted in significant economic benefit to domestic industry far beyond the value of the cylinders sold internationally. Market demand for gases and equipment has increased as a direct result of the reputation of the DOT cylinder for strength, durability and quality.

Since the early 1900's, cylinders manufactured under DOT's "high pressure" specifications have required independent inspection, originally referred to as "disinterested inspection." Occasionally, RSPA receives complaints from companies about costs of independent inspection or claims that the companies' employees are as knowledgeable and qualified, if not more so, as the independent inspector. However, RSPA's Office of Hazardous Materials Enforcement, through its compliance inspection program, has found a higher level of compliance with the regulations when inspection and certification functions are carried out by an Independent Inspection Agency (IIA) instead of by an employee of the manufacturing company. In order for DOT specification cylinders to be acceptable for service in most foreign countries, cylinders must be certified through an inspection process which is not controlled by the cylinder manufacturer. Since 1977, all DOT specification cylinders

manufactured outside the United States under the RSPA foreign cylinder approvals program are required to be inspected and certified by an IIA.

In order to maintain the high level of safety established over the past 100 years, to maintain the acceptability of DOT specification cylinders worldwide, and to facilitate the harmonization between domestic and foreign cylinder specifications, RSPA is proposing that all cylinders manufactured or rebuilt to the new DOT metric-marked cylinder specifications be subject to inspection by an IIA. In effect, this would continue the current DOT inspection requirements for seamless cylinders and extend the practice to welded cylinders.

IV. DOT Approval of Cylinder Qualifiers

RSPA proposes that any person who qualifies a DOT specification cylinder must be approved by the Associate Administrator prior to performing any requalification function that requires an inspection or retest date to be marked on the cylinder. The affected functions include performance of a visual inspection, pressure test, ultrasonic thickness test, repair, or the rebuilding of cylinders. This proposal will enhance the accountability of the cylinder requalification process.

Currently, § 173.34(e)(13) permits a cylinder used exclusively for certain liquefied gases to be requalified for use by performing an external visual inspection and marking the cylinder with the test date and an "E". The "E" indicates that the cylinder was requalified by external visual inspection in accordance with CGA Pamphlet C-6 rather than by a hydrostatic test. A person who performs only external visual inspections is not required to obtain an approval from, or register with, the Associate Administrator. Although current § 173.34(e)(13) requires these persons to maintain records, RSPA does not know who or how many persons requalify and mark cylinders with an inspection date and an "E", or the locations of their places of business. Also, RSPA does not know whether these persons have the knowledge and skills necessary to perform the required functions, including use of required inspection standards.

RSPA inspectors have frequently observed DOT specification cylinders, primarily in liquefied petroleum gas service, that bear markings representing that they were requalified for use. The markings reflected dates of recent requalification by external visual inspection. One cylinder, marked with the letter "E" and the date "6 98," was

examined by RSPA personnel on June 19, 1998, and found to be rusted to an extent that there is no doubt that the rust formed long before the marked inspection date. Considering the amount of undisturbed rust on the cylinder, it was apparent that the person requalifying the cylinder did not properly prepare it for inspection by first completely removing all rust from the exterior surface of the cylinder, as required by paragraph 3.1 of CGA Pamphlet C-6, which was developed by the compressed gas industry for adoption by reference as Federal regulations.

In reviewing the approach for resolving this issue, RSPA considered five options:

- (1) Continue the current provision that allows persons who are not known to RSPA to requalify cylinders by performing visual inspections;
- (2) Adopt a registration program that would require persons who perform visual requalification to be registered with RSPA and to mark their requalifier identification numbers (RIN) on the cylinders they inspect;
- (3) Adopt an approvals program requiring that persons performing requalifications of cylinders by visual inspection be approved by RSPA upon written application containing statements regarding their qualifications;
- (4) Adopt an approvals program that would require persons performing visual requalifications to be reviewed by an independent inspection agency; and
- (5) Discontinue visual requalification of cylinders, thereby requiring all affected cylinders to be hydrostatically retested.

RSPA selected option 3 for this NPRM because it will not impose the burden and added cost of employing an independent inspection agency while ensuring the accountability of a person performing visual requalifications and providing RSPA the authority to revoke or suspend the person's approval for demonstrated non-compliance with the requalification requirements. Also, by requiring a certification that an applicant has the ability to perform requalifications, RSPA believes each applicant's awareness of the importance of compliance will be heightened. RSPA solicits comments on these options and others that RSPA may not have considered.

V. Requalification Markings

RSPA proposes to amend § 171.2(d) to prohibit the misrepresentation of a requalification identification number (RIN) marking. Over the years, through its compliance program, RSPA has been

in contact with dozens of individuals who did not perform the required hydrostatic tests, but stamped the cylinders as though each cylinder had passed the inspections and tests. The steel stamps used to mark the cylinders are readily available, low-cost and simple to use. RSPA believes that these and other factors (e.g., the high cost of purchasing and maintaining hydrostatic test equipment when compared to the mere cost of obtaining a set of steel stamps) provide an economic inducement for some individuals to engage in fraudulent activities. Based on recent enforcement data, this safety problem appears to be more widespread than RSPA originally thought. RSPA is concerned about the number of cylinders that are fraudulently stamped and then are used to transport hazardous materials in commerce. These cylinders, whose structural integrity has not been verified, pose substantial risks to health, safety and property. When RSPA discovers these situations, RSPA publishes a safety alert notice (see Notice No. 97-2, 62 FR 19651; Notice No. 97-3, 62 FR 24548) and, where appropriate, refers the matter to the Department of Justice for possible criminal prosecution (see *United States v. American Oxygen Company, et al.*, Docket No. 97-533 (D.N.M.)).

RSPA is also soliciting comments on the issue of what future method or methods should be used to mark DOT specification cylinders during the requalification process. Currently, after a cylinder meets the requalification standards (e.g., passes a hydrostatic test, internal and external visual examinations, etc.), the requalifier stamps the month and year of the test and its RIN on the cylinder. This marking is normally accomplished with steel stamps (Note: currently under an exemption certain fiber-wrapped cylinders may be marked with labels.). Through this rulemaking, RSPA is evaluating the merits of new marking methods for DOT specification cylinders following the requalification process.

RSPA is considering incorporating a number of marking options (e.g., labeling, marking with a laser, replacing the RIN with a symbol that is difficult to duplicate, etc.). RSPA is requesting comments from the public as to the feasibility, costs and benefits of alternatives to the metal stamping method and whether the public believes there is justification for RSPA adopting an alternative method.

VI. Toxic Gases

Division 2.3 and 6.1, Hazard Zone A and B toxic inhalation hazard (TIH)

materials present a substantial risk to the public, transport workers and emergency responders even when small quantities are released. For smaller cylinders, shifting freight and dropping are major sources of package damage and releases of hazardous materials. Cylinders are sometimes dropped in handling, resulting in valve damage or cylinder punctures. In a study of Hazardous Materials Information System (HMIS) reports for the past 10 years, RSPA found that over 30% of all reported cylinder incidents involved valve damage. Valve damage occurs when valves are inadequately protected by outer packagings or valve protection devices. Punctures most commonly occur when a cylinder is impacted by handling equipment or other cargo or is dropped upon other cargo or handling equipment. To reduce the probability that a handling incident may result in the release of a TIH material, RSPA proposes to expand the current drop test requirement for cylinders containing TIH materials to include Hazard Zone B materials and a performance test for cylinder puncture for TIH materials in Hazard Zones A and B. These proposed performance tests apply to bare cylinders and cylinders packed in strong outside packagings.

The performance test for puncture is based upon dropping a cylinder seven feet; the same height used in the drop test for cylinder valve protection. The seven-foot drop height represents the typical distance that an industrial gas cylinder would encounter if it fell from a truck. RSPA chose an angle iron (2 inch by 2 inch by 0.25 inch thick) as a typical penetrator. The major parameters controlling cylinder penetration are cylinder material, wall thickness, drop height and the cylinder's gross weight. For consistency, RSPA proposes the cylinder weight be the water-filled weight. To represent in-service stress conditions, the proposed test is performed on the filled cylinder charged to service pressure for nonmetric-marked cylinders and 67% of test pressure for metric-marked cylinders.

The puncture-performance test would be required for metric-marked and nonmetric-marked cylinders. To facilitate implementation of this requirement for nonmetric-marked cylinders, RSPA is proposing a two-year implementation period. RSPA also proposes a table showing threshold values of wall thickness for cylinders of a particular specification, material, and water-filled weight range. Cylinders meeting the specified criteria with a minimum side wall thickness equal to or greater than the value specified in the

table would qualify under current § 173.40(d)(1) without puncture testing. To minimize the testing burden, RSPA plans to perform puncture testing to develop initial values for the table. RSPA is requesting that cylinder manufacturers and shippers assist RSPA in developing this table. RSPA is also soliciting comments on whether welded cylinders and cylinders with wall thickness of 2.0 mm or less are used for the transportation of Division 2.3 and 6.1 Hazard Zone B, C, and D materials. RSPA will use this information to further develop the puncture testing threshold table. When sufficient data is available, RSPA would consider the development of a graph or calculation as a more practical means to depict a minimum thickness threshold for puncture resistance.

VII. Discontinuation of Certain Cylinder Specifications

RSPA proposes to discontinue the use of the following DOT cylinder specifications: 3C, 3D, 4, 4A, 4B240X, 4B240FLW, 4C, 9, 25, 26, 33, 38, 40 and 41. RSPA believes that these cylinders are obsolete and no longer in general use. Authorization to manufacture these cylinders was removed from the regulations on September 11, 1980 (45 FR 59887). Comments are solicited from persons who may be using these cylinders.

If the proposals contained in this NPRM lead to publication of a final rule, RSPA proposes to provide a transition period of five years from the effective date of the final rule for the continued construction of cylinders made to the following DOT specifications: 3A, 3AX, 3AA, 3AAX, 3AL, 3B, 3T, 3BN, 4B, 4BA, 4BW, 4B240ET, and 4E. RSPA believes a five-year transition period for new construction of cylinders conforming to these specifications will reduce the burdens incurred by persons affected by this proposal. Cylinders made to these specifications would be authorized for continued use as long as they meet standards for periodic requalification. Voluntary compliance with the new metric or revised requirements would be authorized 90 days following publication of the final rule in the **Federal Register**.

VIII. Pressure Relief Device (PRD) Systems

In a previous rulemaking (see, Docket No. HM-220A, 61 FR 26750, 26756; May 28, 1996), RSPA proposed voluntary compliance with CGA Pamphlet S-1.1, paragraph 9.1.1.1, which would require verification that the PRDs operate properly. RSPA made this proposal based on the view that

over time certain components within a PRD will cease to function as designed. Thus, RSPA proposed adopting paragraph 9.1.1.1 which would have required that the operation of the PRD be verified. A number of commenters opposed this proposal citing its cost and the lack of incident data supporting adoption of this requirement. Based on the need to gather more data and review the cost estimates submitted, RSPA withdrew the proposal and agreed to consider the proposal in a future rulemaking. RSPA continues to evaluate adopting this industry standard.

Since publication of HM-220A final rule, gas industry representatives have expressed the view that over time most polymers, used as seats in PRDs, vulcanize. Vulcanization prevents the devices from functioning as designed. RSPA solicits information on the following:

1. Data and comments on the cost, effectiveness and need for adopting paragraph 9.1.1.1, in CGA Pamphlet S-1.1.
 2. Additional incident data from State and local officials concerning incidents that involved compressed gas cylinders which may not have been reported to RSPA because the incident did not involve a hazardous materials carrier or did not meet the reporting criteria specified in 49 CFR § 171.16.
 3. Comments on the need to require PRD manufacturers to certify a performance range and period for their devices. Thus, a PRD would have to perform within specific limits throughout a specific life.
- Public comments that address these issues will be considered in a future rulemaking.

IX. Related Rulemakings, Petitions for Rulemaking, and Safety Recommendations

Docket HM-176A (RIN 2131-AB51). RSPA proposes to amend § 178.46 to remove aluminum alloy 6351-T6 as an authorized material for the manufacture of DOT 3AL seamless cylinders. In January 1990, at RSPA's urging, manufacturers of DOT 3AL cylinders voluntarily discontinued the use of aluminum alloy 6351-T6 because cylinders made of this alloy are susceptible to cracks that could result in leaks or ruptures.

On July 10, 1987, RSPA published in the **Federal Register** a safety advisory and advance notice of proposed rulemaking (ANPRM) (Docket No. HM-176-A; 52 FR 26027) to inform all persons possessing DOT 3AL (49 CFR 178.46) cylinders, made of aluminum alloy 6351 manufactured by Luxfer USA Limited, that cracks had developed during service which occasionally resulted in leakage and loss of cylinder contents. In addition to the safety advisory, the notice identified those cylinders at risk, suggested steps that users should take to minimize risks, and requested industries' comments concerning the extent of the problem and their suggestions on corrective measures.

RSPA received 31 comments from manufacturers, distributors, and industrial users of aluminum alloy cylinders. Some commenters submitted findings of studies for cylinders manufactured with aluminum alloy 6351, including sustained load cracking (SLC) behavior testing. The majority of the comments and findings concluded

that DOT 3AL cylinders made from aluminum alloy 6351, including cylinders authorized under exemption DOT-E 7235, pose a greater probability of failure than other cylinders. Further, information available to RSPA reveals that it is difficult to detect cracks in these cylinders which adds to the risks. RSPA published several notices to alert persons to the safety risk associated with cylinders manufactured to the DOT 3AL specification or under exemption DOT E-7235 and containing alloy 6351 (50 FR 32944, August 15, 1985; 58 FR 15895, March 24, 1993, 59 FR 38028, July 26, 1994). Thus, there is sufficient data which demonstrates that this alloy is not suitable for the manufacture of compressed gas cylinders and that it should be removed as an authorized construction material.

Petitions for rulemaking. RSPA has received numerous petitions for rulemaking requesting changes to the cylinder specifications and related commodity and requalification requirements. These petitions were held in abeyance and were considered in the development of this NPRM. Most of the requested changes are included in this NPRM. Because of the proposals in this NPRM to establish four new cylinder specifications and to discontinue construction of cylinders to certain current specifications, some of the requests for changes to the current regulations are no longer warranted. A summary of the petitions, with RSPA's comment shown in brackets, are as follows:

Petition No.	Request
0095	Consolidate the DOT 3-series specifications to permit unified specifications. Filed by CGA [Proposed in §§ 178.69-178.73 for metric-marked cylinders].
0154	Permit filling of non-toxic, nonliquefied flammable gases to 110% of the cylinder's marked service pressure (including hydrogen). Filed by CGA [Proposed in § 173.302b for metric-marked cylinders].
0312	Align rejection criteria of welded cylinder specifications to permit testing of second specimen from same lot if first specimen fails. Filed by the Canadian Transport Commission [Proposed in § 178.81 for metric-marked cylinders].
0324	(Request same as P-0312). Filed by the Association of American Railroads.
0457	Revise cylinder repair and rebuilding requirements. Filed by CGA [Proposed in § 180.211 for all cylinders].
0553	Amend Part 178 to change cylinder lot size in each specification. Filed by CGA [Proposed in § 178.70 for seamless metric-marked cylinders and in § 178.81 for metric-marked welded cylinders].
0652	Revise § 173.302(c)(3) table to add a fifth class of steel for DOT 3 series cylinder tubes. Filed by CGA [Proposed in § 178.70 for metric-marked cylinders].
0752	Amend the table in 178.37-5(a), by adding a column titled "Authorized Chemical analysis (designation 10B30)." Filed by Pressed Steel Tank. (See DOT E 8311) [Proposed in § 178.70 for metric-marked cylinders].
0823	Incorporate by reference CGA Pamphlets C-1 and C-5. (See also P-981). Filed by CGA [Incorporated by reference in § 171.7].
0866	Revise required sequence for display of specification markings on seamless aluminum cylinders and allow use of new marking techniques [Proposed in § 178.69 for metric-marked cylinders].
0953	Establish a new specification for manufacture of new welded, stainless steel cylinders. (See E-4884). Filed by CGA [Proposed in § 178.81 DOT 4M specification].
1040	Revise § 173.304(c) and (d)(4) to expand specific gravities for LPG, at 42% filling density, from 0.504-510 to 0.497-0.510. Filed by the National Propane Gas Association [Proposed in § 173.304b for metric-marked cylinders].
1071	Permit use of DOT 3AL cylinders for any gas or gas mixture that is compatible with aluminum. Filed by CGA [Proposed greater use DOT 3ALM cylinders in § 173.302b].

Petition No.	Request
1082	Revise 173.302(f) to remove 5/6 filling pressure limitation applicable to DOT 3AL cylinders. Filed by CGA [Proposed in § 173.301a for DOT 3AL cylinders and in § 173.301b for DOT 3ALM cylinders].
1087	Establish a new specification for seamless steel cylinders having a design stress of not more than 90,500 psi and a water capacity of not more than 150 pounds. (E-9001, 9370, 10047). Filed by CGA [Included in proposed new DOT 3FM specification in § 178.73].
1090	Require that a cylinder requalified by visual inspection must be marked with the retester's identification number. Filed by CGA [Proposed in § 180.213].
1189	Establish a new low pressure welded stainless steel cylinder specification. Filed by CGA. Includes P-0953 [Proposed in § 178.81 DOT 4M specification].
1229	Revise §§ 178.36 thru 178.60 to specify procedures for conducting tensile test. Filed by CGA [Proposed in § 178.69 for metric-marked cylinders].
1233	Permit nondestructive requalification testing of compressed natural gas (CNG) cylinders. Filed by FIBA [Proposed in §§ 178.69, 180.207 and 180.209 for metric-marked cylinders and certain nonmetric-marked cylinders].
1263	Revise § 173.34(e)(18) to permit the use of a permanent, non-transferrable label for retest and inspection markings on fire extinguishers. Filed by Amerex [Proposed in 180.213].
1277	Revise § 173.34(i)(4) to except DOT 4BW cylinders from heat treatment after replacement of nonpressure attachments. Filed by Manchester [Proposed in § 180.211 subject to certain conditions].

National Transportation Safety Board (NTSB) Safety Recommendations.

- I-92-001
 Recommends that RSPA require attachments to all DOT authorized hazardous materials packagings be designed to minimize the risk of puncturing other hazardous materials packagings during an accident situation. (Proposed in § 173.301(m))
- I-90-008
 Recommends that RSPA require hazardous material cargo to be secured in transportation with adequate restraint systems to prevent ejection of cargo from vehicles. (Proposed in § 177.840)
- I-90-009
 Recommends that RSPA require independent inspection of new and reconditioned low pressure cylinders that are consistent with present independent inspection requirements for high pressure cylinders [Proposed for 4M cylinders in § 178.69.]

New section	Old section	New section	Old section
(c)(6)		(a)(2)	(a)(2).
(c)(7)		(a)(3)	(a)(4).
(d)	(c), (i).	(a)(4)	(a)(3).
107.805(a)	173.34(e)(2)(ii).	(a)(5)	(a)(4)-(5).
(b)	(e)(2)(ii).	(b)	(c).
(c)	(e)(2)(ii)(A).	(c)	(f).
(d)	(e)(2)(ii)(B).	(d)	(f).
(e)	(e)(2)(ii)(B).	(e)	(d).
(f)		173.302b	
107.807(a)	173.300b.	173.304(a)	173.304(a) intro, (a)(1).
(b)	(b).	(a)(1)	(a)(4).
(c)	(g).	(a)(2)	
173.301(a)		(a)(3)	
(a)(1)	173.301(h).	(b)	(b).
(a)(2)	173.34(e)(1).	(c)	(a) intro.
(a)(3)	(e)(17).	(d)	(e).
(a)(4)	(a)(2).	(e)	(f).
(a)(5)	(e)(1)(ii).	173.304a(a) ..	173.304(a).
(a)(6)	173.301(k).	(c)	(c).
(a)(7)		(d)	(d).
(a)(8)		(e)	(h).
(a)(9)		173.304b	
(a)(10)	173.301(k).	173.315(p)	173.301(d)(5).
(b)	173.34(c).	180.201	
(c)	173.301(a).	180.203	
(d)	(b).	180.205(a)	
(e)	173.34(c).	(b)	173.34 (e)(2).
(f)	173.301(d).	(c) intro	(e)(1).
(g) intro		(c)(1)	(e)(1).
(g)(1) thru	173.301(g)(1) thru (g)(3).	(c)(2)	
(g) (3).		(c)(3)	(c)(3).
(h)	(g).	(c)(4)	
(i)		(d)	
(j)	(i).	(e)	(e)(17).
(k)		(f)	(e)(3).
(l)	(j).	(g)	(e)(4).
(m)		(h)	(e)(5).
173.301a(a) ..	173.301(e).	(i)	(e)(6).
(b)	(e)(1).	180.207	
(c)	(e)(2).	180.209(a)	173.34(e) intro.
(d)	(f) .	(b)	(e)(16).
(e)	173.34(b).	(c)	(e)(9).
173.301b		(d)	(e)(10).
173.302(a)	173.302(a)(4), (a)(5)(i) thru	(e)	(e)(11).
	(iii).	(f)	(e)(12).
(b)	173.302(a)(4), (a)(5)(i) thru	(g)	(e)(13).
	(iii).	(h)	(e)(14).
(c)	173.301(e).	(i)	(e)(18).
(d)	173.301(f).	(j)	(e)(19).
173.302a(a)	173.302(a).	(k)	
intro.		180.211	173.34(g), (i) through (l).
(a)(1)	(a)(1).	180.213	173.34(c), (e)(7).

X. Cross Reference Table

The following table lists the proposed paragraphs or sections and, where applicable, the corresponding paragraph or section contained in the current HMR. In some cases, the cross references are to provisions which are similar to, but not identical with current provisions.

New section	Old section
107.801	
107.803(a)	173.300a(a).
(b)	173.300a, 173.34(e)(2)(ii) third sentence.
(c) intro	173.300a(b).
(c)(1)	(b)(2).
(c)(2)	(b)(3).
(c)(3)	(b)(6).
(c)(4)	(b)(7).
(c)(5)	(a).

New section	Old section
180.215	173.34(e)(2)(v), (e)(8), (e)(13).

XI. Summary of Regulatory Changes by Section

Part 107, Subpart I

Section 107.801-107.807

This new subpart would contain procedures whereby persons may seek approval from the Associate Administrator to be a cylinder requalifier, an independent inspection agency (IIA), or to have chemical tests or analysis performed outside the United States for DOT specification cylinders manufactured outside the United States. These requirements are contained currently in §§ 173.300a, 173.34(e) and 173.300b, respectively. This new subpart would contain the specific requirements. Current requirements in 49 CFR Subpart H of Part 107 would be referenced for minimum content of an application, the RSPA office where an application is to be filed, and the procedures that will be used to process or terminate an application for approval.

The criteria permit the selection of any person or organization, foreign as well as domestic, that is technically competent to perform the prescribed functions and is free from undue influence by persons involved with the fabrication, ownership or movement of the cylinders that the applicant, if approved, would be called upon to evaluate and certify. Under this proposal, RSPA would accept for transportation in the United States foreign-made cylinders that are similar in construction to the proposed DOT metric-marked cylinders. As part of this policy, if the United States recognizes cylinders manufactured outside the United States and approved by a third party inspector approved by another government, then equal treatment is expected of that government relative to cylinders manufactured in the United States and approved by an IIA approved by DOT. Therefore, a foreign third-party inspector, who certifies cylinders manufactured outside the United States, must submit a statement from the competent authority of the foreign government stating that similar authority is delegated to manufacturers of metric-marked cylinders in the United States and that no additional limitations are imposed.

Proposed § 107.803 (current § 173.300a) prescribes application procedures for approval or renewal as an IIA. These procedures, contained

currently in § 173.300a, would also permit an IIA, upon approval by the Associate Administrator, to perform other functions relating to the cylinder requalification requirements prescribed in Part 180.

Proposed § 107.805 (current § 173.34(e)(2)) prescribes application procedures for a person seeking an approval to perform periodic cylinder requalifications. The procedures would be revised and broadened to apply to any person who performs a function after which the cylinder is required to be marked with a date as discussed in Part IV of this preamble under the heading "DOT approval of cylinder requalifiers". Because these provisions would be expanded to apply to repairers and rebuilders, the terms "retester" and "retester identification number" would be replaced with the terms "requalifier" and "requalifier identification number," respectively.

Proposed § 107.807 (current § 173.300b) prescribes the application procedures for issuance or renewal of an approval to perform chemical analyses and tests outside the United States on DOT specification cylinders manufactured outside the United States.

Part 171

Section 171.2

Paragraph (d)(3) would be amended to clarify that no one may mark a requalifier identification number on a cylinder that has not been requalified in accordance with the applicable requirements.

Section 171.7

This section would incorporate the latest editions of previously approved CGA Pamphlets, incorporate certain additional ASTM and CGA standards, and add references to certain publications of the American National Standards Institute (ANSI).

Section 171.8

Definitions for "metric-marked cylinder" and "nonmetric-marked cylinder" would be added.

Section 171.12

Paragraph (b)(15) would be revised to include references to § 171.12a(b)(13).

Section 171.12a

On August 18, 1998, RSPA issued a notice of proposed rulemaking [Docket HM-215C; 63 FR 44312] which proposed to revise paragraph (b)(13) to provide reciprocity for certain Canadian specification cylinders to be transported within the United States. This HM-215C proposed change is reprinted here for the benefit of readers.

Part 172

In the § 172.101 Table, in column (8b) for the entries "Cyanogen", "Germane", and "Iron Pentacarbonyl" would be revised to specify packaging authorization sections that are consistent with their toxic properties.

Part 173

Section 173.34

The provisions in this section would be relocated to subpart I of part 107, § 173.301 and subpart B of part 180, as appropriate, and § 173.34 would be removed. All references to § 173.34 in the HMR, approximately 150 in number, would be removed and replaced with the appropriate section reference.

Section 173.40

The requirements for toxic materials packaged in cylinders would be revised to include an additional performance criteria for puncture resistance. The requirements in § 173.40 currently apply only to materials in Hazard Zone A. All requirements except the controls on closures would be expanded to Hazard Zone B materials. RSPA requests comments on whether cylinders with Hazard Zone B materials should be required to meet the same closure requirements required for Hazard Zone A.

As discussed earlier in this preamble, DOT 3AL cylinders made of aluminum alloy 6351-T6 are susceptible to sustained load cracking (SLC) in the neck and shoulder area of the cylinder head and, therefore, may leak in transportation. Leaks of Toxic Inhalation Hazard (TIH) materials pose a significant threat to health and safety. At least two major gas suppliers have voluntarily stopped using these cylinders in TIH gas services. The proposed regulation will reduce the risk to health and safety associated with TIH materials leaking through cracks in cylinders. RSPA proposes that this regulation be imposed on the effective date of this rule. After that date, cylinders made of 6351 alloy may not be filled and offered for transportation in TIH service. Cylinders filled prior to that date may be offered for transportation and transported to their ultimate destination and, when necessary, cylinders containing unused gas may be returned to the person who filled the cylinder.

Section 173.163

The requirements for nonmetric-marked cylinders containing hydrogen fluoride would be amended to require ultrasonic examination as the only authorized requalification method. This

proposal is based on the fact that the presence of moisture in a cylinder containing hydrogen fluoride causes rapid corrosion of the cylinder wall. Since removal of all moisture after hydrostatic testing is very difficult, the current requirements authorize only the external visual inspection in lieu of hydrostatic testing and internal visual inspection. At the time the requirement was last amended, no other alternative examination was available to reliably examine the cylinder without introducing moisture into the cylinder. An ultrasonic examination, to examine the internal sidewall for defects, can be performed without introducing moisture to the cylinder. This section also would be amended to include metric-marked cylinders for use in hydrogen fluoride service.

Section 173.192

The title of this section would be revised to reflect that requirements are applicable to Hazard Zone A gases. The restriction on aluminum cylinders by highway and rail would be extended beyond arsine and phosphine to include all Hazard Zone A gases. Paragraph (c) would be amended to authorize alternative leakage tests having an equivalent level of sensitivity as the current water bath leakage test, upon written approval from the Associate Administrator. Currently without exception, cylinders containing any amount of phosgene gas must be subjected to a water bath leakage test prior to offering them for transportation.

Section 173.198

An editorial change would be made to paragraph (a).

Section 173.226

Paragraph (a) would be revised to include only seamless specification cylinders conforming to all requirements of § 173.40. Currently, Division 6.1, Hazard Zone A materials may be shipped in any DOT specification cylinder except 8, 8AL and 39. RSPA believes that this must be corrected in order to require these high hazard materials to be transported in cylinders with a higher level of safety.

Section 173.227

Paragraph (a) would be revised to include only seamless and welded specification cylinders conforming to the requirements of § 173.40.

Section 173.228

Paragraph (a) would be amended to include metric-marked specification cylinders and to require that cylinders used for bromine pentafluoride and

bromine trifluoride in Hazard Zones A and B materials must conform to § 173.40 as required for similar materials.

Sections 173.300a–173.300c

The provisions in these sections would be relocated to new Subpart I of Part 107 and §§ 173.300a, 173.300b and 173.300c would be removed.

Sections 173.301–173.301b

Current § 173.301 would be revised and proposed §§ 173.301a and 173.301b would be added. Section 173.301 would contain the general shipper requirements for the use of specification cylinders that are currently in § 173.34 and the standard requirements for cylinders that are currently in § 173.301. These requirements include general prefill requirements, maintenance and legibility of markings, PRD, valve protection, manifolding of cylinders and the charging of foreign cylinders. A derivation table showing the relocation of the requirements appears in Part X of this preamble.

Certain other changes would be made to § 173.301. The cargo tank manifolding requirements that are currently in § 173.301(d) would be removed and placed with other cargo tank requirements in § 173.315.

Proposed paragraph (a)(6) would prohibit the offering for transportation and transportation in commerce of a filled cylinder having a specified service life after its service life has expired. This requirement will ensure cylinders that may be unsafe are removed from service for transportation of hazardous materials.

Proposed paragraph (d) contains the general prohibition, that is currently contained in paragraph (a), against filling a cylinder with gases that are capable of combining chemically with each other or with the cylinder material so as to endanger its serviceability. This provision would be expanded to prohibit the use of DOT 3AL cylinders made of aluminum alloy 6351-T6 for gases having pyrophoric properties. Leaks of gases having pyrophoric properties, such as, silane, would cause spontaneous flame and pose a significant threat to the health and safety. A transition period of six months after the effective date of the final rule would be provided for cylinders filled prior to the specified date.

Proposed paragraph (f) contains PRD system and setting requirements. The general purpose of a hazardous material packaging is to prevent the unintentional release of a hazardous material under normal conditions of transportation, including mishandling

and minor traffic accidents. Also, the packaging standards for cylinders are designed to prevent failure of a cylinder from over pressurization, particularly, when it retains substantial stored energy. Thus, a balance must be set between competing interests for keeping a hazardous material, particularly Division 2.1 and 2.3 gases and Division 2.2 gases with oxidizing properties, in a packaging and allowing such a material to escape in order to prevent the packaging from rupturing.

Under current regulations, the type and setting of PRD systems are established by CGA Pamphlet S-1.1. CGA Pamphlet S-1.1 allows a PRD setting to be 75% to 100% of test pressure of the cylinder. Based on RSPA's analysis of the currently authorized settings, a fully charged nonmetric-marked DOT-3 series gas cylinder at 130 °F operating temperature will likely release hazardous gases when the PRDs, conforming to the authorized tolerances on device function, are set below test pressure. RSPA believes this creates a serious threat to safety by allowing an improper balance between keeping the hazardous material in the package and preventing the cylinder from rupturing. In contrast, RSPA does not believe this condition applies to DOT-4 series cylinders because the ratio of test pressure to service pressure is 2:1 as compared to 1.67:1 for DOT-3 series cylinders.

To correct this condition, RSPA is proposing a PRD setting of 100% of the marked test pressure for metric-marked and nonmetric-marked DOT-3 series cylinders. To allow users sufficient time to change their nonmetric-marked cylinders to meet the new PRD setting requirement, RSPA is proposing that each cylinder be brought into compliance at the first requalification of the cylinder after the effective date of the final rule.

RSPA believes a setting of 100% of test pressure for a PRD is a reasonable balance between keeping a gas in a cylinder and preventing a cylinder from rupturing in the event of a fire or overfill. PRDs designed to release at not less than test pressure will eliminate the possibility of gas release through the relief device at a temperature less than or equal to 54 °C (130 °F). At the same condition, test pressure, the factor of safety for cylinder rupture is 1.6. As a result of discussions with gas shippers, RSPA believes many major shippers of DOT-3 series cylinders are currently setting PRDs at 90–100% of test pressure for toxic and flammable gases. Because it is common practice for many shippers of DOT-3 series cylinders to replace the PRD at the time of a

cylinder's requalification. RSPA believes the proposal will result in minimal incremental cost. For most gases, RSPA believes the increased PRD setting will not significantly impact the performance of cylinders in bonfire tests. RSPA requests the following:

1. Data on the performance of PRDs set at test pressure in bonfire tests.
2. Comments on any gases or cylinders where a 100% of test pressure setting could prevent a cylinder from passing a bonfire test.
3. Comments on the need to requalify PRDs in a bonfire test.

Proposed paragraph (h) would contain the cylinder valve protection requirements that are currently in paragraph (g). These requirements would be revised to require a performance-oriented approach to valve assembly protection. A six foot drop test would be required to verify that each cylinder valve (with or without protection assembly) has sufficient strength to survive falls incidental to handling in transportation. An acceptable drop test result would be that no leakage occurs after the cylinder is dropped, although the cylinder may show damage. A similar drop test is currently required for all non-bulk performance-oriented packagings to ensure that the packages can withstand normal conditions of transportation. RSPA believes that cylinders should be held to at least the same level of performance as drums and fiberboard boxes. A period of five years is proposed in paragraph (h)(1)(i) to provide a smooth transition to meet this performance requirement.

Proposed paragraph (k) would be added to permit foreign cylinders to be imported into the United States and transported within a single port area subject to certain conditions.

Proposed paragraph (m) would be added to prohibit cylinder attachments with sharp features that may cause damage to other freight. This new provision is in response to NTSB Recommendation I-92-001 with respect to cylinders. Attachments for other hazardous material packaging types will be addressed in a separate rulemaking action.

Proposed § 173.301a would contain the current requirements pertaining to the pressure in a nonmetric-marked cylinder at 70 °F and 130 °F. It would also contain a grandfather provision that is currently in § 173.34(b).

Proposed § 173.301b contains additional general requirements for metric-marked cylinders used for nonliquefied (permanent) gases. Definitions would be added for "critical temperature," "dissolved gas," "filling

factor of liquefied compressed gas," "high pressure liquefied compressed gas," "low pressure liquefied compressed gas," "permanent (non-liquefied compressed) gas," "safety factor," and "settled pressure." These proposed definitions, which are used in ISO Standard 11622, will provide for harmonization with the international standards.

Sections 173.302-173.302b

Current § 173.302 would be revised and proposed §§ 173.302a and 173.302b would be added. Proposed § 173.302 prescribes the general requirements that would apply to filling a specification cylinder with a nonliquefied (permanent) compressed gas.

Proposed 173.302a prescribes requirements for filling a nonmetric-marked cylinder with a nonliquefied compressed gas, i.e., the current requirements in § 173.302. In addition, RSPA proposes to remove the 5/6 filling pressure limitation for DOT 3AL cylinders in carbon monoxide service, in response to a CGA petition (P-1082). CGA furnished information to support its conclusion that, although evidence shows that carbon monoxide can cause stress corrosion cracking in steel cylinders, there is no evidence that carbon monoxide causes corrosion cracking or carbonyl formation in aluminum cylinders.

Proposed § 173.302b prescribes requirements for filling a metric-marked cylinder with permanent gas. Because a metric-marked cylinder is stamped with the test pressure in bar, the fill pressure is calculated from the marked test pressure. The charge pressure for a metric-marked cylinder is 2/3 of the test pressure for seamless DOT 3M, 3FM and 3ALM cylinders, and 1/2 of the test pressure for welded DOT 4M cylinders. The NPRM proposes a uniform standard which reduces the possibility of overfilling and allows the gas industry to ship an additional 1.5% gas. Because the NPRM proposes that the cylinder be marked and charged in accordance with ISO Standard 11622, it would facilitate shipments of hazardous material in DOT specification cylinders internationally.

Section 173.304-173.304b

Current § 173.304 would be revised and proposed §§ 173.304a and 173.304b would be added. Proposed § 173.304 prescribes general requirements that would apply to filling a specification cylinder with a liquefied gas.

Proposed § 173.304a prescribes specific requirements for filling a nonmetric-marked cylinder with a liquefied gas, i.e., the requirements that are currently in § 173.304. Currently,

§ 173.304 limits the filling of a cylinder with a liquefied compressed gas based on the maximum expected operating temperature (130 °F) and the minimum specific gravity of the liquid at 60 °F. The maximum filling densities for many gases are prescribed in a table that would be retained in the HMR in § 173.304a for nonmetric-marked cylinders.

The current regulation defines a liquefied compressed gas to be partially liquid at an operating temperature of 20 °C (68 °F) and authorizes a filling limit based on a wide range of critical temperatures. Therefore, the safety factor derived from filling limits is conservative for some gases and marginal for other gases. In addition, the current regulations limit the internal volume of a DOT-39 specification cylinder to 75 cubic inches when used for liquefied petroleum gases. This requirement is revised to apply to all liquefied flammable gases and appears in proposed § 173.304a(a)(3). In proposed § 173.304b for metric-marked cylinders, filling limits are based on the maximum operating temperature and filling factor. Instead of a maximum filling density table, the proposed filling limits are based on a filling factor which is directly related to the critical temperature of the liquefied compressed gas. The proposed filling limits are applicable to all liquefied compressed gases. Under the proposed filling limits, the filling factor is defined based on the critical temperature and the operating condition of each individual gas. Therefore, the proposal enhances the level of safety and allows the gas industry to fill the cylinders with more product.

Section 173.334

This section would be amended to include metric-marked specification cylinders.

Section 173.336

This section would be amended to include metric-marked specification cylinders.

Section 173.337

This section would be amended to include metric-marked specification cylinders.

Part 177

§ 177.840 Class 2 (Gases) Materials

RSPA proposes to revise paragraph (a)(1) to allow horizontal loading of cylinders containing Class 2.2 materials. In addition, the horizontal loading of Class 2.1 and Class 2.3 materials would be permitted for cylinders designed so that the inlet to the PRD is located in the

vapor space and provided that the cylinders are properly secured during transportation.

This paragraph also would require the use of cylinder restraint systems to reduce the likelihood of the cylinders being ejected from the vehicle in event of an accident. This proposal is based on a NTSB Recommendation I-90-008, that urges RSPA to require hazardous materials packages to be secured with adequate cargo restraint systems to prevent their ejection from the vehicle during transportation. NTSB made the recommendation following an accident in Collier County, Florida that involved a number of cylinders, containing a poisonous by inhalation gas, being ejected from an overturned tractor-flatbed semitrailer. Considering the wide variation in cylinder sizes, and the various types of restraints that would be required, RSPA solicits information on anticipated safety benefits and the costs of requiring the use of restraint systems, particularly on small businesses.

Part 178

Section 178.46

As discussed in Part IX of this preamble, the tables in paragraph (b)(4) would be revised to remove aluminum alloy 6351 as an authorized material for the manufacture of DOT 3AL seamless cylinders. In addition, in Table 1, several changes would be made to the chemical composition limits for 6061 alloy for consistency with limits stated in The Aluminum Association Standards and Data, 1993 edition. The Si maximum that is currently stated as 0.80% would be revised to read 0.8%, the Fe maximum that is currently stated as 0.70% would be revised to read 0.7%, the Mg minimum that is currently stated as 0.80% would be revised to read 0.8%, and the Mg maximum that is currently stated as 1.20% would be revised to read 1.2%. Finally, Table 1 limits the chemical composition of Pb (lead) and Bi (bismuth) to 0.01. RSPA proposes to change these limits to 0.005.

Section 178.69

This new proposed section contains general design and manufacturing requirements applicable to all metric-marked DOT specification cylinders. This proposed section contains much of the same information as the current § 178.35, including compliance, inspection and analyses, duties of inspector, PRDs, and markings; however, proposed § 178.69 is extended to address definitions, authorized material, threads, and tests. Thus, § 178.69 would simplify the regulations in that all information common to

metric-marked cylinders will be centrally located, and will allow the simplification and streamlining of the individual cylinder specifications proposed in §§ 178.71, 178.72, 178.73 and 178.81.

Paragraph (b) will define common terms for clarity and consistency. The addition of the new definition for "volumetric expansion test" will clarify RSPA's meaning of the many terms used by industry to describe pressure testing.

Paragraph (c) specifies the requirements for inspection and analyses. RSPA proposes that all DOT 4-series metric-marked cylinders have inspection and analyses performed by an independent inspection agency.

In paragraph (e), duties of the inspector, RSPA proposes a change to allow the inspector to obtain a certified cast or heat analysis from the cylinder manufacturer in addition to the material producer or supplier, as needed. The current regulations require the inspector to verify that the material of construction meets the requirements of the applicable specification by either making a chemical analysis of each heat of material; obtaining a certified chemical analysis from the material manufacturer for each heat of material; or by making a check analysis of a sample from each coil, sheet, or tube if an analysis is not provided by the material manufacturer for each heat of material. These alternative methods for verifying compliance are something raised by independent inspectors to require cylinder manufacturers to perform check analyses when readily available information may be used. The proposed regulation would allow cylinder manufacturers to use analyses obtained from the mill to verify the material conforms to standards for the cylinder specification.

Paragraph (f) specifies performance-oriented requirements for threads. These requirements would allow the manufacturer to design the threads in conformance with any appropriate standard as long as certain thread shear strength limits are met.

Paragraphs (h) and (i) list all tests that apply to metric-marked cylinders. A new approach for the metric-marked cylinders is the categorization of design qualification tests (paragraph (h) in addition to production tests in paragraph (i)). These paragraphs include criteria for each test as well as acceptance criteria. The individual cylinder specifications prescribe which tests in § 178.69 apply to each specification, as well as any unique test requirements or acceptable results. Centralizing all test information in one location reduces repetition in the

regulations and reduces the likelihood of inconsistent requirements in the specifications. The requirement that new metric-marked cylinders have cycle testing performed during design qualification incorporates current industry practice. RSPA believes that the cycle test is an important design performance test that assesses cylinder fatigue life and, therefore also, proposes this requirement for welded cylinders.

Paragraph (i)(12) contains requirements for ultrasonic examination (UT); a non-destructive test method designed to detect surface and subsurface flaws and to measure the thickness of a cylinder and the size of a flaw or crack. The UT equipment has the capability to detect the presence of discontinuities on or even within the cylinder sidewall, shoulder, or bottom. UT would be required for all seamless and some welded metric-marked cylinders at the time of manufacture.

Paragraph (k) prescribes marking requirements. A significant change for the new metric-marked cylinders is marking with the test pressure, rather than service pressure, expressed in bar. To communicate vital information to requalifiers, metric-marked cylinders that require UT examination during requalification must be marked "UT" as well as with the minimum wall thickness. Other markings, such as country of origin, will be required for metric-marked cylinders; thereby making them more acceptable for transportation of hazardous materials in international commerce.

Paragraph (l) includes a prohibition on coatings that may interfere with inspections and tests, or that allow moisture to accumulate between the cylinder wall and the coating. This provision is RSPA's response to potential threats to safety associated with coating materials, such as vinyl, which promote corrosion.

Section 178.70

This proposed section groups the common requirements that apply to all DOT 3 series metric-marked seamless cylinders (DOT 3M, DOT 3ALM, and DOT 3FM).

Paragraph (c) specifies materials for 3 series cylinders. Authorized materials are located in Appendix A, Table 1 for steel and nickel and Table 2 for aluminum. The steel compositions authorized include two carbon manganese type, one chrome moly type steel, and one stainless steel type. The aluminum composition is a 6061 alloy. These compositions are broad enough to cover most material specifications currently in use.

Paragraph (e) specifies wall thickness requirements. The current DOT 3AAX requirement in § 178.37(a)(2)(i) that addresses additional design loads due to bending is proposed in this general section for all DOT 3-series metric-marked cylinders. The inclusion of this requirement sets a precedent in the HMR by allowing manufacturers the flexibility to adapt any metric-marked cylinder specification to a "tube trailer" type cylinder.

Section 178.71

This section proposes the new DOT 3M metric-marked cylinder specification. This specification combines aspects of the current DOT 3A, 3AX, 3AA, 3AAX, 3B, and 3BN specifications.

Proposed paragraph (c) authorizes construction using steel, stainless steel, and nickel. The carbon manganese composition authorized encompasses the steel currently used for DOT 3A specification cylinders. The inclusion of the stainless steel composition for a seamless cylinder will eliminate the need for many exemptions.

Section 178.72

This section proposes the new DOT 3ALM metric cylinder specification. This specification is very similar to the current DOT 3AL except that aluminum alloy 6351 is not authorized as a material of construction.

Section 178.73

This section proposes the new DOT 3FM metric-marked cylinder specification. The proposed DOT 3FM cylinder is designed to a high stress level similar to the DOT 3T, and incorporates the strong structural integrity of the DOT 3AA cylinder. This specification meets many of the requirements of the ISO Standard 9809-2 cylinder, which should make it readily acceptable in international commerce. The authorized materials of construction are Grade B, a chrome molybdenum type steel currently authorized for 3T cylinders and Grade E a new chrome molybdenum type steel. Steels such as Grade E with higher ultimate strength levels (above 115,000 psi) are currently authorized under exemption. Because the most critical failure mode is cracking, these cylinders will be subjected to UT examination at the time of manufacture and requalification.

Section 178.81

This section contains specific requirements for the proposed DOT 4M metric-marked cylinder specification. This specification combines aspects of

the current DOT 4B, 4BA, 4BW, 4B240ET, 4E, 4D, 4DA, 4DS and 4AA480 specifications. The maximum design test pressure is 140 bar (2030 psi). This represents a pressure of more than double what is currently authorized for welded cylinders, except the DOT 4DA and 4DS specification, which have a maximum test pressure of 1800 psi. Authorized materials would include aluminum alloy 5154 currently used for the DOT 4E specification cylinder, as well as carbon, HSLA, stainless, and 4130X steels. For DOT 4M specification cylinders with a test pressure of 70 bar or more, the welds must be 100% radiographed to provide assurance of the joint quality. Manufacturers of DOT 4M specification cylinders would have the option of performing an ultrasonic examination in lieu of the radiographic examination.

RSPA solicits comments on the need for a higher performance welded cylinder specification than what is proposed in this NPRM. Comments are also requested as to whether such a higher performance specification should be distinguished from the lower performance by pressure, or by material strength, or some other performance standard. RSPA is currently considering a cylinder specification with a design test pressure of either more than 140 bar (2030 psi) or with an ultimate tensile strength of 830 Mpa (121,000 psi) or higher.

Part 180

Part 180, Subpart C

This new subpart would prescribe requirements for the continuing qualification, maintenance, repair and rebuilding of DOT specification and exemption cylinders. Most of the requirements are currently contained in §§ 173.34 and 173.301. Readers should refer to the references under Part X of this preamble for the citation of the corresponding provision that is similar to the current provision contained in the HMR. The proposed requirements include DOT metric-marked cylinders.

Section 180.203

This section contains definitions for terms used throughout Subpart C. Some of these definitions are "commercially free of corrosive components," "condemn," "defect," "rejected cylinder," and "volumetric expansion test."

Section 180.205

This section prescribes general requirements for the continuing qualification and use of cylinders and for each person performing a cylinder requalification function.

Section 180.207

This section prescribes requirements for the periodic requalification of metric-marked specification cylinders. Proposed Table I specifies the periodic requalification requirements. The standard requalification period is once every five years, with extended requalification periods provided for cylinders used exclusively to transport certain gases. For example, when used exclusively for noncorrosive, nontoxic (LC50 of not less than 5000 ppm) gases, DOT 3M, 3ALM, and 3FM specification cylinders must be requalified at least once every ten years. Similarly, a DOT 4M specification cylinder must be requalified at least once every 15 years. DOT 3M and 4M specification cylinders used exclusively as fire extinguishers and meeting the limitation of special provision 18 must be requalified at least once every twelve years, as currently required for nonmetric-marked DOT specification cylinders used as fire extinguishers.

All DOT 3M, 3ALM, 3FM and 4M specification cylinders must be requalified using the ultrasonic examination, instead of a volumetric expansion test. A DOT 4M specification cylinder, with a marked test pressure of 70 bar or less and having a tensile strength less than 830 Kpa (120,000 psi), may be subjected to a volumetric expansion test in lieu of an ultrasonic examination. Ultrasonic examination improves safety by automating the identification and measurement of wall thickness, pitting and cracking. It improves the probability of detection for internal pits and cracks over current internal visual inspection. Ultrasonic examination also reduces inspection and labor costs, cleaning costs and waste water by allowing cylinder requalification without removing the valve and purging the cylinder's contents, and without the deliberate introduction of water into the cylinder.

Comments are invited on the proposed requirements for ultrasonic examination of cylinders. RSPA also solicits information on industry practices in this area, the costs and benefits for using UT examinations and the pass/fail criteria in Table II.

Section 180.209

This section prescribes requirements that are currently contained in § 173.34(e) for the periodic requalification of nonmetric-marked specification cylinders. The current rule for the requalification of most DOT specification and exemption cylinders requires a volumetric expansion test, external and internal visual inspections

which are not suitable for detecting a buried or internal crack.

In proposed paragraph (a)(1), note 2 following the table requires detection and measurement of the sidewall cracks in DOT 3T and 3HT cylinders at each requalification period by an approved non-destructive test (NDT) method. Cracks in these cylinders can be detected by using a suitable NDT method, such as acoustic emissions or appropriate shear wave ultrasonic examination. Because the ultimate tensile strength (UTS) of DOT 3T and 3HT cylinders are above 7,900 Mpa (155,000 psi), crack growth due to stress corrosion and fatigue can occur during normal service. An undetected crack can grow to a critical size and result in a catastrophic failure. Manufacturers of specification DOT 3T and other high strength exemption cylinders are required to perform UT examinations at the time of manufacture.

Proposed paragraph (a)(2) allows for nonmetric-marked specification cylinders to be ultrasonically examined as an alternative requalification method. An external visual inspection is required to be conducted in conjunction with the UT examination. The requalification period for nonmetric-marked cylinders is the same as required in Table I of this proposed section.

Section 180.211

This section prescribes repair, rebuild and heat treatment requirements currently prescribed in §§ 173.34(g) thru 173.34(l), with certain revisions. These requirements are standardized and simplified.

Section 180.213

This section contains marking requirements presently contained in § 173.34(e)(7), with certain revisions.

A new requirement for all specification cylinders would be added to identify the type of inspection, test, or work performed on a cylinder. This new requirement would enable shippers, carriers, and enforcement personnel to readily determine the type and date of each inspection or test, or whether any repair or rebuilding work has been performed on a cylinder.

The methods for marking cylinders would permit stamping, engraving, scribing or any other method approved in writing by the Associate Administrator for HMS. In response to a NPGA petition, RSPA also proposes allowing use of pressure sensitive labels to display the requalification markings on fire extinguishers. However, RSPA is also soliciting comments on whether there are any methods that should or

should not be authorized for application of requalification markings. Currently, after a cylinder passes the requalification volumetric expansion test, internal and external visual examinations, etc., the RIN holder stamps the month and year of the test and its RIN on the cylinder. This marking is normally accomplished with steel stamps. However, RSPA has granted exemptions, such as E-11372, authorizing certain fire extinguishers and fiber-wrapped cylinders to display the requalification markings using labels. RSPA is considering whether to incorporate new marking methods for DOT specification cylinders following the requalification process.

RSPA requests comments on the feasibility, costs and benefits of alternative marking methods, and whether affected persons believe there is justification for RSPA to adopt alternative methods.

Section 180.215

This section contains the reporting and record retention requirements currently prescribed in § 173.34(e)(8), with certain revisions.

The retester authorization record requirements in current § 173.34(e)(8)(i) would be revised to include all cylinder requalifiers who inspect, test, repair, or rebuild cylinders. In addition, proposed paragraph (d)(1) requires that records covering any work involving welding or brazing repairs, or the building or reheat treatment of cylinders must be retained by the cylinder requalifier for 15 years. The requalifier would be required to retain inspection and test records until expiration of the inspection or requalification period or until the cylinder is again requalified, whichever occurs first. Records of any welding or brazing repair, rebuilding or reheat treatment would be required to be retained for 15 years.

XII. Regulatory Analyses and Notices

A. Executive Order 12866 and DOT Regulatory Policies and Procedures

This proposed rule is considered a significant regulatory action under section 3(f) of Executive Order 12866 and was reviewed by the Office of Management and Budget. The rule is considered significant under the Regulatory Policies and Procedures of the Department of Transportation (44 FR 11034) because of public interest. A preliminary regulatory evaluation is available for review in the docket.

B. Regulatory Flexibility Impact

General

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires an agency to review regulations to assess their impact on small entities unless the agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities. RSPA is unable, at this time, to certify that this proposed rule will not have a significant impact on a substantial number of small entities. RSPA has performed an Initial Regulatory Flexibility Analysis (IRFA) of this proposed rule's potential impact on small entities, and the assessment has been placed into the public docket for this rulemaking. Written public comments that clarify the degree of potential impacts on affected small entities are requested.

IRFA Summary

The Regulatory Flexibility Act is concerned with identifying the economic impact of regulatory actions on small businesses and other small entities. Unless alternative definitions have been established by the agency in consultation with the Small Business Administration, the definition of "small business" has the same meaning as under the Small Business Act. As RSPA has established no special definition, the agency employs thresholds published under criteria in 13 CFR 121.101, e.g., 500 employees for cylinder manufacturers (SIC 3443—Fabricated Plate Work (Boiler Shops) and SIC 3462 Iron and Steel Forgings).

Need for the proposed rule. As indicated throughout the preamble to this proposed rule, current requirements for the manufacture, use, and requalification of cylinders can be traced to standards first applied in the early 1900's. The regulations were subsequently revised in a piecemeal fashion, with adjustments being made to address particular situations and problems on a case-by-case basis. This notice represents RSPA's first comprehensive review of requirements pertaining to the transportation of compressed gases in cylinders and spheres. This action is being taken to: (1) Simplify requirements for the production of new cylinders, (2) provide flexibility in the design, construction processes and permitted use of cylinders, (3) adopt advanced technological processes and procedures for cylinder manufacturing and requalification, (4) achieve an increased level of safety through simplification of the rules and regulations, (5) reduce the need to issue, and renew, exemptions

that permit variances from detailed specifications concerning materials of construction, design, and manufacturing processes, and (6) facilitate international commerce in the transportation of compressed gases.

Objectives and legal basis for the proposed rule. The intended effect of this action is to reduce threats to health, safety and property in the transportation of hazardous materials, particularly flammable, toxic and other compressed gases. Federal hazardous materials transportation law (49 U.S.C. 5101 et seq.) directs the Secretary of Transportation to prescribe regulations for the safe transportation of hazardous materials in intrastate, interstate and foreign commerce. Section 5103(b) specifies that the regulations shall apply to persons transporting hazardous materials in commerce; causing hazardous materials to be transported in commerce; or manufacturing, fabricating, marking, maintaining, reconditioning, repairing, or testing a packaging or container that is represented, marked, certified, or sold by such persons as qualified for use in transporting hazardous material in commerce.

Identification of potentially affected small entities. 1. Businesses likely to be most affected by this proposed rule are manufacturers of specification DOT-3 and DOT-4 series cylinders (SIC 3443 and SIC 3462). Currently, RSPA estimates there are 40 manufacturers of specification DOT-3 and DOT-4 series cylinders. Of that number, approximately 29 are "small businesses" under the Small Business Act.

In the case of approximately eleven (11) manufacturers (five (5) of whom are small businesses) of high-pressure (specification DOT-3 series) cylinders there should be little or no burden attributed to requirements contained in this proposed rule, as many of these new processes and technological innovations have already been adopted as part of their own quality management program.

In addition to the above, there are another twenty-nine (29) cylinder manufacturers (twenty-four (24) of whom are small businesses) identified in RSPA's database of registered markings for packaging manufacturers, and/or holders of exemptions that authorize the manufacture, marking, and sale of cylinders that do not fully conform to specifications for the DOT-3 and DOT-4 series. Eight (8) of these cylinder manufacturers (including five (5) that meet the criterion of a small business) are members of the Compressed Gas Association (CGA), one

of the primary initiators of petitions for rulemaking to revise the HMR for greater consistency with regulations of the world's leading industrial nations. It is RSPA's understanding that all CGA members support proposed revisions contained in the CGA petitions. However, that leaves another twenty-one (21) non-CGA-member cylinder manufacturers, of which RSPA assumes at least 90% (approximately nineteen (19)) meet the SBA criterion for a small business, that would be affected by the proposed rule.

Some small entities may experience an adverse economic impact attributed to the proposed rule's prohibition on the manufacture of non-metric-marked specification DOT-3 and DOT-4 series cylinders after a future date (five years from the effective date of a final rule). Prior to that date, small entities would, at their own discretion, be permitted to manufacture (1) non-metric-marked cylinders only, (2) metric-marked cylinders only, or (3) a combination of non-metric-marked cylinders and metric-marked cylinders. However, after the phase-out date, these small entities may manufacture DOT-3 and DOT-4 cylinders conforming to metric-marked specifications only.

RSPA anticipates that, upon review of these proposed requirements, some small entities currently producing specification DOT-3 or DOT-4 series cylinders may determine that it is not economically feasible to continue this line of products. For example, RSPA estimates the average annual cost of the proposed requirement for an independent inspection agency to observe cylinder manufacturing operations and processes at \$59,286 per facility. However, that average is calculated on the basis of a wide range of costs for individual facilities that produce specification DOT-4 series cylinders (e.g., \$5,000 for an occasional production run to \$100,000 for a manufacturer that operates a dedicated line). For manufacturers that produce a relatively large volume of these cylinders the CGA estimates the additional cost of manufacturing attributed to this provision will be an additional 10¢ per cylinder. For a completed 20-pound propane cylinder that currently sells for approximately \$25 (retail price), RSPA expects that the added expense would not be prohibitively costly to the manufacturer or to the ultimate consumer.

RSPA understands that the production of specification DOT-3 and DOT-4 cylinders by some manufacturers that are small businesses oftentimes is but one of a wide-range of pressure vessels, or other products, in

the company's product line. Knowing the importance of specification DOT-3 and DOT-4 series cylinders to the viability of these small entities, is critical to RSPA's determination of whether this rule may have a significant economic impact on a substantial number of small manufacturing companies. Small entities are, therefore, specifically invited to provide comments on the economic impact of the proposed rule on their overall operations.

2. In addition to cylinder manufacturers, there are approximately 1,400 businesses currently engaged in the periodic requalification of high-pressure cylinders. Here, also, RSPA conservatively estimates that at least 90 percent of these requalifiers are small businesses. This number includes businesses that manage large fleets of cylinders, such as cylinders charged with propane to power forklift trucks, and for use by retail customers through cylinder exchange programs. Still other companies, generally thought to fall within SIC 7389 (business services, not elsewhere classified), manage fleets of cylinders used in (1) carbon dioxide service for carbonated soft drinks, (2) fire extinguisher service, and (3) compressed air/oxygen breathing equipment used in recreational diving operations, as well as by emergency services personnel, like firefighters. All of these businesses are currently approved to requalify cylinders through performance of the hydrostatic pressure test.

The proposed rule would require each business to determine whether it should: (1) upgrade test equipment from the hydrostatic type to ultrasonic examination type to be able to service the older DOT specification cylinders and the new metric-marked cylinders, or (2) continue to maintain its currently installed hydrostatic test equipment and service only the older DOT specification cylinders (estimated to now number 300 million, a majority of which may be expected to remain in service well into the next century) and the proposed DOT-4M metric-marked cylinder that have a marked test pressure of ≤ 70 bar.

RSPA anticipates that some small entities currently performing requalification functions by the hydrostatic pressure test method may determine that investments in new ultrasonic test equipment (requiring an investment currently estimated at \$50-\$80 thousand amortized over a period of ten (10) years) may not be economically feasible, considering the comparatively small number of metric-marked cylinders (vs. the current size of the domestic fleet of approximately 300

million cylinders) that will be produced beginning perhaps as early as 1999, and first requiring periodic requalification in 2004. Currently, five (5) of the eighteen (18) retester facilities currently performing requalification of cylinders by ultrasonic examination, rather than by hydrostatic pressure testing, under terms of special exemptions issued by RSPA are thought to meet the criterion for a small business.

Although the ultrasonic examination method initially involves a large capital investment, it offers cost savings for businesses that own and/or use cylinders for the transportation of compressed gases. In addition, ultrasonic examination provides (1) substantial benefits for increased safety, (2) opportunities for reducing emissions of hazardous materials to the environment, and (3) reduced contamination of cylinders.

Commenters are specifically invited to provide additional information with respect to this proposed requirement for ultrasonic testing of metric-marked cylinders and its potential impact on small entities. RSPA requests comments from affected small entities regarding the potential adverse impact this proposed rule may have on their cylinder requalification operations specifically, and the overall viability of their enterprise should they determine it would be economically prohibitive to continue to perform cylinder requalification services.

3. Finally, there are literally hundreds of thousands of commercial establishments that own and use cylinders manufactured to specifications in the DOT-3 and DOT-4 series. Those business sectors include agriculture; mining; construction; manufacturing; transportation, communications, electric, gas and sanitary services; wholesale trade; retail trade; services; and many other nonclassifiable establishments. On the basis of a Small Business Administration estimate that of the 24 million businesses located in the U.S. only 15,000 (.000625%) are large firms, RSPA concedes it is likely that over 99% of the businesses that make use of compressed gases in DOT specification cylinders are small businesses. (Source: SBA Office of Advocacy, Small Business Answer Card 1998).

RSPA believes the proposed rules will generally have a small individual, though significant in the aggregate (i.e., \$10 million annually), positive benefit for all of these businesses by making the metric-marked cylinders they buy or lease acceptable for trade and use in worldwide commerce. In addition, those cylinders will be allowed to be charged

with a wider range of compressed gases and other materials, and, in many cases, the period between periodic requalification will be extended by several years, thereby resulting in cost savings attributed to less frequent inspections. For example, in the case of a specification DOT-3AL aluminum cylinder, the 5 year retest cycle would be extended to 10 years for the specification DOT-3ALM. In time, there may be as many as 1 million such cylinders in carbon dioxide service for the carbonated beverage industry alone. A single retest of this fleet of cylinders over a ten-year period vs. the current five-year period, at an average cost of \$10 per cylinder, i.e., \$10 million, would result in aggregate savings to the cylinder owners of \$1 million per year. In the very competitive soft-drink industry, RSPA believes that the cost savings would be shared broadly.

To the extent that RSPA has failed to recognize potential impacts on the general universe of small entities that own or use cylinders, commenters are invited to identify those impacts and the magnitude of their affect on small entities.

Reporting and recordkeeping requirements. This proposed rule contains one new requirement for reporting and recordkeeping. Specifically, persons who requalify cylinders by a visual inspection, as currently authorized by § 173.34(e)(13), would, under proposed § 180.209(g), be required to first obtain a requalification identification number (RIN) from RSPA's Associate Administrator for Hazardous Materials Safety under provisions of proposed § 107.805. Essential elements of the application for approval include: (1) the name and address of the facility manager, (2) identification of the DOT specification/exemption cylinders that will be inspected at the facility, and (3) a signed and dated certification by the applicant that the facility will operate in compliance with applicable requirements of the HMR, and that the hazmat employees performing inspections have been properly trained, to include familiarization with the appropriate CGA C-6 series pamphlets concerning the conduct of visual inspections.

An approval, if issued by the Associate Administrator for Hazardous Materials Safety, would be effective for a maximum of five years, at which time the approval holder would have to file a new application for approval. Other than the requirements for having to file an application for approval, and entering the four-digit RIN (in addition to the month, year and letter "E"

currently required) on each cylinder requalified by the visual inspection method, there is no additional regulatory burden associated with this proposal.

While the actual number of facilities currently operating under the exception provided by § 173.34(e)(13) is unknown, RSPA assumes, on the basis of data compiled by the Bureau of the Census, that the actual number is not more than 6,691, of which 5,651 are retail dealers of bottled liquefied petroleum gases (SIC Code 5984), 968 are merchant wholesalers of industrial gases, except liquefied petroleum gases (SIC Code 5169), and 72 are entities identified as EPA-approved reclaimers of refrigerant gases.

On a per facility basis, RSPA estimates the cost of this reporting and recordkeeping requirement would be \$122.50 per five-year cycle. This estimate was calculated on the basis of cost data submitted by RSPA to the Office of Management and Budget in support of an approval issued by OMB (2137-0022) concerning Testing, Inspection and Marking Requirements for Cylinders. RSPA does not see this proposed regulatory requirement as inhibiting the ability of currently excepted retesters to continue to provide this cylinder requalification service to an extent that it threatens the viability of their primary business, i.e., the sale of compressed gases in relatively small units. RSPA specifically invites commenters to provide data that supports or refutes this estimate of the costs of compliance with the new requirement to obtain a retester (requalification) identification number and its impact on small businesses currently authorized to perform this requalification function without first having to obtain an approval from the Associate Administrator for Hazardous Materials Safety.

Related Federal rules and regulations. With respect to the production, permitted use, and periodic requalification of cylinders used in the transportation in commerce of compressed gases, there are no related rules and regulations issued by other departments or agencies of the Federal government.

Alternate proposals for small businesses. The Regulatory Flexibility Act directs agencies to establish exceptions and differing compliance standards, when possible, for small business, while still meeting objectives of the applicable regulatory statutes. In the case of manufacture, use, inspection, testing, retesting and requalification of DOT specification cylinders in compressed gas service, RSPA believes

that it is not possible to establish such differing standards and still accomplish the objectives of Federal hazardous materials transportation law (49 U.S.C. 5101–5127). RSPA further believes that the discussion in this NPRM as to the need for regulatory action, issues raised by many of the affected parties through petitions for rulemaking, applications for exemption, and otherwise, effectively requires RSPA to apply one set of requirements applicable to small and large businesses alike.

While certain regulatory actions may affect the competitive situation of an industry by imposing relatively greater burdens on small-scale than on large-scale enterprises, RSPA does not believe that this will be the case with the proposed rule. The principal types of compliance expenditure effectively required by the proposed rule would be imposed on each cylinder represented through its specification markings as conforming to a DOT specification, whether manufactured by, used by, or serviced by a large or a small business. There are administrative efficiency advantages, and economies of scale, available to a large firm, but the requirements considered in this rulemaking are intended to assure a minimum level of safety for packagings used to contain hazardous materials that pose high-order risks in transportation. Thus, no provisions may be waived simply on the basis that they would be burdensome to a small business.

At the same time, RSPA notes that the proposed rules were developed under the assumption that small businesses comprise an overwhelming majority of entities that would be compelled to comply, particularly regarding permitted use of cylinders and their periodic requalification for continued use. For that reason, in its development of the proposed rules, RSPA considered each requirement and determined this set represents the minimal requirements necessary for it to be able to assure an adequate level of safety in transportation.

For example, as an accommodation to small businesses, RSPA proposes to (1) permit facilities to continue to use their currently installed hydrostatic pressure test equipment to retest non-metric marked specification cylinders, millions of which have been in service for several decades and may be expected to continue in service for many more decades, and (2) permit the requalification of certain metric-marked cylinders, i.e., specification DOT-4M with a marked test pressure ≤ 70 bar.

Section 610 Review

Pursuant to section 610 of the Regulatory Flexibility Act (5 U.S.C. § 610), RSPA has conducted a review of current requirements for the manufacture, use, and requalification of cylinders. The purpose of this review was to identify regulations that have a significant economic impact on a substantial number of small entities and to revise those regulations, where appropriate. In proposing revisions to the existing regulations, RSPA has attempted to minimize the economic impact on small business entities. It has done this, in part, by proposing to reduce from fifteen to four the number of authorized DOT-3 and DOT-4 series cylinder specifications, allowing greater fill limits for metric-marked cylinders, and extending the time between periodic requalification of metric-marked cylinders. Also, small business, such as boiler shops (SIC 3443), iron and steel forging shops (SIC 3462), merchant wholesalers of industrial gases, except liquefied petroleum gas (LPG) (SIC 5169), retail dealers of LPG (SIC 5984), and business services, not elsewhere classified (SIC 7389), will benefit from the greater safety provided by this proposed rule. RSPA encourages small entities to comment on the economic impact of proposals contained in this NPRM.

First, RSPA examined whether there is a continuing need for its cylinder regulations. Based on the various characteristics of compressed gases (e.g., flammability and toxicity) and the associated risks that are involved in the transportation of gases, RSPA recognizes that there is a continuing need for its cylinder regulations. However, as discussed previously in this preamble, RSPA is in receipt of numerous petitions for rulemaking concerning the cylinder regulations. Many of these petitions propose that RSPA incorporate accepted industry practices and new technology (e.g., new marking methods). RSPA has accepted many of these petitions and is proposing to incorporate new technology where the new technology achieves an equivalent or higher level of safety (e.g., ultrasonic testing). RSPA also reviewed exemptions issued under 49 CFR Part 107 and has incorporated those exemption provisions that have achieved a proven safety record.

In addition to the above, over the years, the regulated community has requested that RSPA reduce the complexity of its cylinder regulations. RSPA addressed these concerns by modifying the language used in the proposed rule, including a definition

section and changing the organizational structure of the cylinder regulations. RSPA also recognizes that market conditions have changed dramatically since many of the existing rules were first adopted. Today, cylinders are manufactured, used, and transported to, from, and between entities in the global marketplace. In recognition of that worldwide sale and distribution of compressed gases in cylinders, RSPA is proposing to revise the HMR in a manner that is harmonious with international standards (e.g., metric-marked cylinders).

RSPA is confident that the proposed rule and existing cylinder regulations do not duplicate or conflict with other Federal rules. In addition, conflicts with state or local regulations are expressly provided for in Federal hazardous materials transportation law (49 U.S.C. § 5125). Under this statutory authority, RSPA issues preemption determinations as to whether a State, political subdivision, or Indian tribe regulation or law, governing the transportation of hazardous materials, is preempted under Federal law (see 49 C.F.R. Part 107, Subpart C).

C. Executive Orders 12612 and 13084

This proposed rule has been analyzed in accordance with the principles and criteria contained in Executive Orders 12612 ("Federalism") and 13084 ("Consultation and Coordination with Indian Tribal Governments"). Because this proposed regulation would have no substantial direct effect on the States or the relationship, or the distribution of power and responsibilities, between the Federal Government and the States, RSPA has determined that this rule does not have sufficient federalism implications to warrant preparation of a Federalism Assessment. Because this rule would not significantly or uniquely affect the communities of the Indian tribal governments, the funding and consultation requirements of Executive Order 13084 do not apply.

Federal hazardous material transportation law contains express preemption provisions at 49 U.S.C. 5125 that preempt State, local, and Indian tribe requirements if—

(1) Complying with a requirement of the State, political subdivision, or Indian tribe and Federal hazardous material transportation law or regulations is not possible;

(2) The requirement of the State, political subdivision, or Indian tribe, as applied or enforced, is an obstacle to accomplishing and carrying out Federal hazardous material transportation law or regulations; or

(3) The requirement of the State, political subdivision, or Indian tribe concerns any of the following "covered subjects" and is not substantially the same as a provision of Federal hazardous material transportation law or regulations:

(A) The designation, description, and classification of hazardous material;

(B) The packing, repacking, handling, labeling, marking, and placarding of hazardous material;

(C) The preparation, execution, and use of shipping documents related to hazardous material and requirements related to the number, contents, and placement of those documents;

(D) The written notification, recording, and reporting of the unintentional release in transportation of hazardous material; and

(E) The design, manufacture, fabricating, marking, maintenance, reconditioning, repairing, or testing of a packaging or container represented, marked, certified, or sold as qualified for use in transporting hazardous material.

This proposed rule concerns the packing and handling of hazardous materials, and the design, manufacture, fabrication, marking, maintenance, and testing of cylinders that are marked and certified as qualified for use in the transportation of hazardous materials. If so adopted as final, this rule would preempt any State, local, or Indian tribe requirements concerning these subjects unless the non-Federal requirements are "substantially the same" (see 49 CFR 107.202(d)) as the Federal requirements. Federal law (49 U.S.C. 5125(b)(2)) provides that if DOT issues a regulation concerning any of the covered subjects, DOT must determine and publish in the **Federal Register** the effective date of Federal preemption. The effective date may not be earlier than the 90th day following the date of issuance of the final rule and not later than two years after the date of issuance.

RSPA requests comments on what the effective date of the Federal preemption should be for the requirements in this proposed rule that concern covered subjects.

D. Unfunded Mandates Reform Act of 1995

This proposed rule would not impose unfunded mandates under the Unfunded Mandates Reform Act of 1995. It does not result in costs of \$100 million or more, in the aggregate, to any of the following: State, local, or Indian tribal governments, or the private sector. This rule is the least burdensome alternative that achieves the objective of the rule.

E. Paperwork Reduction Act

Under regulations implementing the Paperwork Reduction Act of 1995, " * * * an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number." 5 CFR 1320.8(b)(iii)(6).

The information collection and recordkeeping requirements in current §§ 173.34, 173.302(c) and 178.35 pertaining to records prepared by persons performing the requalification, repair, rebuild and use of cylinders and requirements in current § 173.34 pertaining to persons seeking approval to requalify cylinders, were approved by the Office of Management and Budget (OMB) under the provisions of 44 U.S.C. chapter 35 and assigned control number 2137-0022, with an expiration date of August 31, 1999. This information is used to verify that cylinders meet the required manufacturing standards prior to being authorized for initial use, and that once manufactured, the cylinders are maintained and used in compliance with applicable requirements of the HMR as packagings for hazardous materials. In this proposed rule, these information collection and recordkeeping requirements for records are revised and are in §§ 178.35, 178.69(e)(13), 180.205, 180.209, 180.211, 180.213, and 180.215.

The information and recordkeeping requirements in current §§ 173.300a and 173.300b for persons seeking approval to be an independent inspection agency, and for chemical analyses and tests of DOT specification and exemption cylinders conducted outside of the United States, were approved by OMB and assigned control number 2137-0557, with an expiration date of July 31, 1999. The information is used to evaluate an applicant's qualification to perform the applicable packaging functions and to ensure material of construction used in cylinders made outside the United States are in accordance with the applicable requirements. In this proposed rule, the information collection and recordkeeping requirements are in §§ 107.803, 107.805, 107.807 and 180.205(c). The information collection and recordkeeping requirements for persons seeking approval as cylinder requalifiers and approval to change a cylinder's service pressure are removed from OMB control number 2137-0022 and being placed with the other approval requirements under OMB control number 2137-0557. OMB control number 2137-0557 includes information and recordkeeping requirements for other than cylinders.

The estimates contained in this proposed rule address only the cylinder provisions.

Because this proposed rule would establish certain new cylinder specifications, broaden the approval requirements for affected persons who requalify cylinders, and would relocate the cylinder requalification requirements to other sections, revisions would be made to the current burden hour submission. RSPA has revised the burden estimates based on the proposal in this NPRM and will submit revised burden estimates to OMB.

OMB Control Number 2137-0022

Affected Public: Cylinder requalifiers, repairers and rebuilders, and owners of certain DOT specification and exemption cylinders.

Annual Reporting and Recordkeeping Burden:

Number of Respondents: 500.

Total Annual Responses: 5,000.

Total Annual Burden Hours: 1,729.

Total Annual Cost for Development and Maintenance: \$42,683.

OMB Control Number 2137-0557

Affected Public: Cylinder manufacturers, requalifiers, and persons seeking to change a cylinder's service pressure.

Annual Reporting and Recordkeeping Burden:

Number of Respondents: 2,027.

Total Annual Responses: 2,027.

Total Annual Burden Hours: 2,628.

Total Annual Cost for Development and Maintenance: \$294,544.

RSPA invites comments on these revised information collection estimates, including any paperwork burdens not already considered. Requests for a copy of these information collections should be directed to Deborah Boothe, Office of Hazardous Materials Standards, Room 8102, 400 Seventh Street, SW, Washington, DC 20590-0001. Telephone (202) 366-8553 or 1-800-467-4922. Written comments should be received by the close of the comment period identified in the **DATES** section of this rulemaking and should be addressed to the Dockets Management System as identified in the **ADDRESSES** section of this rulemaking. Comments must reference the docket number, RSPA 98-3684 (HM-220).

F. Regulation Identifier Number (RIN)

A regulation identifier number (RIN) is assigned to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. The RIN contained in the heading

of this document can be used to cross-reference this action with the Unified Agenda.

List of Subjects

49 CFR Part 107

Administrative practice and procedure, Hazardous materials transportation, Packaging and containers, Penalties, Reporting and recordkeeping requirements.

49 CFR Part 171

Exports, Hazardous materials transportation, Hazardous waste, Imports, Incorporation by reference, Reporting and recordkeeping requirements.

49 CFR Part 172

Hazardous materials transportation, Hazardous waste, Labeling, Packaging and containers, Reporting and recordkeeping requirements.

49 CFR Part 173

Hazardous materials transportation, Packaging and containers, Radioactive materials, Reporting and recordkeeping requirements, Uranium.

49 CFR Part 177

Hazardous materials transportation, Motor vehicle safety, Packaging and containers, Reporting and recordkeeping requirements.

49 CFR Part 178

Hazardous materials transportation, Packaging and containers, Reporting and recordkeeping requirements.

49 CFR Part 180

Hazardous materials transportation, Motor vehicle safety, Packaging and containers, Reporting and recordkeeping requirements.

In consideration of the foregoing, title 49, Chapter I, Subchapters A and C of the Code of Federal Regulations, are proposed to be amended as follows:

PART 107—HAZARDOUS MATERIALS PROGRAM PROCEDURES

1. The authority citation for Part 107 would continue to read as follows:

Authority: 49 U.S.C. 5101–5127, 44701; Sec. 212–213, Pub. L. 104–121, 110 Stat. 857; 49 CFR 1.45, 1.53.

§ 107.3 [Amended]

2. In § 107.3, the definition of “Registration” would be amended by removing the wording “registration with RSPA as a cylinder retester pursuant to 49 CFR 173.34(e)(1), or”.

3. Subpart I would be added to Part 107 to read as follows:

Subpart I—Approval of Independent Inspection Agencies, Cylinder Requalifiers, and Non-domestic Chemical Analyses and Tests of DOT Specification Cylinders

Sec.

107.801 Purpose and Scope.

107.803 Approval of independent inspection agency.

107.805 Approval of cylinder requalifiers.

107.807 Approval of non-domestic chemical analyses and tests.

Subpart I—Approval of Independent Inspection Agencies, Cylinder Requalifiers, and Non-domestic Chemical Analyses and Tests of DOT Specification Cylinders

§ 107.801 Purpose and scope.

(a) This subpart prescribes procedures for—

(1) A person who seeks approval to be an independent inspection agency to perform cylinder inspections and verifications required by parts 178 and 180 of this chapter;

(2) A person who seeks approval to engage in the requalification (i.e., inspection, testing or certification), rebuild or repair of a cylinder manufactured in accordance with a DOT specification under subchapter C of this chapter or under the terms of an exemption issued under this part;

(3) A person who seeks approval to perform the manufacturing chemical analyses and tests of DOT specification or exemption cylinders outside the United States.

(b) No person may engage in a function identified in paragraph (a) of this section unless approved by the Associate Administrator in accordance with the provisions of this subpart. Each person shall comply with the applicable requirements in this subpart. In addition, the procedural requirements in subpart H of this part apply to the filing, processing and termination of an approval issued under this subpart.

§ 107.803 Approval of independent inspection agency.

(a) *General.* Prior to performing cylinder inspections and verifications required by parts 178 and 180 of this chapter, a person must apply to the Associate Administrator for an approval as an independent inspection agency. A person approved as an independent inspection agency is not a RSPA agent or representative.

(b) *Criteria.* No applicant for approval as an independent inspection agency may be engaged in the manufacture of cylinders for use in the transportation of hazardous materials, or be directly or indirectly controlled by, or have a financial involvement with, any entity that manufactures cylinders for use in

the transportation of hazardous materials, except for providing services as an independent inspector.

(c) *Application information.* Each applicant must submit an application in conformance with § 107.705 that must contain the information prescribed in § 107.705(a). In addition, the application must contain the following information:

(1) Name and address of each manufacturing facility where tests and inspections are to be performed and a detailed description of the inspection and testing facilities to be used by the applicant and the applicant's ability to perform the inspections and to verify the inspections required by part 178 of this chapter or under the terms of an exemption issued under this part.

(2) Name, address, and principal business activity of each person having any direct or indirect ownership interest in the applicant greater than three percent and any direct or indirect ownership interest in each subsidiary or division of the applicant.

(3) Name of each individual whom the applicant proposes to employ as an inspector and will be responsible for certifying inspection and test results and a statement of that person's qualifications.

(4) An identification or qualification number assigned to each inspector who is supervised by a certifying inspector identified in (c)(3) of this section.

(5) A statement that the applicant will perform its functions independent of the manufacturers and owners of the cylinders.

(6) If the applicant's principal place of business is in a country other than the United States—

(i) A copy of the designation from the Competent Authority of that country delegating to the applicant an approval or designated agency authority for the type of packaging for which a DOT designation is sought; and

(ii) A statement from the Competent Authority of that country stating that similar authority is delegated to other Independent Inspection Agencies who are approved under this subpart and that no condition or limitation will be imposed upon United States citizens or organizations that is not required of its own citizenry.

(7) The date and signature of the person certifying the approval application

(d) *Facility inspection.* Upon the request of the Associate Administrator, the applicant shall allow the Associate Administrator or the Associate Administrator's designee to inspect the applicant's facilities and records. The person seeking approval must bear the cost of RSPA's inspection.

§ 107.805 Approval of cylinder requalifiers.

(a) *General.* A person must meet the requirements of this section to be approved to inspect, test, certify, repair, or rebuild a cylinder in accordance with a DOT specification under subpart C of part 178 or subpart C of part 180 of this chapter or under the terms of an exemption issued under this part.

(b) Each applicant must arrange for an independent inspection agency, approved by the Associate Administrator pursuant to this subpart, to perform a review of its inspection or requalification operation. The person seeking approval must bear the cost of the inspection. A list of approved independent inspection agencies is available from the Associate Administrator at the address listed in § 107.705. Assistance in obtaining an approval may be requested from the same address.

(c) *Application for approval.* If the inspection performed by an independent inspection agency is completed with satisfactory results, the applicant must submit a letter of recommendation from the independent inspection agency, an inspection report, and an application that must contain the information prescribed in § 107.705(a). In addition, the application must contain the following information: the name of the facility manager; the DOT specification/exemption cylinders that will be inspected, tested, repaired, or rebuilt at the facility; a certification that the facility will operate in compliance with the applicable requirements of subchapter C of this chapter; and the date and the signature of the person making the certification.

(d) *Issuance of requalifier identification number (RIN).* The Associate Administrator issues a RIN as evidence of approval to requalify DOT specification/exemption cylinders if it is determined, based on the applicant's submission and other available information, that the applicant's qualifications and, when applicable, facility are adequate to perform the requested functions in accordance with the criteria prescribed in subpart C of part 180 of this chapter.

(e) *Expiration of RIN.* Unless otherwise provided in the issuance

letter, an approval expires five years from the date of issuance, provided that the applicant's facility and qualifications are maintained at or above the level observed at the time of inspection by the independent inspection agency, or at the date of the certification in the application for approval, for facilities only performing inspections made under § 180.209(g) of this chapter.

(f) *Exceptions.* Notwithstanding requirements in paragraphs (b) and (c) of this section, a person who only performs inspections in accordance with § 180.209(g) of this chapter must submit a request which, in addition to the information prescribed in § 107.705(a) contains; the facility manager for each location in which requalifications would be performed; the DOT specification/exemption cylinders that will be inspected at the facility; a certification that the facility will operate in compliance with the applicable requirements of subchapter C of this chapter; a certification that the persons performing inspections have been trained and have the information contained in each applicable CGA pamphlet incorporated by reference in § 171.7 of this chapter that applies to the requalifiers activities; and the date and the signature of the person making the certification. Each person shall comply with the applicable requirements in this subpart. In addition, the procedural requirements in subpart H of this part apply to the filing, processing and termination of an approval issued under this subpart.

§ 107.807 Approval of non-domestic chemical analyses and tests.

(a) *General.* A person who seeks to manufacture DOT specification or exemption cylinders outside the United States must seek an approval from the Associate Administrator to perform the chemical analyses and tests of those cylinders outside the United States.

(b) *Application for approval.* Each applicant must submit an application that must contain the information prescribed in § 107.705(a). In addition, the application must contain the following information: 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; 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 or exemption 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; the name of the independent inspection agency to be used; and the date and the signature of the person making the certification.

(c) *Facility inspections.* Upon the request of the Associate Administrator, the applicant shall allow the Associate Administrator for HMS or the Associate Administrator's designee to inspect the applicant's cylinder manufacturing and testing facilities and records, and must provide such materials and cylinders for analyses and tests as the Associate Administrator may specify. The applicant or holder shall bear the cost of the initial and subsequent inspections, analyses, and tests.

PART 171—GENERAL INFORMATION, REGULATIONS, AND DEFINITIONS

4. The authority citation for part 171 would continue to read as follows:

Authority: 49 U.S.C. 5101–5127; 49 CFR 1.53.

§ 171.2 [Amended]

5. In § 171.2, paragraph (d)(3) would be amended by removing the wording "retest or exemption markings" and adding in its place the wording "retest, exemption or requalification identification number (RIN) markings".

6. In § 171.7, in the table in paragraph (a)(3), new entries would be added in alphanumeric sequence to read as follows:

§ 171.7 Reference material.

(a) * * *

(3) *Table of material incorporated by reference.* * * *

Source and name of material	49 CFR reference
* * * * *	* *
American Society for Nondestructive Testing, PO Box 28518, 1711 Arlingate Lane, Columbus, OH 43228-0518 ASNT Recommended Practice SNT-TC-1A, 1992	Part 178, subpart C, Appendix B.
* * * * *	* *
American Society for Testing and Materials	

Source and name of material	49 CFR reference
ASTM B 221-96 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.	178.46(a)(4), Table 2.
ASTM B 221M-96 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.	Part 178, Subpart C, Appendix A, Table 2, Aluminum.
ASTM E 10-96 Standard Test Method for Brinell Hardness of Metallic Materials	178.69.
ASTM E 18-94 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials.	178.70.
ASTM E 165-95 Standard Test Method for Liquid Penetrant Examination	178.69.
ASTM E 213-93 Standard Practice for Ultrasonic Examination of Metal Pipe and Tubing ...	178.71; 178.72; 178.73; Part 178, Subpart C, Appendix B; 180.215.
ASTM E 399-90e1 Standard Test Method for Plane-Strain Fracture Toughness of Metallic Materials.	178.73.
ASTM E 709-95 Standard Guide for Magnetic Particle Examination	178.69.
ASTM E 797-95 Standard Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Straight-Beam Method.	Part 178, Subpart C, Appendix B; 180.215.
Compressed Gas Association, Inc.	
CGA Pamphlet C-1, Methods for Hydrostatic Testing of Compressed Gas Cylinders, 1996	178.69; 178.81; 180.205.
CGA Pamphlet P-20, Standard for the Classification of Toxic Gas Mixtures, 1995	173.115.
CGA Pamphlet S-7, Method for Selecting Pressure Relief Devices for Compressed Gas Mixtures in Cylinders, 1996.	173.301.

§ 171.7 [Amended]

7. In addition, in § 171.7, in the table in paragraph (a)(3), the following changes would be made:

a. In the entry ASTM A240/A240M-94b, the wording "A240M-94b" would be revised to read "A240M-96a."

b. The entry ASTM A 388-67 would be removed.

c. In the entry ASTM B 557-84, in column 2, the reference "178.69;" would be added, in numeric order.

d. In the entry ASTM E 8-89, the wording "E 8-89" would be revised to read "E 8-96a" and in column 2, the references "178.36; 178.37; 178.38; 178.39;," "178.45;," "178.50; 178.51;," "178.55;," "178.61;," and "178.68;" would be removed and "178.69;" would be added, in numerical order.

e. In the entry ASTM E 23-60, in column 1, the wording "E 23-60" would be revised to read "E 23-96" and in column 2, the reference "178.69;" would be added, in numeric order.

f. In the entry ASTM E 112-88, the wording "E 112-88" would be revised to read "E 112-96" and in column 2, the

reference ";178.69" would be added, in numeric order.

g. In the entry ASTM E 290-92, in column 2, the references ";178.69; 178.72" would be added, in numeric order.

h. In the entry CGA Pamphlet C-3, the year "1975" would be revised to read "1994" and in column 2, the references "178.50; 178.51;," "178.54;," "178.61;," "178.68" would be removed and "178.69;," "178.81;," "180.211" would be added, in numeric order.

i. In the entry CGA Pamphlet C-5, in column 2, the reference "173.302" would be removed and "173.302a" would be added, in its place.

j. In the entry CGA Pamphlet C-6, in column 2, the reference "173.34; 180.519" would be removed and the references "173.198; 180.205; 180.209; 180.211." would be added, in its place.

k. In the entry CGA Pamphlet C-6.1, in column 2, the reference "173.34" would be removed and the references "180.205; 180.209" would be added, in its place.

l. In the entry CGA Pamphlet C-6.2, in column 2, the reference "173.34"

would be removed and the reference "180.205" would be added, in its place.

m. In the entry CGA Pamphlet C-6.3, in column 2, the reference "173.34" would be removed and the references "180.205; 180.209" would be added, in its place.

n. In the entry CGA Pamphlet C-8, in column 2, the reference "173.34" would be removed and the reference "180.205" would be added, in its place.

o. In the entry CGA Pamphlet C-11, in column 2, the reference "178.35" would be removed and the references "178.35; 178.69" would be added, in its place.

p. In the entry CGA Pamphlet C-12, in column 2, the reference "173.34;" would be removed and the references "173.301;" and ";180.205" would be added, in numeric order.

q. In the entry CGA Pamphlet C-13, in column 2, the reference "173.34;" would be removed and the references "; 180.205;," and "180.209." would be added, in numeric order.

r. In the entry CGA Pamphlet C-14, in column 2, the reference "173.34" would

be removed and the reference "173.301" would be added, in its place.

s. In the entry CGA Pamphlet S-1.1, in column 2, the reference "173.34" would be removed and the references "173.301; 173.304a." would be added, in its place.

8. In § 171.8, definitions for "Metric-marked cylinder" and "Nonmetric-marked cylinder" would be added, in alphabetical order, to read as follows:

§ 171.8 Definitions and abbreviations.

* * * * *

Metric-marked cylinder means a cylinder manufactured to the DOT 3M, 3ALM, 3FM or 4M specification prescribed in §§ 178.69 through 178.81 of this subchapter.

* * * * *

Nonmetric-marked cylinder means a cylinder manufactured to a DOT specification prescribed in §§ 178.35 through 178.68 of this subchapter that was in effect on [DATE PRIOR TO EFFECTIVE DATE OF THE FINAL RULE].

* * * * *

§ 171.8 [Amended]

9. In addition, in § 171.8, in the definition of "Filling density", paragraph (1) would be amended by revising the reference "§ 173.304(a)(2)Table Note 1" to read "§ 173.304a(a)(2) Table Note 1".

10. In § 171.12, paragraph (b)(15) would be revised to read as follows:

§ 171.12 Import and export shipments.

* * * * *

(b) * * *

(15) Cylinders not manufactured to a DOT specification must conform to the requirements of § 173.301(j) through (l) of this subchapter or, for Canadian manufactured cylinders, to the requirements of § 171.12a(b)(13).

* * * * *

11. In § 171.12a, in paragraph (b)(13) a new sentence would be added at the end of the paragraph, and paragraphs (b)(13)(i) through (b)(13)(v) would be added to read as follows:

§ 171.12a Canadian shipments and packagings.

* * * * *

(b) * * *

(13) * * * However, a cylinder made in Canada that meets the following conditions is authorized for the transportation of a hazardous material within the United States:

(i) The cylinder was manufactured on or after January 1, 1977;

(ii) During the manufacturing process, the cylinder was marked with an approval number and an inspector's

mark authorized by TDG or by its predecessor, the Railway Transport Committee of the Canadian Transport Commission (CTC), in its regulations for the Transport of Dangerous Commodities by Rail and was marked "CTC" or "TDG";

(iii) The cylinder is in full conformance with the specifications prescribed by the TDG regulations;

(iv) The cylinder has been requalified under a program authorized by the Canadian regulations or requalified in accordance with subpart C of part 180 of this subchapter within the prescribed requalification period; and

(v) At the time the requalification is performed, in addition to the markings prescribed in § 180.211 of this subchapter, the cylinder is marked "DOT/" immediately before the Canadian specification marking.

* * * * *

PART 172—HAZARDOUS MATERIALS TABLE, SPECIAL PROVISIONS, HAZARDOUS MATERIALS COMMUNICATIONS, EMERGENCY RESPONSE INFORMATION, AND TRAINING REQUIREMENTS

12. The authority citation for Part 172 would continue to read as follows:

Authority: 49 U.S.C. 5101-5127; 49 CFR 1.53.

§ 172.101 [Amended]

13. Section 172.101, in the Hazardous Materials Table, the following changes would be made:

a. For the entry "Cyanogen", in Column (8b), the reference "192" would be removed and "304" would be added in its place.

b. For the entry "Germane", in Column (8b), the reference "192" would be removed and "302" would be added in its place.

c. For the entry "Iron pentacarbonyl", in Column (8b), the reference "192" would be removed and "226" would be added in its place.

PART 173—SHIPPERS—GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS

14. The authority citation for Part 173 would continue to read as follows:

Authority: 49 U.S.C. 5101-5127, 44701; 49 CFR 1.45, 1.53.

§ 173.34 [Removed]

15. Section 173.34 would be removed.

16. Section 173.40 would be revised to read as follows:

§ 173.40 General packaging requirements for toxic materials packaged in cylinders.

When this section is referenced for a hazardous material elsewhere in this subchapter, 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. After [EFFECTIVE DATE OF THE FINAL RULE] DOT 3AL cylinders made of aluminum alloy 6351 may not be filled and offered for transportation or transported with a Division 2.3, Zone A or B material, a Division 6.1, Zone A or B material or any liquid that meets the definition of Division 6.1 and meets criteria for Packing Group I, Hazard Zones A or B, as specified in § 173.133.

(b) *Closures.* Each cylinder containing a Hazard Zone A material 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.

(c) *Additional handling protection.* Each cylinder or cylinder overpack combination offered for transportation containing a Division 2.3 or 6.1 Hazard Zone A or B material must meet the puncture resistance and valve damage protection performance requirements of this section. In addition to the requirements of this section, overpacks must conform to the overpack provisions of § 173.25.

(1) *Puncture resistance.* Each cylinder or cylinder overpack combination must be qualified under the puncture resistance test specified in § 178.69(h)(3) of this subchapter. However, a cylinder meeting the conditions in the following table is excepted from the puncture resistance test requirements of this section and of § 178.69(h)(3) of this subchapter:

DOT specification/material	Maximum water filled gross weight (lbs.)	Minimum wall thickness (inch)
3A	215	0.180
3AA	255	0.220

(2) *Valve damage protection.* Each cylinder with a valve must be equipped with a protective cap, other valve protection device or an overpack sufficient to protect the valve from deformation, breakage or leakage resulting from a drop of 2.0 m (7 ft) onto a non-yielding surface. Impact must be at an orientation most likely to cause damage.

(d) *Interconnection.* Cylinders may not be manifolded or interconnected.

§ 173.115 [Amended]

17. In § 173.115, in paragraph (c)(2), in the last sentence, the wording "or CGA Pamphlet P-20" is added immediately following the word "subpart".

18. In § 173.115, in paragraph (j), the reference "§ 173.304(a)(2)" would be revised to read "§ 173.304a(a)(2)".

19. Section 173.163 would be revised to read as follows:

§ 173.163 Hydrogen fluoride.

Hydrogen fluoride (hydrofluoric acid, anhydrous) must be packaged in specification 3, 3A, 3AA, 3B, 3BN, 3E, 4A, or 3M cylinders; or Specification 4B, 4BA, 4BW, or 4M cylinders, if they are not brazed. Filling density may not exceed 85 percent of the cylinder's water weight capacity. Metric-marked cylinders must be requalified by ultrasonic examination in accordance with § 180.207 of this subchapter. Nonmetric-marked cylinders must be requalified by ultrasonic examination in accordance with § 180.209(a)(2) of this subchapter.

20. Section 173.192 would be revised to read as follows:

§ 173.192 Packaging for certain toxic gases in Hazard Zone A.

When § 172.101 of this subchapter specifies that a toxic material be packaged under this section, only specification cylinders are authorized, as follows:

(a) Specification 3A1800, 3AA1800, 3AL1800, or 3E1800 cylinders; 3M, 3ALM, or 3FM cylinders with a marked test pressure of 200 bar (2900 psig); under the following conditions:

(1) Specification 3A, 3AA, 3AL, 3M, 3ALM, or 3FM cylinders may not exceed 57 kg (125 pounds) water capacity (nominal).

(2) Specification 3AL or 3ALM cylinders may only be offered for transportation or transported by highway and rail.

(b) Packagings must conform to the requirements of § 173.40.

(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 cylinder containing phosgene must be tested for leakage before it is offered for transportation or transported and must show 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°C (150°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. Alternatively, each cylinder containing phosgene may be tested for leakage by a method approved in writing by the Associate Administrator for Hazardous Materials Safety.

§ 173.198 [Amended]

21. In § 173.198, in paragraph (a), the reference "§ 173.34(e)" would be revised to read "§ 180.205 of this subchapter".

22. In § 173.226, paragraph (a) would be revised to read as follows:

§ 173.226 Materials poisonous by inhalation, Division 6.1, Packing Group I, Hazard Zone A.

* * * * *

(a) In seamless specification cylinders conforming to the requirements of § 173.40.

* * * * *

23. In § 173.227, paragraph (a) would be revised to read as follows:

§ 173.227 Materials poisonous by inhalation, Division 6.1, Packing Group I, Hazard Zone B.

* * * * *

(a) In packagings as authorized in § 173.226 and seamless and welded specification cylinders conforming to the requirements of § 173.40.

* * * * *

24. Section 173.228 would be revised to read as follows:

§ 173.228 Bromine pentafluoride or bromine trifluoride.

(a) The following packagings are authorized:

(1) Specification 3A150, 3AA150, 3B240, 3BN150, 4B240, 4BA240, 4BW240 and 3E1800 cylinders;

(2) Specification 3M, 3ALM, 3FM, and 4M cylinders with a minimum marked test pressure of 25 bar (363 psig).

(b) Material in Hazard Zones A and B must be transported in cylinders conforming to the requirements of § 173.40, except that material in Hazard Zone A must be transported only in seamless specification cylinders.

(c) Cylinder valves must be protected as specified in § 173.301(h). No cylinder may be equipped with any pressure relief device.

§§ 173.300a, 173.300b, 173.300c [Removed]

25. In part 173, §§ 173.300a, 173.300b, and 173.300c would be removed.

26. Section 173.301 would be revised to read as follows:

§ 173.301 General requirements for shipment of compressed gases in cylinders and spherical pressure vessels.

(a) *General qualifications for use of cylinders.* As used in this subpart, *filled* means an introduction or presence of a hazardous material in a cylinder. A Class 2 material (gas) offered for transportation in a cylinder must be prepared in accordance with this section and §§ 173.302 through 173.305.

(1) Compressed gases must be in metal cylinders and containers built in accordance with the DOT (and ICC, as shown) specifications, as shown in this paragraph (a)(1), in effect at the time of manufacture, and marked as required by the specification and the regulation for requalification if applicable:

Packagings

- 2P
- 2Q
- ICC-3¹
- 3A¹
- 3AA¹
- 3AL¹
- 3ALM
- 3AX¹
- 3A480X¹
- 3AAX¹
- 3B¹
- 3BN¹
- 3E
- 3FM
- 3HT
- 3M
- 3T¹
- 4AA480
- 4B¹
- 4B240ET¹
- 4BA¹
- 4BW¹
- 4D
- 4DA

¹ Use of existing cylinders is authorized. New construction is not authorized after [FIVE YEARS FROM EFFECTIVE DATE OF THE FINAL RULE], except that new construction of ICC-3 cylinders is currently not authorized.

4DS
4E¹
4L
4M
8
8AL
39

(2) A cylinder must be filled in accordance with this part. Before each filling of a cylinder, the person filling the cylinder must visually inspect the outside of the cylinder. A cylinder that has a crack or leak, is bulged, has a defective valve or pressure relief device, or bears evidence of physical abuse, fire or heat damage, or detrimental rusting or corrosion may not be used unless it is properly repaired and requalified as prescribed in subpart C of part 180 of this subchapter.

(3) A cylinder that has previously contained a Class 8 material must be requalified in accordance with § 180.205(e) of this subchapter.

(4) When a cylinder with a marked pressure limit is prescribed, another cylinder made under the same specification but with a higher marked pressure limit is authorized. For example, a cylinder marked "DOT-4B500" may be used when "DOT-4B300" is specified and a cylinder marked "DOT-3FM140" may be used when "DOT-3FM70" is authorized.

(5) No person may fill a cylinder overdue for periodic requalification with a hazardous material and then offer it for transportation. This requirement does not apply to a cylinder that was filled prior to the requalification due date.

(6) After its authorized service life has expired, a cylinder may not be offered for transportation in commerce.

(7) For nonmetric-marked cylinders, the pressure of the hazardous material at 55°C (131°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°C (131°F).

(8) Metric-marked cylinders containing permanent gases must be filled in accordance with § 173.302b.

(9) Metric-marked cylinders containing liquefied gases must be filled in accordance with § 173.304b.

(10) DOT 2P, 2Q, 3E, 3HT, spherical 4BA, 4D, 4DA, 4DS, 39, and spherical 4M cylinders must be shipped in strong outside packagings. The strong outside packaging must conform to paragraph (h) of this section and to § 173.25.

(b) *Cylinder markings.* Required markings on a cylinder must be legible and must meet the applicable requirements of subpart C of part 180 of this subchapter. Additional information may be marked on the cylinder

provided it does not affect the required markings prescribed in the applicable cylinder specification.

(c) *Toxic gases and mixtures.* Cylinders containing toxic gases and toxic gas mixtures that meet the criteria of Division 2.3 Hazard Zone A or B must conform to the requirements of § 173.40, CGA Pamphlets S-1.1 and S-7. DOT 39 cylinders may not be used for toxic gases or toxic gas mixtures that meet the criteria for Division 2.3 Hazard Zone A or B.

(d) *Gases capable of combining chemically.* A filled cylinder may not contain any gas or material that is capable of combining chemically with the cylinder's contents or with the cylinder material of construction so as to endanger the cylinder's serviceability. After [EFFECTIVE DATE OF THE FINAL RULE] DOT 3AL cylinders made of aluminum alloy 6351 may not be filled and offered for transportation with pyrophoric gases.

(e) *Ownership of cylinder.* A cylinder filled with a hazardous materials may not be offered for transportation unless it was filled by the owner of the cylinder or with the owner's consent.

(f) *Pressure relief device systems.* (1) Except as provided in paragraph (f)(6) and (f)(7) of this section, a cylinder filled with a gas for transportation must be equipped with one or more pressure relief devices sized and selected as to type, location and quantity and tested in accordance with CGA Pamphlets S-1.1 (compliance with paragraph 9.1.1.1 of CGA Pamphlet S-1.1 is not required) and S-7. A pressure relief device is required on a DOT 39 cylinder and a cylinder used for acetylene in solution, regardless of cylinder size or filled pressure. A DOT 39 cylinder used for liquefied Division 2.1 materials must be equipped with a metal pressure relief valve. Fusible pressure relief devices are not authorized on a DOT 39 cylinder containing a liquefied gas.

(2) When installed, a pressure relief device must be in the vapor space of a cylinder.

(3) For a metric-marked cylinder, the start-to-discharge pressure of a pressure relief device may not be less than the marked test pressure of the cylinder. For a nonmetric-marked DOT-3 series cylinder, from the first requalification due on and after [EFFECTIVE DATE OF THE FINAL RULE,] the start-to-discharge pressure of the pressure relief device, may not be less than the minimum required test pressure. To ensure that the relief device does not open below its set pressure, the allowable tolerances for all the pressure relief devices must range from zero to plus 10% of its setting. The pressure

relief device must be capable of preventing rupture of the normally filled 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.

(4) Before each filling of a cylinder equipped with a pressure relief device, the person filling the cylinder must visually inspect each pressure relief device for corrosion, damage, rust, plugging of external pressure relief device channels, and other mechanical defects such as extrusion of fusible metal. A cylinder with a defective pressure relief device may not be used.

(5) Before a filled cylinder is offered for transportation from the cylinder filling facility, the pressure relief device must be tested for leaks. A cylinder with a leaking pressure relief device may not be offered for transportation.

(6) A pressure relief device is not required on—

(i) A cylinder 305 mm (12 inches) or less in length, exclusive of neck, and 114 mm (4.5 inches) or less in outside diameter, except:

(A) When filled with a liquefied gas for which this part requires a service pressure of 1800 psi or higher for a nonmetric-marked cylinder, and a test pressure of 186 bar (2700 psi) or higher for a metric-marked cylinder; or

(B) When filled with a nonliquefied gas to a pressure less than 1800 psi for a nonmetric-marked cylinder and 124 bar for a metric-marked cylinder.

(ii) A cylinder with a water capacity of less than 454 kg (1000 lbs) filled with a nonliquefied gas to a pressure of 21 bar (300 psi) or less at 21°C (70°F).

(iii) A cylinder containing a Class 3 or a Class 8 material without pressurization unless otherwise specified for the hazardous material.

(7) A pressure relief device is prohibited on a cylinder filled with a Division 2.3 or a Division 6.1 material in Hazard Zone A.

(g) *Manifolding cylinders in transportation.* (1) Cylinder manifolding is only authorized under conditions prescribed in this paragraph (g). Manifolder cylinders shall be supported and held together as a unit by structurally adequate means. Except for Division 2.2 materials, each cylinder must be equipped with an individual shutoff valve that must be tightly closed while in transit. Manifold branch lines must be sufficiently flexible to prevent damage to the valves which otherwise might result from the use of rigid branch lines. Each cylinder must be individually equipped with a pressure relief device as required in paragraph (f) of this section. Pressure relief devices

on manifolded cylinders, filled with a compressed gas, must be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any escaping gas from contacting personnel or any adjacent cylinders. Valves and pressure relief devices on manifolded cylinders, filled with a compressed gas, must be protected by framing or other method which is equivalent to the valve protection required in paragraph (h) of this section. Manifolding is authorized for cylinders containing the following gases:

- (i) Nonliquefied compressed (permanent) gases authorized by § 173.302.
 - (ii) Liquefied compressed gases that are authorized by § 173.304. Each manifolded cylinder, containing a liquefied compressed gas, must be separately filled and means must be provided to ensure that no interchange of cylinder contents can occur during transportation.
 - (iii) Acetylene as authorized by § 173.303.
- (2) For the checking of tare weights or for replacement of solvent, the cylinder must be removed from the manifold. This requirement is not intended to prohibit the filling of acetylene cylinders while manifolded.

(h) *Cylinder valve protection.* (1) Except for a cylinder meeting the following conditions, a cylinder offered for transportation must meet the performance requirements specified in paragraph (h)(2) of this section:

- (i) A cylinder manufactured before [FIVE YEARS FROM EFFECTIVE DATE OF THE FINAL RULE.];
- (ii) A cylinder containing only a Division 2.2 material without a Division 5.1 subsidiary hazard;
- (iii) A cylinder containing a Class 9 material or a Class 8 material only corrosive to metal;
- (iv) A cylinder with a water capacity of 4.8 liters (293 cubic inches) or less containing oxygen, compressed;
- (v) A cylinder containing oxygen, refrigerated liquid (cryogenic liquid).

(2) Each cylinder valve assembly must be of sufficient strength or protected such that no leakage occurs when a cylinder with the valve installed is dropped 1.8 m (6 ft.) or more onto a non-yielding floor, impacting the valve assembly or protection device at an orientation most likely to cause damage. The cylinder valve assembly protection may be provided by any method that meets the performance requirement in this paragraph (h)(2), examples include:

- (i) Equipping the cylinder with a securely attached metal cap.

(ii) Packaging the cylinder in a box, crate or other strong outside packaging conforming to the requirements of § 173.25.

(iii) Constructing the cylinder such that the valve is recessed into the cylinder or otherwise protected.

(i) *Cylinders mounted on motor vehicles or in frames.* Seamless DOT specification cylinders longer than two meters (6.5 feet) 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 by rail in container on freight car (COFC) or trailer on flat car (TOFC) service only under conditions approved by the Associate Administrator for Safety, Federal Railroad Administration. The cylinder must be configured 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 pressure relief device protective structure must be sufficiently strong to withstand a force equal to twice the weight of the cylinder and framework assembly with a safety factor of four, based on the ultimate strength of the material used; and

(3) Discharge from a pressure relief device shall be arranged in such a manner to prevent any escaping gas from contacting personnel or any adjacent cylinders.

(j) *Non-specification cylinders in domestic use.* Except as provided in paragraphs (k) and (l) of this section, a filled non-DOT specification cylinder, other than a DOT exemption cylinder, may not be offered for transportation or transported to, from, or within the United States.

(k) *Importation of foreign cylinders for discharge within a single port area.* A cylinder manufactured to other than a DOT specification that has been certified as being in conformance with the transportation regulations of another country may be authorized upon written request to and approval by the Associate Administrator for Hazardous Materials Safety, for transportation within a single port area, provided—

- (1) The cylinder is transported in a closed freight container;
- (2) The cylinder is certified by the importer to provide a level of safety at least equal to that required by the regulations in this subchapter for a comparable DOT specification cylinder; and

(3) The cylinder is not refilled for export unless in compliance with paragraph (l) of this section.

(l) *Charging of foreign cylinders for export.* A cylinder manufactured outside the United States that was not manufactured, inspected, tested and marked in accordance with part 178 of this subchapter or a cylinder manufactured to other than a DOT specification or exemption may be filled with a gas in the United States and offered for transportation and transported for export, if the following conditions are met:

(1) The cylinder has been requalified and marked with the month and year of requalification in accordance with subpart C of part 180 of this subchapter, or has been requalified as authorized by the Associate Administrator for Hazardous Materials Safety.

(2) The maximum filling density and service pressure for each cylinder conform to the requirements of this part for the gas involved.

(3) The bill of lading or other shipping paper shall identify the cylinder and shall carry the following certification: "This cylinder has (These cylinders have) been qualified, as required, and filled in accordance with the DOT requirements for export."

(m) *Sharp attachments.* Attachments to cylinders filled for transportation may not have sharp corners, edges, or any other features that are capable of causing puncture or damage to other freight. Attachments include all permanent structural attachments, as well as anything temporarily attached to the cylinder, such as skids.

27. Section 173.301a would be added to read as follows:

§ 173.301a Additional general requirements for shipment of nonmetric-marked cylinders.

(a) *General.* The requirements in this section are in addition to the requirements in § 173.301 and apply to the shipment of gases in nonmetric-marked cylinders.

(b) *Authorized cylinders not marked with a service pressure.* For authorized cylinders not marked with a service pressure, the service pressure is designated as follows:

Specification marking	Service pressure psig
3	1800
3E	1800
8	250

(c) *Cylinder pressure at 21°C (70°F).* The pressure in a cylinder at 21°C (70°F) may not exceed the service pressure for which the cylinder is marked or designated, except as provided in § 173.302a(b). For certain liquefied

gases, the pressure at 21°C (70°F) must be lower than the marked service pressure to avoid having a pressure at a temperature of 54.4°C (131°F) that is greater than permitted.

(d) *Cylinder pressure at 55°C (131°F)*. The pressure in a cylinder at 55°C (131°F) may not exceed 5/4 times the service pressure, except:

(1) A cylinder filled with acetylene, liquefied nitrous oxide or carbon dioxide.

(2) When a cylinder is filled in accordance with § 173.302a(b), the pressure in the cylinder at 55°C (131°F) may not exceed 5/4 times the filling pressure.

28. Section 173.301b would be added to read as follows:

§ 173.301b Additional general requirements for shipment of metric-marked cylinders.

(a) *Definitions*. For purposes of this subpart, the following definitions apply to Class 2 materials in metric-marked cylinders:

Critical temperature means the temperature above which the substance can not exist in the liquid state.

Dissolved gas means a gas which is dissolved under pressure in a liquid phase solvent. The solvent may be supported in a porous mass.

Filling factor of liquefied compressed gas means the mass of a gas, in kg (or pound), which can be filled into a 1 liter (61 cubic inches) water capacity container. The filling factor of each liquefied compressed gas must be calculated to meet all requirements of § 173.304b.

High pressure liquefied compressed gas means a gas which has a critical temperature in the range from -10 °C (14 °F) to less than 70 °C (158 °F).

Low pressure liquefied compressed gas means a gas which has a critical temperature equal to or above 70 °C (158 °F).

Permanent (non-liquefied compressed) gas means a gas other than in solution, which has a critical temperature below -10 °C (14 °F).

Safety factor means the ratio of the cylinder burst pressure to its marked test pressure. For example, a cylinder with a marked test pressure of 180 bar (2610 psi) and a burst pressure of 340 bar (4930 psi) and has a safety factor of 1.89.

Settled pressure (formerly referred to as service pressure) means the pressure of the contents of the cylinder at 15 °C (59 °F).

(b) *Pressure in cylinders containing a permanent gas*. The pressure in a DOT 3M, 3FM, 3ALM or 4M cylinder containing a permanent gas must be as prescribed in § 173.302b.

(c) *Pressure in cylinders containing a liquefied compressed gas*. (1) The pressure in a cylinder containing a liquefied compressed gas which has critical temperature ranging from -10 °C (14 °F) up to 70 °C (158 °F) may not exceed the cylinder's marked test pressure or be liquid full at a temperature of 65 °C (149 °F).

(2) The pressure in a cylinder containing a liquefied compressed gas which has a critical temperature greater than or equal to 70 °C (158 °F) may not exceed the cylinder's marked test pressure or be liquid full at 54 °C (130 °F).

(d) *Authorized gases for DOT 3FM cylinders*. A DOT 3FM cylinder may only be used for gases free of corroding components with a dew point below -49 °C (-56 °F). A DOT 3FM cylinder is not authorized for hydrogen or hydrogen bearing gases (e.g., hydrogen sulfide).

29. Section 173.302 would be revised to read as follows:

§ 173.302 Filling of cylinders with non-liquefied compressed gases.

(a) *General requirements*. A cylinder filled with a non-liquefied compressed gas (except gas in solution) must be offered for transportation in accordance with the requirements of this section and §§ 173.301, 173.301a, 173.301b, 173.302a, 173.302b and 173.305. Where more than one section applies to a cylinder, the most restrictive requirement must be followed.

(b) *Aluminum cylinders in oxygen service*. Each aluminum cylinder filled with oxygen must meet the following conditions:

(1) Each cylinder must be equipped only with brass or stainless steel valves;

(2) Each cylinder must have only straight threads in the opening;

(3) Each cylinder must be cleaned in accordance 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 provided they do not react with oxygen. One cylinder selected at random from a group of 200 or less and 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

(4) The pressure in each cylinder may not exceed 207 bar (3000 psig) at 21 °C (70 °F).

(c) Each authorized cylinder containing oxygen which is continuously fed to tanks containing live fish may be offered for transportation and transported

irrespective of the provisions of § 173.24(b)(1).

(d) Shipment of Division 2.1 materials in aluminum cylinders are authorized only when transported by highway, rail, or cargo-only aircraft.

30. Section 173.302a would be added to read as follows:

§ 173.302a Additional requirements for shipment of permanent (nonliquefied) compressed gases in nonmetric-marked cylinders.

(a) *Detailed filling requirements*. Nonliquefied compressed gases (except gas in solution) for which filling requirements are not specifically prescribed in § 173.304a must be shipped, subject to the requirements in this section and §§ 173.301, 173.301a, 173.302 and 173.305 in nonmetric-marked cylinders, as follows:

(1) Specification 3, 3A, 3AA, 3AL, 3B, 3E, 4B, 4BA and 4BW cylinders.

(2) DOT 3HT cylinders. These cylinders are authorized for aircraft use only and only for nonflammable gases. They have a maximum service life of 24 years from the date of manufacture. The cylinders must be equipped with pressure relief devices only of the frangible disc type which meet the requirements of § 173.301(f). 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. Specification 3HT cylinders may be offered for transportation only when packed in strong outer packagings conforming to the requirements of § 173.25.

(3) For a specification 39 cylinder filled with a Division 2.1 material, the internal volume may not exceed 75 cubic inches.

(4) Specification 3AX, 3AAX, and 3T cylinders are authorized for Division 2.1 and 2.2 materials and for carbon monoxide. DOT 3T cylinders are not authorized for hydrogen. When used in methane service, the methane must be a non-liquefied gas which has a minimum purity of 98.0 percent methane and which is commercially free of corroding components.

(5) Aluminum cylinders made to DOT specification 39 and 3AL are authorized for oxygen only under the conditions specified in § 173.302(b).

(b) *Special filling limits for specification 3A, 3AX, 3AA, 3AAX, and 3T cylinders*. A specification 3A, 3AX, 3AA, 3AAX, and 3T cylinders may be filled with a compressed gas, other than a liquefied, dissolved, Division 2.3 or 2.1 material, to a pressure 10 percent in excess of its marked service pressure, provided:

(1) The cylinder is equipped with a frangible disc pressure relief devices (without fusible metal backing) having a bursting pressure not exceeding the minimum prescribed test pressure.

(2) The cylinder's elastic expansion was determined at the time of the last test or retest by the water jacket method.

(3) Either the average wall stress or the maximum wall stress does not exceed the wall stress limitation shown in the following table:

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

(i) 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 = factor $\times 10^{-7}$ 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.

(ii) 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.

(iii) The formula in paragraph (b)(3)(i) of this section is derived from the formula in paragraph (b)(3)(ii) and the following:

$$EE = (PKVD^2) / (D^2 - d^2)$$

(iv) 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 (b) (2), (3), and (4) of this section.

(c) *Carbon monoxide.* Carbon monoxide must be offered in a specification 3, 3A, 3AX, 3AA, 3AAX, 3AL, 3E, or 3T cylinder having a minimum service pressure of 1,800 psig. The pressure in the cylinder may not exceed 1000 psig at 70° F., except that if the gas is dry and sulfur free, the cylinder may be filled to five-sixths of the cylinder's service pressure or 2000 psig, whichever is less. A DOT 3AL cylinder is authorized only when transported by highway, rail or cargo-only aircraft.

(d) *Diborane and diborane mixtures.* Diborane and diborane mixed with compatible compressed gas must be offered in a DOT 3AA1800 cylinder. The maximum filling density of the diborane may not exceed 7 percent. Diborane mixed with compatible compressed gas may not have a pressure exceeding the service pressure of the cylinder if complete decomposition of the diborane occurs. Cylinder valve assemblies must be protected in accordance with § 173.301(h).

(e) *Fluorine.* Fluorine must be offered in a DOT 3A1000, 3AA1000, or 3BN400 cylinder without a pressure relief device and equipped with a valve protection cap. The cylinder may not be filled to over 400 psig at 70° F. and may not contain over 6 pounds of gas.

31. Section 173.302b would be added to read as follows:

§ 173.302b Additional requirements for shipment of permanent gases in metric-marked cylinders.

(a) *General requirements.* Permanent gases (except gas in solution) must be shipped, subject to this section and §§ 173.301, and 173.301b in a DOT specification 3ALM, 3M, 3FM or 4M cylinder.

(1) A cylinder with a marked test pressure greater than or equal to 35 bar (508 psi) is authorized for transportation of Division 2.1, 2.2, or 2.3 Hazard Zone B,C or D gas.

(2) A DOT 3ALM, 3M, or 3FM cylinder with a marked test pressure greater than or equal to 200 bar (2900 psi) is authorized for transportation of Division 2.3 Hazard Zone A gases.

(3) The settled pressure for a DOT 3M, 3FM or 3ALM cylinder may not exceed two-thirds of the cylinder's marked test pressure.

(4) The settled pressure for a DOT 4M cylinder and a DOT 3M cylinder made from nickel may not exceed one-half of the cylinder's marked test pressure.

(5) A DOT 3FM cylinder exceeding 454 kilogram (1000 pounds) water capacity is authorized for dry compressed natural gas (scrubbed to remove acid gases). The cylinder may not contain any liquefied gas and the gas must meet following conditions:

(i) Water content is less than or equal to 0.5 lb. per million cubic feet at standard temperature and pressure (STP) (60° F., 30 inches Hg).

(ii) Hydrogen Sulfide and Mercaptan Sulfur in Natural Gas is less than or equal to 0.1 grain per 100 cubic feet.

(iii) Total Soluble Sulfides other than Hydrogen Sulfide must be less than or equal to 0.1 grain per 100 cubic feet at STP.

(iv) Less than one percent by volume of oxygen.

(v) Less than three percent by volume of carbon dioxide.

(b) *Pressure Limit.* Pressure in a cylinder containing a permanent gas at 70 °C (158 °F) may not exceed the values in the following table:

Division	Percentage of cylinder's marked test pressure
2.3, Zone A	63
2.3, Zone B, C	70
2.1/5.1; 2.3, Zone D	78
2.2	100

(c) *Fluorine.* Fluorine must be shipped in DOT 3M or 4M cylinders without pressure relief devices. The settled pressure may not exceed 1/4 of the cylinder's marked test pressure, or be more than 28 bar (400 psig) at 21 °C (70 °F). The cylinder may not contain over 2.7 kg (6 pounds) of gas.

(d) *Carbon monoxide.* A cylinder filled with carbon monoxide may not exceed 1/3 of the cylinder's marked test pressure, except that if the gas is dry and sulfur free, settled pressure may not exceed 1/2 of the cylinder's marked test pressure.

(e) *Diborane and diborane mixtures.* Diborane and diborane mixed with a compatible compressed gas must be

shipped in a DOT 3M cylinder and the settled pressure may not exceed 1/3 of the cylinder's marked test pressure. The maximum filling density of the diborane may not exceed 7 percent. Diborane mixed with a compatible compressed gas may not have a settled pressure exceeding 2/3 of the cylinder's marked test pressure if complete decomposition of the diborane occurs. The cylinder valve must be protected in accordance with § 173.301(h).

32. Section 173.304 would be revised to read as follows:

§ 173.304 Filling of cylinders with liquefied compressed gases.

(a) *General requirements.* Liquefied compressed gases (except gas in solution) must be shipped in accordance with the requirements in this section and in §§ 173.301, 173.301a, 173.301b, 173.304a, 173.304b and 173.305.

(1) DOT 3AL, 3ALM, 3FM and 4M cylinders may not be used for any material that has a primary or subsidiary hazard of Class 8.

(2) Shipments of Division 2.1 materials in aluminum cylinders are authorized only when transported by highway, rail or cargo-only aircraft.

(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 may not completely fill the packaging at any temperature up to and including 54° C (130° F). The liquid portion of vinyl fluoride, inhibited, may completely fill the cylinder at 54° C (130° F) provided; the pressure at the critical temperature does not exceed one and one-fourth times the service pressure of a nonmetric-marked cylinder; or the pressure at the critical

temperature does not exceed 83% of the test pressure of a metric-marked cylinder.

(c) *Mixture of compressed gas and other material.* A mixture of compressed gas must be shipped in accordance with § 173.305.

(d) *Refrigerant gases.* Refrigerant gases which are nontoxic and nonflammable under this part, must be offered for transportation in cylinders prescribed in §§ 173.304a, 173.304b, or in DOT 2P and 2Q containers (§§ 178.33, 178.33a of this subchapter). DOT 2P and 2Q containers must be packaged 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 inside metal containers may not exceed 6 bar absolute (87 psia) at 21° C (70° F). Each completed metal container filled for shipment must be heated until its contents reach a temperature of 54° C (130° F) without evidence of leakage, distortion, or other defect. Each outside package must be plainly marked "INSIDE CONTAINERS COMPLY WITH PRESCRIBED SPECIFICATIONS."

(e) *Engine starting fluid.* Engine starting fluid containing a flammable compressed gas or gases must be shipped in a cylinder as prescribed in § 173.304a, 173.304b, or as follows:

(1) Inside nonrefillable metal containers having a capacity not greater than 500 ml (32 cubic inches). The containers must be packaged in strong, tight outer packagings. The pressure in the container may not exceed 10 bar absolute (145 psia), at 54° C (130° F). However, if the pressure exceeds 10 bar absolute (145 psia), at 54° C (130° F), a

DOT 2P 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 54° C (130° F). The liquid content of the material and gas must not completely fill the container at 54° C (130° F). Each container, filled for shipment, must have been heated until its contents reach a temperature of 54° C (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]

33. Section 173.304a would be added to read as follows:

§ 173.304a Additional requirements for shipment of liquefied compressed gases in nonmetric-marked cylinders.

(a) *Detailed filling requirements.* Liquefied gases (except gas in solution), must be offered for transportation, subject to the requirements in this section and §§ 173.301, 173.301a and 173.304, in nonmetric-marked cylinders, as follows:

(1) Specification 3, 3A, 3AA, 3B, 3BN, 3E, 4B, 4BA, 4B240ET, 4BW, 4E, 39, except that no Specification 4E or 39 packaging may be filled and shipped with a mixture containing a pyrophoric liquid, carbon bisulfide (disulfide), ethyl chloride, ethylene oxide, nickel carbonyl, spirits of nitroglycerin, or toxic material (Division 6.1 or 2.3), unless specifically authorized in this part.

(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 §§ 173.301(1), 173.301(a)(4) (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.
Bromotrifluoromethane (R-13B1 or H-1301).	124	DOT-3A400; DOT-3AA400; DOT-3B400; DOT-4A400; DOT-4AA480; DOT-4B400; DOT-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-DOT-4L.
Carbon dioxide, refrigerated liquid (see paragraph (e) of this section.) Chlorine (see Note 2).	125	DOT-3AL1800. DOT-3A480; DOT-3AA480; DOT-3; DOT-3BN480; DOT-3E1800.
Chlorodifluoroethane (R-142b) or 1-Chloro-1, 4B150; DOT-4BA225; DOT-4BW225; DOT-1-difluoroethane (Note 8).	100	DOT-3A150; DOT-3AA150; DOT-3B150; 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-3AL240.
Chloropentafluoroethane, (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.

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 §§ 173.301(1), 173.301(a)(4) (see notes following table)
Cyclopropane (see Note 8)	55	DOT-3A225; DOT-3A480X; DOT-3AA225; DOT-3B225; DOT-4A225; DOT-4AA480; DOT4B225; DOT-4BA225; DOT-4BW225; DOT-4B240ET; DOT-3; DOT-3E1800; DOT-39; 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)(Note 8).	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.
1,1-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 Note 8)	35.8	DOT-3A1800; DOT-3AX1800; DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; DOT-3AL1800.
Ethane (see Note 8)	36.8	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; DOT-3AL2000.
Ethylene (see Note 8)	31.0	DOT-3A1800; DOT-3AX1800 DOT-3AA1800; DOT-3AAX1800; DOT-3; DOT-3E1800; DOT-3T1800; DOT-39; and DOT-3AL1800 .
Ethylene (see Note 8)	32.5	DOT-3A2000; DOT-3AX2000; DOT-3AA2000; DOT-3AAX2000; DOT-3T2000; DOT-39; and DOT-3AL2000.
Ethylene (see Note 8)	35.5	DOT-3A2400; DOT-3AX2400; DOT-3AA2400; DOT-3AAX2400; DOT-3T2400; DOT-39; DOT-3AL2400.
Hydrogen chloride, anhydrous	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-14A480; DOT-4B480; DOT-4BA480; DOT-4BW480.; DOT-3E1800; DOT-3AL480.
Insecticide, gases liquefied (See Notes 8 and 12).	Not liquid full at 130 °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 classified flammable, corrosive, toxic & mixtures or solution thereof filled w/nitrogen carbon dioxide, or air (see Notes 7 and 8).	Not liquid full at 130 °F.	Specification packaging authorized in paragraph (a)(1) of this section and DOT-3HT; DOT 4D; DOT-4DA; DOT-4DS.
Methyl acetylene-propadiene, mixtures, stabilized (see Note 5).	Not liquid full at 130 °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-38; DOT-3E1800; DOT-4B240ET.
Methyl mercaptan	80	Cylinders complying with DOT-3A150; DOT-3B150; DOT-4A150, and DOT-4B150 manufactured prior to Dec. 7, 1936 are also authorized. DOT-3A240; DOT-3AA240; DOT-3B240; DOT-4B240; DOT-4B240ET; DOT-3E1800; DOT-4BA240; DOT-4BW240.
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-3AL1800.
Nitrous oxide, refrigerated liquid (see paragraph (e) of this section.)	Not liquid full at 130 °F.	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-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/inhibit	90	DOT-3A1200; DOT-3AA1200; DOT-3E1800.
Trifluorochloroethylene, inhibited	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-3E1800; DOT-3AL150.
Vinyl fluoride, inhibited	62	DOT-3A1800; DOT-3AA1800; DOT-3E1800; DOT-3AL1800.

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 §§ 173.301(1), 173.301(a)(4) (see notes following table)
Vinyl methyl ether, inhibited (see Note 5).	68	DOT-4B150, without brazed seams; DOT-4BA225 without brazed seams; DOT-4BW225; DOT-3A150; DOT-3AA150; DOT-3B1800; DOT-3E1800.

Note 1: "Filling density" means the percent ratio of the weight of gas in a container to the weight of water that the container will hold at 60 °F. (1 lb of water=27.737 cubic inches at 60 °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 pressure relief device. Cylinders purchased after Nov. 1, 1935, and filled 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 filled 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 pressure 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 pressure 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 § 173.301(f) 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(a)(10).

Note 9: [Reserved]

Note 10: Each valve outlet must be sealed by a threaded cap or a threaded solid plug.

Note 11: Must meet the valve and cleaning requirements in § 173.302(b).

Note 12: For an insecticide gas which is nontoxic and nonflammable, see § 173.305(c).

Note 13: For a refrigerant or dispersant gas which is nontoxic and nonflammable, see § 173.304(d).

(3) The internal volume of a Specification 39 cylinder may not exceed 75 cubic inches for a liquefied flammable gas.

(b) [Reserved]

(c) *Verification of content in cylinder.*

Except as noted in paragraph (d)(4) of this section, the amount of liquefied gas filled into a cylinder must be by weight or, when the gas is lower in pressure than required for liquefaction, a pressure-temperature chart for the specific gas may be used to ensure that the service pressure at 21° C (70° F) times 5/4 will not be exceeded at 54° C (130° F). The weight of liquefied gas filled into the container also must be checked, after disconnecting the cylinder from the filling line, by the use of a proper scale.

(d) *Requirements for liquefied petroleum gas.* (1) Filling density limited as follows:

Minimum specific gravity of liquid material at 60 °F	Maximum the filling density in percent of the water-weight capacity of the cylinder	Minimum specific gravity of liquid material at 60 °F	Maximum the filling density in percent of the water-weight capacity of the cylinder
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

(2) Subject to § 173.301a(d), any filling density percentage prescribed in this section is authorized to be increased by 2 for liquefied petroleum gas in specification 3 cylinders or in specification 3A cylinders marked for 1,800 psig, or higher, service pressure.

(3) Liquefied petroleum gas must be shipped in specification cylinders as follows:

(i) Specification 3, 3A, 3AA, 3B, 3E, 3AL, 4B, 4BA, 4B240ET, 4BW, 4E, or 39 cylinders. Shipments of flammable gases in 3AL cylinders are authorized only when transported by highway, rail or cargo-only aircraft.

(ii) Additional containers may be used within the limits of quantity and pressure as follows:

Type of container	Maximum capacity cubic inches	Maximum charging pressure—psig
DOT-2P or DOT-2Q (see Note 1)	31.83	45 psig at 70 °F. and 105 psig at 130 °F. (see Note 2).

Type of container	Maximum capacity cubic inches	Maximum charging pressure—psig
DOT-2P or DOT-2Q (see Note 1)	31.83	35 psig at 70 °F. and 100 psig at 130 °F.

Note 1: Containers must be packed in strong wooden or fiber boxes of such design as to protect valves from damage or accidental functioning under conditions normally incident to transportation. Each completed container filled for shipment must have been heated until its contents reach a 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."

Note 2: A container must be equipped with a pressure relief device which will prevent rupture of the container and dangerous projection of a closing device when exposed to fire.

(4) Verification of content. Cylinders with a water capacity of 200 pounds or more and for use with a liquefied petroleum gas with a specific gravity at 60 °F. of 0.504 or greater may have the quantity of 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 °F., is filled into the container the liquid just reaches the bottom of the tube. The weight of this liquid may not exceed 42 percent of the water capacity of the container which must be stamped thereon. The length of the dip tube, expressed 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 filling 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 filling line.

(e) *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 device and at least one frangible disc conforming to § 173.301(f) and paragraph (a)(2) of this section. 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 the shipment is offered for transportation may not exceed -18 °C (0 °F) and 20 bar (290 psig) for carbon dioxide and -15.6 °C (+4 °F) and 20 bar (290 psig) for nitrous oxide. Maximum time in transit may not exceed 120 hours.

(2) The following pressure relief device settings, design service temperatures and filling densities apply:

Pressure relief device setting maximum start-to discharge gauge pressure in bar (psig)	Maximum permitted filling density (percent by weight)	
	Carbon dioxide, refrigerated liquid	Nitrous oxide, refrigerated liquid
7.2 bar (105 psig)	108	104
11.7 bar (170 psig)	105	101
16 bar (230 psig)	104	99
20 bar (295 psig)	102	97
25 bar (360 psig)	100	95
31 bar (450 psig)	98	83
37 bar (540 psig)	92	87
43 bar (625 psig)	86	80
Design service temperature °C (°F)	-196 °C (-320 °F)	-196 °C (-320 °F)

34. Section 173.304b would be added to read as follows:

§ 173.304b Additional requirements for shipment of liquefied compressed gases in metric-marked cylinders.

(a) *General requirements.* Liquefied gases must be offered for transportation, subject to the requirements in this section, §§ 173.301, 173.301b and 173.304, in the following metric-marked cylinders: DOT 3M, 3FM, 3ALM, and 4M. A filling factor must be calculated for each liquefied compressed gas to meet the following conditions:

(1) The cylinder may not be liquid full at 55 °C (131 °F). In addition, for a low pressure liquefied compressed gas, the vapor space must be at least 5% of the cylinder internal volume at 50 °C (122 °F).

(2) A cylinder with a marked test pressure greater than or equal to 35 bar (508 psi) is authorized for transportation of Division 2.1, 2.2, and 2.3, gases Hazard Zone B, C or D gas.

(3) A DOT 3ALM, 3M, or 3FM cylinder with a marked test pressure greater than or equal to 200 bar (2900 psi) is authorized for transportation of a Division 2.3 Hazard Zone A gas.

(4) The pressure in a cylinder containing a high pressure liquefied compressed gas at 65 °C (149 °F) or low pressure liquefied compressed gas at 55 °C (131 °F) may not exceed the values in the following table:

Division	Percentage of cylinder's marked test pressure
2.3, Zone A	63
2.3, Zone B, C	70
2.1/5.1; 2.3, Zone D	78
2.2	100

(5) Vapor pressure may not exceed, at the maximum anticipated temperature during transportation, the cylinder's marked test pressure.

(6) Cylinder valve and fittings must be rated at or above the cylinder's burst pressure. The suitability of the cylinder, valve and fitting materials must be checked, at the maximum anticipated temperature during transportation, for operation.

(b) A DOT 3FM cylinder may not be used for a material that has a primary or subsidiary hazard of Class 8, hydrogen sulfide or other sulfide bearing compounds, carbon dioxide, carbon monoxide, atmospheric gases with a dew point above $-50\text{ }^{\circ}\text{C}$ ($-58\text{ }^{\circ}\text{F}$), or any other material where the addition of water may make the material corrosive.

(c) A DOT 3FM or 3ALM cylinder may not be used for reclaimed refrigerant gases.

§ 173.305 [Amended]

35. In § 173.305, paragraph (b) would be amended by revising the reference "173.301(e)" to read "173.301a(c)".

§ 173.306 [Amended]

36. In 173.306, the following changes would be made:

a. Paragraph (d)(3)(ii) would be amended by revising the reference "§ 173.301" to read "§ 173.301a or § 173.301b".

b. Paragraph (g)(5) would be amended by revising the reference "§ 173.301(k)" to read "§ 173.301(a)(10)".

37. In 173.315, in paragraph (a), in Note 2 following the table, the reference "§ 173.301(d)" would be revised to read "paragraph (p) of this section" and paragraph (p) would be added to read as follows:

§ 173.315 Compressed gases in cargo tanks and portable tanks.

* * * * *

(p) Manifolding is authorized for cargo tanks containing anhydrous ammonia provided that each individual cargo tank is equipped with a pressure relief valve or valves and gauging devices as required by paragraphs (h) and (i) of this section. Each valve shall be tightly closed while the cargo tank is in transit. Each cargo tank must be filled separately.

38. Section 173.334 would be revised to read as follows:

§ 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; or any 3M, 3FM, or 4M cylinders with a marked test pressure of at least 25 bar (363 psig) or greater; meeting the following requirements:

(a) Each cylinder may be filled 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) No cylinder may be equipped with an eduction tube or a fusible plug;

(c) No cylinder may be equipped with any valve unless the valve is a type approved by the Associate Administrator for Hazardous Materials Safety;

(d) Cylinders must be overpacked in a box, crate or other strong outside packaging conforming to the requirements of § 173.25 and arranged to protect each valve or other closing device from damage. Except as provided in paragraph (e) of this section, no more than four cylinders may be packed in a strong outside packaging. Each strong outside packaging with its closing device protection must be sufficiently strong to protect all parts of each cylinder from deformation or breakage if the completed package is dropped 1.8 m (6 feet) onto a nonyielding surface and impacted at the package's weakest point;

(e) Cylinders may be packed in strong wooden boxes with valves or other closing devices protected from damage, 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 (6 feet) onto a nonyielding surface, impacting at the weakest point.

39. Section 173.336 would be revised to read as follows:

§ 173.336 Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied.

Nitrogen dioxide, liquefied, or dinitrogen tetroxide, liquefied, must be packaged in specification cylinders as prescribed in § 173.192. Specification cylinders prescribed in § 173.192 with valve removed are authorized. Each valve opening must be closed by means of a solid metal plug with tapered thread properly luted to prevent

leakages. Transportation in DOT 3AL and 3ALM 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 and 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.

40. Section 173.337 would be revised to read as follows:

§ 173.337 Nitric oxide.

Nitric oxide must be packed in Specification 3A1800, 3AA1800, 3E1800, or 3AL1800 cylinders; or 3M, 3ALM, or 3FM cylinders with a marked test pressure of 200 bar (2900 psig) or greater filled to a pressure of not more than 52 bar (750 psi) at $21\text{ }^{\circ}\text{C}$ ($70\text{ }^{\circ}\text{F}$). Cylinders must be equipped with a stainless steel valve and valve seat 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) Transportation in 3AL or 3ALM cylinders is authorized only by highway or rail.

(b) 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 and 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.

PART 177—CARRIAGE BY PUBLIC HIGHWAY

41. The authority citation for Part 177 would continue to read as follows:

Authority: 49 U.S.C. 5101–5127, 49 CFR 1.53.

42. In § 177.840, paragraph (a)(1) would be revised to read as follows:

§ 177.840 Class 2 (gases) materials.

* * * * *

(a) * * *

(1) *Cylinders*. Cylinders containing Class 2 (gases) materials shall be securely lashed in an upright position, loaded in racks, or packed in boxes or crates and securely attached to the motor vehicle to prevent the cylinders from being shifted, overturned or ejected from the vehicle. A cylinder containing a Class 2 material may be loaded in a horizontal position provided that the cylinder is designed so that the inlet to the pressure relief device is located in the vapor space and the cylinder is properly secured and lashed.

PART 178—SPECIFICATIONS FOR PACKAGINGS

43. The authority citation for part 178 would continue to read as follows:

Authority: 49 U.S.C. 5101–5127; 49 CFR 1.53.

§ 178.3 [Amended]

44. In § 178.3, paragraph (a)(1) would be amended by removing the wording “DOT 4B240ET” and adding the wording “DOT 3M”, in its place.

§ 178.35 [Amended]

45. In § 178.35, the following changes would be made:

a. In paragraph (b) introductory text, the wording “§ 173.300b of this subchapter” would be revised to read “subpart I of part 107 of this chapter”.

b. In paragraph (b)(1), the wording “§ 173.300a of this subchapter” would be revised to read “subpart I of part 107 of this chapter”.

c. In paragraph (e), the wording “§§ 173.34 and 173.301” would be revised to read “§ 173.301”.

d. In paragraph (f)(2)(ii), the parenthetical wording “(§ 178.44)” and “(§ 178.45)” would be removed.

46. In addition, in § 178.35, paragraph (f)(3) would be revised to read as follows:

§ 178.35 General requirements for specification cylinders.

* * * * *

(f) * * *

(3) *Marking exceptions*. A DOT 3E cylinder is not required to be marked with an inspector’s mark or a serial number.

* * * * *

§§ 178.36, 178.37, 178.38, 178.39, 178.45 [Removed]

47. In subpart C, §§ 178.36, 178.37, 178.38, 178.39, and 178.45 would be removed.

48. In § 178.46(a)(4), in Table 2, the entry “6351-T6” would be removed and Table 1 would be revised to read as follows:

§ 178.46 Specification 3AL seamless aluminum cylinders.

(a) * * *

(4) * * *

TABLE 1.—ALUMINUM

[Heat or Cast Analysis for Aluminum; similar to “Aluminum Association¹” Alloy 6061 Chemical Analysis in Weight Percent²]

Si min/max	Fe max	Cu min/max	Mn max	Mg min/max	Cr min/max	Zn max	Ti max	Pb max	Bi max	Other		Al
										Each max	Total max	
0.40/0.8	0.7	0.15/0.4	0.15	0.8/1.2	0.04/0.35	0.25	0.15	0.005	0.005	0.05	0.15	Bal.

¹ The “Aluminum Association” refers to “Aluminum Standards and Data 1993”, published by the Aluminum Association Inc.

² Except for “Pb” and “Bi”, the chemical composition corresponds with that of Table 1 of ASTM B221 for Aluminum Association alloy 6061.

* * * * *

§§ 178.50, 178.51 and 178.55 [Removed]

49. Sections 178.50, 178.51, and 178.55 would be removed.

§ 178.56 [Amended]

50. In § 178.56, paragraph (b) would be amended by revising the wording “Table 1 of Appendix A to this part” to read “Table 1 of Appendix A to this subpart”.

§ 178.60 [Amended]

51. In § 178.60, paragraph (b) would be amended by revising the wording “Table 1 of Appendix A to this part” to read “Table 1 of Appendix A to this subpart”.

§ 178.61 [Removed]

52. Section 178.61 would be removed.

§ 178.68 [Removed]

53. Section 178.68 would be removed.

54. Section 178.69 would be added to Subpart C to read as follows:

§ 178.69 Applicability and design criteria for all metric-marked DOT specification cylinders.

(a) *Applicability*. The definitions and general requirements prescribed in

paragraphs (b) through (g) of this section apply to the manufacture of cylinders to the DOT 3M, 3ALM, 3FM and 4M specifications prescribed in §§ 178.70 through 178.81. The requirements for design qualification tests and production tests and verifications prescribed in paragraphs (h) and (i) of this section apply only when required by the individual specification. All specification requirements are minimum requirements.

(b) *Definitions*. For purposes of this subpart—

Associate Administrator means the Associate Administrator for Hazardous Materials Safety.

Design qualification tests means a series of tests, including the cycle, burst and puncture resistance test, that measure the structural integrity of a cylinder design or significant design change.

Heat treatment means heating and cooling a solid metal or alloy in such a way as to obtain desired conditions or properties. In addition:

(1) *Quench and temper heat treatment* means the process of heat treating and cooling cylinders by liquid quenching. The liquid must have a cooling rate of less than 80 percent of that of water.

The temperature on quenching shall be appropriate for the material of construction but may not exceed 957°C (1750°F).

(2) *Normalizing heat treatment* means heating a ferrous alloy to a suitable temperature above its transformation temperature, not to exceed 957°C (1750°F), and then cooling it in air to ambient temperature.

(3) *Annealing heat treatment* means heating to and holding at a suitable temperature and then cooling to facilitate cold working.

(4) *Stress relieving heat treatment* means heating to a suitable temperature, holding long enough to reduce residual stresses and then cooling slowly enough to minimize the development of new residual stresses.

Lot means a group of cylinders successively produced in a work shift of not more than 10 hours of continuous operation having—

(1) The same specified size and configuration, within the parameters of “significant change” to an original design as defined in this section;

(2) The same specified material of construction (i.e. cast or heat);

(3) The same process of manufacture; and

(4) Been subjected to similar conditions of time, temperature, cooling rate, and atmosphere during heat treatment.

Plugged cylinder is a cylinder with a permanent end closure achieved by the insertion of a threaded plug.

Proof pressure test means a pressure test by interior pressurization without the determination of the cylinder's expansion.

Settled pressure, (formerly referred to as service pressure) means the pressure of the contents of the cylinder at 15 °C (59 °F).

Significant change to an original design means—

(1) A 10 percent or greater change in cylinder wall thickness, test pressure or diameter;

(2) A 30 percent or greater change in water capacity or base thickness;

(3) Any change in specified material;

(4) An increase in the diameter of openings of over 100 percent; or

(5) Any change in the number of openings.

Spun cylinder is a cylinder with an end closure that has been welded by the spinning process.

Volumetric expansion test means a pressure test by interior pressurization to measure a cylinder's expansion by using the water jacket or direct expansion methods.

(1) *Water jacket method* means a volumetric expansion test to determine a cylinder's total and permanent expansion by measuring the difference between the volume of water the cylinder externally displaces at test pressure and the volume of water the cylinder externally displaces at ambient pressure

(2) *Direct expansion method* means a volumetric expansion test to calculate a cylinder's total and permanent expansion by measuring the amount of water forced into a cylinder at test pressure, adjusted for the compressibility of water, as a means of determining the expansion.

(c) *Inspection and analyses*. Inspection and analyses must be in compliance with the following:

(1) Inspections and verifications, as required, must be performed by a hazmat employee of an independent inspection agency that has been approved in writing by the Associate Administrator in accordance with § 107.803 of this chapter.

(2) Chemical analyses and tests must be made in the United States or at a facility located outside the United States that is approved in writing by the Associate Administrator in accordance with § 107.807 of this chapter and under the supervision of an independent

inspection agency approved under § 107.803 of this chapter.

(d) *Authorized material and material identification*. (1) Material of construction must be of uniform quality.

(2) Materials with seams, cracks, laminations or other defects likely to weaken the finished cylinder may not be used.

(3) Materials must be identified with the heat or cast code by a suitable method during manufacture. If the heat or cast identification is permanently stamped on the cylinder, it must be stamped in an area other than the sidewall of the cylinder.

(e) *Duties of the inspector*. The inspector shall determine that each cylinder conforms to the requirements in this section and the applicable individual specification. In making these determinations, the inspector shall:

(1) Verify that all procedures for obtaining and reporting the chemical analysis are in accordance with the appropriate requirements of ASTM Chemical Analysis Test Methods and that the chemical analysis is in conformance with the individual specification by—

(i) Obtaining a certified cast or heat analysis from the material producer, supplier, or from the cylinder manufacturer, for each heat or cast of material; or

(ii) Performing or obtaining a check (solid metal) analysis, when such check analysis is required;

(2) Witness that the applicable design qualification tests prescribed in paragraph (h) of this section for each new cylinder design or a significant change to an original design have been performed with satisfactory results;

(3) Select samples for all tests;

(4) Select samples for the check analysis, when performed;

(5) Verify that identification of material is proper;

(6) Verify that the manufacturer makes a complete internal inspection of the cylinder body before closing the ends;

(7) Verify that wall thickness was measured and that the specified minimum thickness is met;

(8) Verify that the heat treatment is proper;

(9) Witness each test (except that results of the hardness test and the grain size test may be verified);

(10) Verify by gauge that threads are in conformance with the specification;

(11) Verify that each cylinder is marked in accordance with the applicable specification;

(12) Verify that gauges and test equipment are properly calibrated;

(13) Prepare a report containing, at a minimum, the information required by the applicable provisions of this subpart and the information listed in CGA Pamphlet C-11 and provide the report to the manufacturer and, upon request, to the purchaser. The inspector must retain the reports required by this section and the applicable individual specification for 15 years from the original test date on the cylinder. Each report must be legible and in English; and

(14) Certify that all cylinders represented by the test report meet all applicable requirements of the specification through inspection, verification, or any other action required to assure compliance.

(f) *Threads*. Threads must conform to the following:

(1) Each thread must be clean cut, even, without checks and to gauge.

(2) Taper threads must conform to one of the following—

(i) American Standard Pipe Thread (NPT) type must conform to the requirements of Federal Standard H-28, Section 7 (FED-STD-H28/7A);

(ii) National Gas Taper thread (NGT) type must conform to the requirements of Federal Standard H-28 Sections 7 (FED-STD-H28/7A), and 9 (FED-STD-H28/9A);

(iii) Other taper threads conforming to other standards may be used provided the total thread shear strength is not less than that specified for NPT threads.

(3) Straight threads must conform to one of the following—

(i) National Gas Straight Thread (NGS) type must conform to the requirements of Federal Standard H-28, Sections 7 (FED-STD-H28/7A), and Section 9 (FED-STD-H28/9A);

(ii) Unified Thread (UN) type must conform to the requirements of Federal Standard H-28, Section 2 (FED-STD-H28/2B);

(iii) Controlled Radius Root Thread (UNJ) type must conform to the requirements of Federal Standard H-28, Section 4 (FED-STD-H28/4);

(iv) Other straight thread types conforming to other standards may be used provided the requirements of paragraph (f)(4) of this section are met.

(4) All straight threads must have at least 4 engaged threads, a tight fit, and calculated shear strength of at least 10 times the shear stress at the test pressure of the cylinder. Shear strength must be calculated by using the appropriate thread shear area in accordance with Federal Standard H-28 Section 2, Appendix B (FED-STD-H28/2B Appendix B). Gaskets are required to prevent leakage.

(g) *Pressure relief devices and protection for valves, pressure relief devices, fittings and connections.* (1) Pressure relief devices on cylinders must conform to the requirements of § 173.301(f) of this subchapter.

(2) Protection for valves, pressure relief devices, fittings and connections must conform to the requirements of § 173.301(h)(2) of this subchapter.

(h) *Design qualification tests.* Each cylinder design and each cylinder design having a "significant change" from the original design must be subjected to the design qualification tests prescribed in this paragraph (h).

(1) *Cycle test.* The cycle test must be performed on a cylinder after it has passed the volumetric expansion test, by subjecting it to successive hydraulic pressurization and depressurization cycles. The rate of cycling may not exceed 10 cycles per minute.

(i) The lower cyclic pressure may not exceed 10 percent of the upper cyclic pressure. The upper cyclic pressure must be at least equal to the prescribed minimum test pressure.

(ii) The test cylinder must be subjected to a pressure exceeding 90 percent of the upper cyclic pressure for at least 20 percent of the duration of each cycle.

(iii) The cycle test must be performed on at least three representative samples of each design or any significant change to an original design.

(iv) All cylinders used in the cycle test must be rendered incapable of holding pressure following completion of the cycle test.

(2) *Burst test.* The burst test must be performed on a representative completed cylinder selected at random after heat treatment by hydraulically pressurizing the cylinder to failure. The rate of pressurization may not exceed 14 bar (200 psi) per second. Burst testing of each design or any significant change to a previously tested design must be performed on at least 3 representative cylinders.

(3) *Puncture resistance test.* Each cylinder design type intended for the transportation of Division 2.3 gases or Division 6.1 liquids in Hazard Zones A and B must pass the following test. Cylinders that are shipped in an overpack must be tested in the overpack.

(i) The puncture resistance test must be performed on three representative cylinders selected at random after heat treatment. The cylinder must be filled with water and pressurized to $\frac{2}{3}$ the marked test pressure at 21° C (70° F). The cylinder must be tested on its sidewall, supported on an unyielding support and tied down so that there is

no movement during impact. The puncturing probe must consist of a 2 inch x 2 inch x $\frac{1}{4}$ inch angle iron, its end sawed off at 90° to form a sharp corner. The probe must have a weight attached that is equivalent to the weight of the cylinder including the heaviest material to be shipped. The probe must be dropped from a minimum height of 2.1m (7 feet) from the top surface of the cylinder, perpendicular to the cylinder's longitudinal centerline, and must impact the cylinder sidewall on the top of the cylinder. The sharp corner of the angle iron must impact the centerline of the cylinder. (See Figure 1 of this section.)

(ii) There must be no leakage as a result of the impact. The cylinder must be leak tested, using compressed gas charged to $\frac{2}{3}$ of the marked test pressure.

(4) *Acceptable test results.* Acceptable design qualification test results are as prescribed in the individual cylinder specification.

(i) *Production tests and verifications.* When the individual specification requires a particular production test to be performed, the test must be conducted on the finished cylinder as prescribed in this paragraph (i). Unless otherwise noted in this section, acceptable test results are prescribed in the individual cylinder specification. Any lot not meeting acceptable test results must be rejected:

(1) *Flattening or bend test.* Flattening or bend tests must be performed, on a representative completed cylinder selected at random or, if authorized by the individual specification on a test ring, after heat treatment. Each test ring used for the test must meet the requirements of paragraph (i)(7) of this section.

(i) During the flattening test, the cylinder or test ring must be flattened between wedge-shaped knife edges with the longitudinal axis of the cylinder at approximately 90 degrees to the knife edges. For steel and nickel cylinders, the knife edges must have a 60 degree included angle and be rounded to a 13 mm ($\frac{1}{2}$ inch) radius. For aluminum cylinders, see § 178.72(i)(4).

(ii) A bend test in accordance with ASTM E 290 may be substituted for the flattening test. Two test pieces cut from a sidewall ring or rings shall be tested. The width shall be the greater of 25 mm (1 inch) or four times the thickness of the test specimen. A load shall be applied to the inside surface of the test piece by a mandrel at the mid-length until the interior edges are no further apart than the mandrel diameter. For steel cylinders the mandrel shall not be

greater than four times the actual wall thickness.

(iii) For a cylinder with a water capacity of 454 kg (1,000 pounds) or less, the flattening or bend test must be performed on a cylinder selected from each lot.

(iv) For a cylinder with a water capacity exceeding 454 kg (1,000 pounds), the flattening or bend test must be performed on a cylinder or on a test ring out of each lot when cylinders are heat treated in a batch furnace, or from one cylinder or test ring out of each four hours or less of production when the cylinders are heat treated in a continuous furnace.

(v) A retest using one additional set of specimens is authorized if a test was considered improper due to the presence of a fault in the equipment or specimen preparation. Retest specimens must be taken from this same cylinder if space permits or from another randomly selected cylinder in the same lot.

(2) *Grain size.* For cylinders made from nickel, preparation and examination of the specimen and grain size calculation must be as prescribed in ASTM E 112.

(3) *Hardness test.* Apparatus and procedures must be in conformance with ASTM E 18 for Rockwell C scale (HRC) hardness number or ASTM E 10 for Brinell hardness number (HBS).

(4) *Impact test.* The impact test must be performed on specimens taken from the cylinder or, if authorized by the individual specification, from a test ring, after heat treatment. Each test ring used for the test must meet the requirements of paragraph (i)(7) of this section. Impact specimens must be prepared and tested in accordance with ASTM E 23 and the specific requirements in the individual specification. A cylinder or a test ring need represent only one of the heats in the lot, provided the other heats in the lot were heat treated under the same conditions and have previously been tested and have passed the tests.

(i) For a cylinder with a water capacity of 454 kg (1,000 pounds) or less, the specimens must be taken from one cylinder or test ring out of each lot.

(ii) For a cylinder with a water capacity exceeding 454 kg (1,000 pounds), the specimens must be taken from one cylinder or test ring out of each batch when cylinders are heat treated in a batch furnace, or from one cylinder or test ring out of each 4 hours or less of production when cylinders are heat treated in a continuous furnace.

(5) *Leakage test.* Spun cylinders must be tested for leakage by subjecting the inside of the finished bottom to a

pressure of not less than $\frac{1}{2}$ of the cylinder's marked test pressure. The bottom must be clean and free from all moisture. Pressure must be applied, using dry gas, over an area of at least six percent of the total area of the bottom but not less than 19 mm ($\frac{3}{4}$ inch) in diameter including the closure. The required pressure must be applied for at least one minute, during which time the outside of the bottom under test must be covered with water or other suitable leak detecting fluid and closely examined for indication of leakage. The leakage test must be performed prior to the closing of the cylinder. The cylinder may not show any evidence of leakage.

(6) *Magnetic particle and liquid penetrant examinations.* The apparatus and procedures for the magnetic particle examination, wet or dry method, must conform to ASTM E 709. The apparatus and procedures for the liquid penetrant inspection must conform to ASTM E 165.

(7) *Mechanical tests.* Unless otherwise specified in the individual cylinder specification, a mechanical test must be performed on a minimum of two specimens taken at least 160 degrees apart from a representative completed cylinder which is selected at random after pressure testing and heat treatment. For cylinders more than 2 meters (6.5 feet) long, the mechanical test may be performed on a test ring which has been heat treated with the completed cylinders. The test ring must be at least 61 cm (24 inches) long and must have its ends covered during heat treatment so as to simulate the heat treatment process of the finished cylinder it represents. Each test ring used for the test must be of the same specification material, diameter and thickness as the finished cylinder it represents. A test cylinder or test ring need represent only one of the heats in the lot provided the other heats in the lot have previously been tested and have passed the tests.

(i) Specimens must conform to the following:

(A) The long axis of the specimen must be parallel to the longitudinal axis of the cylinder.

(B) The tensile specimen reduced section may not be flattened. However, the grip ends may be flattened to within 25 mm (1 inch) of each end of the reduced section.

(C) Temperatures generated during the preparation of a specimen may not exceed 204 °C (400 °F) for steel or nickel, or 121 °C (250 °F) for aluminum.

(ii) The tensile strength, yield strength, and elongation of the material must be determined as follows:

(A) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(B) For steel and nickel, the yield strength must be determined by the "offset" method or the extension under load method described in ASTM E 8. For aluminum material, the yield strength must be determined by the "offset" method or the extension under load method as described in ASTM B 557.

(C) The cross-head speed of the testing machine may not exceed 3 mm ($\frac{1}{8}$ inch) per minute during the determination of yield strength, however, any test speed may be used until one-quarter of the specified tensile strength is reached.

(D) The specimens must be taken from one cylinder selected from each lot.

(E) When the length of the cylinder does not permit securing straight specimens, then specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows. The inspector's report must indicate that the specimens were taken and prepared in this manner.

(F) The size of the specimen must be one of the following—

(1) gauge length of 50 mm (2 inches) and a maximum width of 38 mm (1.5 inches);

(2) gauge length of 200 mm (8 inches) and a maximum width of 38 mm (1.5 inches); or

(3) gauge length of at least 24 times specimen actual thickness and a maximum width of 6 times actual thickness, provided that the cylinder wall is not over 4.7 mm ($\frac{3}{16}$ inch) thick.

(G) For a cylinder with a water capacity exceeding 454 kg (1,000 pounds):

(1) The specimens must be taken from one cylinder or test ring out of each batch when cylinders are heat treated in a batch furnace or from one cylinder or test ring out of each 4 hours or less of production when cylinders are heat treated in a continuous furnace.

(2) The size of the specimen must be as prescribed in the individual specification.

(iii) A retest using one additional set of specimens is authorized if a test was considered improper due to a fault in the equipment or specimen preparation. Retest specimens must be from the same cylinder if space permits, or from another randomly selected cylinder from the same lot.

(8) *Mechanical tests of welds.* (i) Tensile test: Specimens must be prepared in accordance with and meet the requirements of CGA Pamphlet C-3.

Should any specimen from the first test fail to meet the requirements, a second test may be performed taken from three additional cylinders selected at random from the same lot. If either of the additional specimens fails to meet the requirements of CGA Pamphlet C-3, the entire lot must be rejected.

(ii) Guided bend test: Specimens must be prepared in accordance with and meet the requirements of CGA Pamphlet C-3.

(iii) Alternate guided-bend test: This test may be used as an alternative to the guided bend test specified in paragraph (i)(8)(ii) of this section and must be performed in accordance with CGA Pamphlet C-3. The specimen shall 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", shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 340 MPa (50,000 psi), as provided in table 4 of § 178.81.

(9) *Production burst test.* When required by a particular specification, must be performed on at least one cylinder from each lot. A cylinder used in the cycle test may be used for the production burst test. If a cylinder fails the production burst test, a second sample of three cylinders from the same lot must be selected by the independent inspector. If any of these tested cylinders fail, the lot must be rejected.

(10) *Proof pressure test.* The pressure for the proof pressure test must be at least equal to the marked test pressure and must be maintained for at least ten seconds, and sufficiently longer, as necessary, to assure there is no leakage and no drop in pressure. The cylinder may show no evidence of leakage or distortion.

(11) *Radiographic examination.* Radiographic examination of cylinders must conform to the techniques and acceptability criteria set forth in CGA Pamphlet C-3. When fluoroscopic examination is used, permanent film records need not be retained.

(12) *Ultrasonic examination.* The ultrasonic examination must be performed on the cylindrical section of the completed cylinder after it has passed the volumetric expansion test. Testing must be in accordance with Appendix B of this subpart.

(13) *Volumetric expansion test.* After heat treatment, each cylinder must be subjected to an internal pressure at least equal to the marked test pressure. The water jacket method must be performed in accordance with paragraph 4 and Appendices A and B of CGA Pamphlet C-1. An alternative test procedure, such as direct expansion, may be used when

approved in writing by the Associate Administrator. If the required test pressure can not be maintained due to failure of test apparatus, the cylinder must be rejected or the test must be repeated at a pressure increased by 10 percent of the test pressure or 7 bar (100 psi) whichever is lower. Only two retests are authorized. The permanent expansion measured at zero gauge pressure may not exceed 10 percent of the total measured expansion at test pressure.

(j) *Rejected cylinders.* When a lot of cylinders is rejected, and reheat treatment may correct the cause of rejection, the lot may be reheat treated and retested as if it were a new lot.

(1) Volumetric expansion test: Reheat treatment of rejected cylinders that failed due to excessive permanent expansion is authorized.

(2) Magnetic particle, liquid penetrant and ultrasonic examinations: Any cylinder rejected because of cracks may not be requalified.

(k) *Markings.* Required markings on the cylinder must be in accordance with the following:

(1) Each cylinder must be legibly and permanently marked by stamping on the shoulder, top head or neck. The depth of marking must ensure that the wall thickness measured from the root of the stamping to the interior surface is equal

to or greater than the prescribed minimum wall thickness.

(2) For a DOT-4M specification cylinder the required markings must be stamped plainly and permanently on the shoulders, top head, neck, valve boss, valve protection sleeve, collar, or similar part permanently attached to the top of the cylinder. For cylinders that do not exceed 11.3 kg (25 pounds) water capacity, the marking may be on the footing permanently attached to the cylinder.

(3) The required markings specified in this paragraph (k) (3) must be stamped on the cylinder in the sequence shown in items 1 through 12, with no additional information interspersed, as illustrated in the following example:

DOT-3M/USA/M1234/SN123456/UT/
200BAR/IA01/98-09/250/5.8/SS/56.5

Where:

1. DOT 3M = DOT specification number.
2. USA = country of manufacture.
3. M1234 = symbol of manufacturer assigned by the Associate Administrator.
4. SN123456 = manufacturer's serial number.
5. UT = stamp for non-destructive ultrasonic examination, if applicable.
6. 200BAR = test pressure (bar).
7. IA01 = Independent Inspection mark.

8. 98-09 = date of test (year and month).

9. 250 = water capacity (liters).

10. 5.8 = minimum guaranteed wall thickness (millimeters).

11. SS = identification of alloy (SS:stainless steel, NI:Nickel, AL: Aluminum CS: Carbon Steel).

12. 56.5 = tare weight (kilograms).

(4) Required markings must be at least 6 mm (0.250 inch) high, except that cylinders having an inside diameter less than 102 mm (4 inches) may have markings that are at least 3 mm (0.116 inch) high.

(5) Stamping on the side wall is prohibited.

(6) No other markings may conflict with the required markings.

(7) Other variations in stamping required marks is authorized only when necessitated by lack of space or as approved in writing by the Associate Administrator.

(l) *Coatings.* Coatings on a cylinder's exterior or interior walls are authorized, except that the coating must not cause markings to be illegible, obscure defects, or allow moisture to be trapped between the cylinder wall and the coating. Any coating that may prevent adequate visual inspection or ultrasonic examination is prohibited.

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Figure 1 to § 178.69

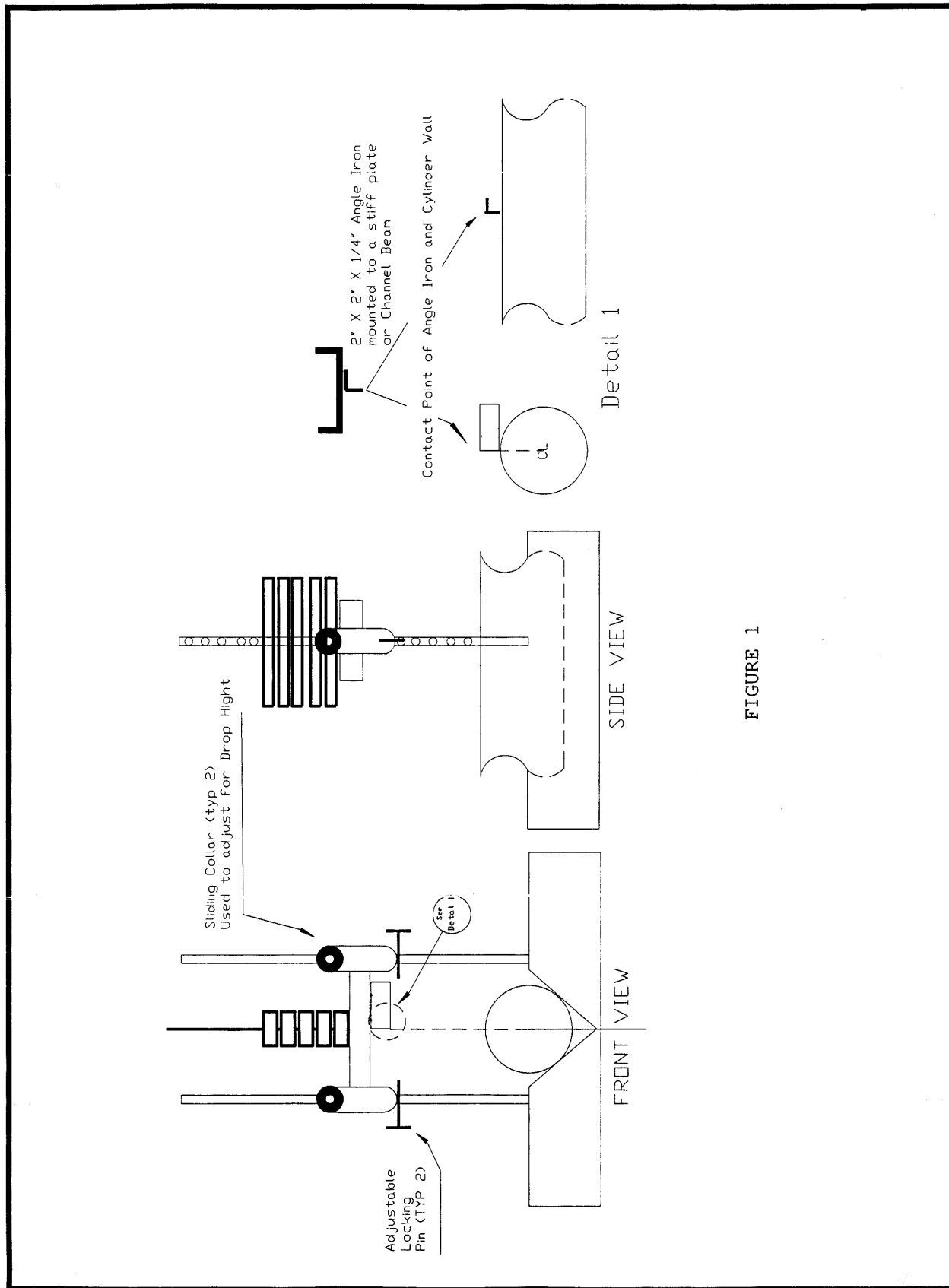


FIGURE 1

55. Section 178.70 would be added to Subpart C to read as follows:

§ 178.70 General requirements for DOT 3 series metric-marked seamless cylinders.

(a) DOT specifications 3M (§ 178.71), 3ALM (§ 178.72), and 3FM (§ 178.73) cylinders must meet the requirements contained in this section, § 178.69, and the requirements of the applicable individual specification contained in §§ 178.71 through 178.73.

(b) *Lot size.* In no case may a lot exceed 200 cylinders, but any cylinder processed for use in the required destructive testing need not be counted as being one of the 200.

(c) *Authorized material and identification of material.* All tubing, billet, sheet, plate or cast stock must be in conformance with one of the specifications in Table 1 or 2 of Appendix A of this subpart. The inspector may require a check analysis to establish the heat or cast analysis when necessary to meet the requirements of § 178.69(c)(2). The material may not be used if the results of such analysis indicates nonconformance with the requirements of the material specification.

(d) *Manufacture.* (1) Each cylinder must be of seamless construction with integrally formed heads and bottoms.

(2) The manufacturing process must be capable of producing a cylinder that is free from defects likely to weaken the finished cylinder. For a cylinder with a water capacity of more than 454 kg (1000 pounds), permanent closures formed by spinning are prohibited and integral heads must be concave to pressure.

(3) Dirt and scale must be removed to permit proper inspection. Each cylinder must have a smooth and uniform finish. Fissures, laps, tears, or other defects that are likely to weaken the finished cylinder are not acceptable. The thickness of the treated areas must be measured and may not be less than the prescribed minimum sidewall thickness. Machining or other treatment of the cylinder to eliminate defects must be completed before heat treatment and volumetric expansion testing.

(4) Head and bottom configurations must be as follows:

(i) Bottoms of bumped-back cylinders must have a minimum thickness of not less than two times the prescribed minimum sidewall thickness. Such bottom thickness 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.

(ii) For heads and bottoms concave to pressure, the inside shape must be

hemispherical, ellipsoidal, or torispherical with a major to minor axis not exceeding 2 to 1, or a dished shape falling within these limits. Such heads and bottoms must be at least the prescribed minimum wall thickness of the cylindrical shell, except as follows:

(A) The thickness at the point of closure of spun cylinders must be at least 2 times the prescribed minimum sidewall thickness.

(B) The thickness of the hemispherical bottoms on cylinders formed from sheet or plate must be at least 90 percent of the prescribed minimum sidewall thickness.

(5) Welding or brazing for any purpose is prohibited on cylinders manufactured in accordance with this section.

(6) Plugged cylinders are not authorized.

(e) *Wall thickness.* The following requirements apply:

(1) The minimum wall thickness for a cylinder must be the greater of the thickness as determined by this paragraph (e), or as required by the individual specification.

(2) For the minimum wall thickness calculations, the following formula must be used:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

Where:

S = Wall stress in Mpa (psi).

P = Minimum test pressure in bar (psi), as prescribed for the volumetric expansion test, but not less than 31 bar (450 psi).

D = Outside diameter in mm (inches).

d = Inside diameter in mm (inches).

(3) A steel cylinder longer than 2 meters (6.5 feet) must meet the following additional requirements if the cylinder is horizontally supported at its two ends. The load of the cylinder consists of the weight per unit length, in newtons per millimeter, of the cylindrical portion filled with water and pressurized to the prescribed minimum test pressure. The wall thickness must be increased when necessary to meet the following requirements:

(i) The sum of 2 times the maximum tensile stress at the mid-point of the unsupported length, due to bending (see paragraph (e)(3)(ii) of this section), plus the maximum longitudinal stress in the same area, due to the hydrostatic pressure (see paragraph (e)(3)(iii) of this section), may not exceed 80 percent of the minimum yield strength of the steel as determined by the mechanical tests prescribed in § 178.69(i)(7) and the applicable individual specification.

(ii) The following formula must be used to calculate the maximum tensile stress due to bending—

$$S = MC/I$$

Where:

S = tensile stress in MPa.

M = bending moment in newton-mm = .125WL².

C = radius (D/2) of cylinder in mm.

I = Moment of inertia = .04909 (D⁴ - d⁴) in mm⁴.

W = weight in newtons per mm of cylinder length full of water.

l = length of cylinder in mm.

D = outside diameter in mm.

d = inside diameter in mm.

(iii) The following formula must be used to calculate the maximum longitudinal tensile stress due to volumetric expansion test pressure—

$$S(\text{MPa}) = [A_1 P / 10 A_2]$$

Where:

S = tensile strength in MPa.

A₁ = internal area in cross section of the cylinder in mm².

A₂ = area of metal in cross section of the cylinder in mm².

P = volumetric expansion test pressure in bar.

(f) *Openings.* Openings are not permitted on the side wall and must be centered on the heads. Openings may not exceed the smaller of one-half of the cylinder's outside diameter or 200 mm (8 inches). All openings must be circular and threaded.

(g) *Heat treatment.* After forming, cylinders must be uniformly and properly heat treated under similar conditions of time, temperature, cooling rate and atmosphere prior to all tests. The furnace temperature must be controlled to assure a uniform process and have sufficient instrumentation to control performance.

56. Section 178.71 would be added to Subpart C to read as follows:

§ 178.71 Specification 3M; seamless steel, nickel and stainless steel metric-marked cylinders.

(a) *General requirements and test pressure.* Each DOT specification 3M cylinder must meet the general requirements contained in §§ 178.69 and 178.70 and the specific requirements contained in this section. The design test pressure must be no less than 15 bar (218 psi).

(b) *Duties of the inspector.* In addition to the duties prescribed in § 178.69(e), an inspector must verify that the grain size in a 3M cylinder manufactured from nickel is in accordance with paragraph (h)(6) of this section.

(c) *Authorized materials and identification of materials.* Materials must be in accordance with the following:

(1) All tubing, billet, sheet, plate or cast stock must be in conformance with

Grade A, C, or D material specified in Table 1 of Appendix A of this subpart.

(i) Grade A material is authorized for steel cylinders.

(ii) Grade C material is authorized for stainless steel cylinders.

(iii) Grade D material is authorized for nickel cylinders.

(d) *Manufacture.* Spun closures for nickel cylinders are prohibited.

(e) *Wall thickness.* (1) For cylinders with a test pressure less than 93 bar (1350 psi), the minimum wall must be such that the wall stress at the prescribed minimum test pressure does not exceed 165 MPa (24,000 psi) for cylinders made from Grade A or C material and in no case may the wall thickness be less than 2mm (.078 inch).

(2) For cylinders with a test pressure of 93 bar (1350 psi) or more, the minimum wall must be such that the wall stress at the prescribed minimum test pressure does not exceed the following:

(i) 380 MPa (55,000 psi) for cylinders made from Grade A material;

(ii) 235 MPa (34,000 psi) for cylinders made from Grade C material.

(3) For cylinders made from Grade D material, the minimum wall must be such that the wall stress at the prescribed minimum test pressure does not exceed 100 MPa (15,000 psi), or 50 percent of the minimum tensile strength as determined by the mechanical properties tests prescribed in § 178.69(i)(7).

(f) *Heat treatment.* A cylinder made from:

(1) Grade A material must be heat treated by normalizing at a metal temperature most suitable for the material, and air cooled. Liquid quenching is not authorized. Intermediate manganese steel may be given a quench and temper heat treatment.

(2) Grade C material does not require heat treatment.

(3) Grade D material does not require heat treatment. If the cylinder is heat treated, the furnace atmosphere during heat treatment must be sulfur-free and neutral or reducing.

(g) *Design qualification tests.* The following design qualification tests described in § 178.69 apply:

(1) *Cycle test.* Cylinders representative of the design must withstand, without distortion or failure, at least 10,000 pressurizations.

(2) *Burst test.* Representative cylinders of each design must meet the following—

(i) For nickel cylinders the test cylinders must withstand at least 2 times test pressure.

(ii) For steel cylinders the test cylinders must withstand at least 1.6 times test pressure.

(h) *Production tests and verification.*

The following examinations and tests apply. Unless otherwise noted in this section, acceptable results are prescribed in § 178.69.

(1) Volumetric expansion test.

(2) Leakage test for spun cylinder.

(3) Ultrasonic examination in accordance with ASTM E 213 for measurement of sidewall defects: Any cylinder having a discontinuity greater than two times in length and 10 percent in depth of the designed minimum wall thickness or any discontinuity greater than 15% of the minimum designed wall thickness in depth must be rejected.

(4) Mechanical test: The yield strength may not exceed 73 percent of the tensile strength for steel cylinders, or 50 percent of the tensile strength for nickel cylinders. Elongation must be at least 20 percent for a 50mm (2-inch) gauge length specimen or at least 10 percent in other cases. In this instance, a flattening test or bend test is required. If elongation is at least 40 percent for the 50mm (2-inch) gauge length specimen, or at least 20 percent in other cases, a flattening test or bend test is not required.

(5) Flattening or bend test: Steel cylinders must withstand flattening to six times wall thickness without cracking; nickel cylinders must withstand flattening to four times wall thickness without cracking. Bend test specimens must be free of cracking when deformed around a mandrel not greater in diameter than 4 times the wall thickness for steel or 2 times the wall thickness for nickel.

(6) Grain size verification: For nickel cylinders, a specimen must be taken from the sidewall of a representative cylinder from each lot. The diameter of the average grain cross section may not exceed 0.065 mm (0.0026 inch). The corresponding ASTM micro-grain size number is 5.0. When the grain size in the test cylinder exceeds this limit, the lot must be rejected.

(7) Magnetic particle or liquid penetrant examination: Magnetic particle or liquid penetrant inspection must be performed on each cylinder constructed of intermediate manganese steel after heat treatment to determine the presence of quenching cracks. Cracked cylinders must be rejected.

(i) *Rejected cylinders.* Nickel cylinders, rejected for unacceptable grain size, may be reheat treated. Thereafter, the reheat treated cylinders must pass all prescribed tests including verification of acceptable grain size.

57. Section 178.72 would be added to Subpart C to read as follows:

§ 178.72 Specification 3ALM; seamless aluminum metric-marked cylinders.

(a) *General requirements.* Each DOT Specification 3ALM seamless aluminum cylinder must meet the general requirements contained in §§ 178.69, 178.70 and the specific requirements contained in this section.

(b) *Capacity.* The water capacity may not exceed 454 kg (1,000 pounds).

(c) *Duties of the inspector.* In addition to the duties prescribed in § 178.69(e), the inspector must verify compliance with the provisions in paragraph (d) of this section, either by inspection or by obtaining the material manufacturer's certificate of inspection.

(d) *Authorized material and identification of materials.* Only the aluminum alloy specified in Table 2 of Appendix A to this subpart is authorized. Material must be identified with the heat or cast code by a suitable method that will identify the alloy. Cast stock must have uniform isotropic grain structure not to exceed 500 microns maximum.

(e) *Manufacture.* Only the extrusion process is authorized. Closures formed by spinning are prohibited. The cylinder bottom must be concave to pressure. The thickness of the cylinder base may not be less than the side wall thickness. The bottom of the cylinder must have an inside shape that is torispherical, hemispherical or ellipsoidal, 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—

(1) Any area of deviation is accompanied by an increase in base thickness;

(2) All radii of merging surfaces are equal to or greater than the knuckle radius; and

(3) Each design has been qualified by successfully passing the cycling and burst tests specified in paragraph (h) of this section.

(f) *Wall thickness.* The minimum wall thickness must be such that the wall stress at the prescribed minimum test pressure does not exceed 80 percent of the minimum yield strength nor 67 percent of the minimum tensile strength of the cylinder material as determined by the mechanical properties tests prescribed in § 178.69(i)(7), but in no case may the minimum wall thickness be less than 4mm (0.156 inch).

(g) *Heat treatment.* Prior to any test, each cylinder must be subjected to a solution heat treatment and aging treatment appropriate for the type of aluminum used.

(h) *Design qualification tests.* The following design qualification tests described in § 178.69 apply:

(1) *Cycle test.* Cylinders representative of the design must withstand, without distortion or failure, at least 10,000 pressurizations to the prescribed minimum test pressure.

(2) *Burst test.* Cylinders representative of the design, must have a minimum burst of 1.6 times test pressure.

(i) *Production tests and verifications.* The following examinations and tests apply. Unless otherwise noted in this section, acceptable results are prescribed in § 178.69.

(1) Volumetric expansion test.

(2) *Ultrasonic examination.* The examination must be performed in accordance with ASTM E 213 for measurement of sidewall defects. Any cylinder having a discontinuity greater than two times in length and 5 percent in depth of the design minimum wall thickness must be rejected.

(3) *Mechanical tests.* Mechanical tests must be performed as follows: The two tensile specimens must be one of the following: Flat specimen, 50 mm (2-inch) gauge length; Flat specimen, 24t gauge length by 6t width; or Round specimen, 4D gauge length with diameter "D". When the cylinder sidewall is greater than 5 mm ($\frac{3}{16}$ -inch), a retest without reheat treatment using this "4D" specimen is authorized if the test using the 2-inch specimen fails to meet elongation requirements. The 4D specimen must meet requirements of ASTM E 8. Tensile strength must be at least 260 Mpa (38000 psi). Yield strength must be at least 240 Mpa (35,000 psi). Elongation must be at least 14 percent for 50 mm (2-inch) gauge length specimen, at least 10 percent for 24t by 6t specimen, and at least 14 percent for the "4D" specimen.

(4) *Flattening and bend test.* A flattening or bend test must be performed as follows:

(i) The flattening test must be performed by placing the test cylinder between wedge-shaped knife edges having a 60 degree included angle, and rounded in accordance with the following table. The longitudinal axis of the cylinders must be at an angle of 90 degrees to the knife edges during the test. The test cylinder must withstand flattening to 9 times wall thickness without cracking. The table follows:

TABLE.—FLATTENING TEST

Cylinder wall thicknesses (inches)	Rounded radius (inches)
Under 0.150	0.500
0.150 to 0.249	0.875
0.250 to 0.349	1.500
0.350 to 0.449	2.125
0.450 to 0.549	2.750
0.550 to 0.649	3.500
0.650 to 0.749	4.125

(ii) An alternate bend test, in accordance with ASTM E 290 using a mandrel diameter not more than 6 times the wall thickness, is authorized. This test may be used to qualify a lot that has failed the flattening test. Reheat treatment is not required for this test. If used, this test must be performed on 2 samples from one cylinder taken at random out of each production lot. The test specimens shall 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.

58. Section 178.73 would be added to Subpart C to read as follows:

§ 178.73 Specification for DOT 3FM; seamless steel metric-marked cylinders.

The construction of a cylinder to this specification also meets the requirement of draft ISO 9809-2, Transportation of Seamless Steel Gas Cylinders—Design Construction and Testing—Part 2: Quenched and Tempered Steel with Tensile Strength Greater Than or Equal to 1100 MPa.

(a) *General requirements and definitions.* Each Specification DOT 3FM seamless steel cylinder must meet the general requirements contained in §§ 178.69, 178.70 and the specific requirements contained in this section.

(b) *Authorized material and identification of materials.* All tubing, billet or cast stock must conform to Grade B or Grade E material specified in Table 1 of Appendix A of this subpart.

(c) *Manufacture.* Closures formed by spinning are prohibited.

(d) *Wall thickness.* The minimum wall thickness must be such that the wall stress at the prescribed minimum test pressure does not exceed the lesser of 483 Mpa (70,000 psi) for Grade B material or 624 MPa (90,500 psi) for Grade E material, or 67 percent of the minimum tensile strength as determined from the mechanical properties tests prescribed in paragraph 178.69(i)(7), but in no case may the minimum wall thickness be less than 1.5 mm (.058 inch).

(e) *Heat treatment.* Each cylinder must be suitably quench and temper

heat treated and held at that temperature for a suitable period of time. Each cylinder must then be air cooled under conditions recommended for the steel. The minimum tempering temperature of the metal must be at least 570 °C (1058 °F).

(f) *Design qualification tests.* The following design qualification tests described in § 178.69 apply:

(1) *Cycle test.* Cylinders representative of the design must withstand, without distortion or failure, at least 10,000 pressurizations to the prescribed minimum test pressure.

(2) *Burst test.* Cylinders representative of the design, must have a minimum burst of 1.6 times the marked test pressure.

(g) *Production tests and verifications:* The following examinations and tests apply. Unless otherwise noted in this section, acceptable results are prescribed in § 178.69.

(1) Volumetric expansion test.

(2) *Ultrasonic examination.* The examination must be performed in accordance with ASTM E 213 for the measurement of sidewall defects. Any cylinder having a discontinuity greater than 24 mm (1 inch) in length and a depth greater than 5 percent of the design minimum wall thickness must be rejected.

(3) *Hardness test.* A hardness test must be performed on the cylindrical section of each cylinder after heat treatment. The tensile strength equivalent of the hardness number obtained from the test may not be more than 1,140 MPa (166,000 psi). The hardness number may not exceed 37 HRC or 344 HBS. If the hardness number is exceeded, then the lot must be rejected.

(4) *Mechanical tests.* (i) Specimen size must be gauge length 50 mm (2 inches) and a maximum width of 38 mm (1.5 inches). For cylinders over 454 kg (1,000 pounds) water capacity, specimens may be the Standard Round Tension Specimen as specified in ASTM A-370 (0.357 inches minimum diameter).

(ii) Elongation must be at least 16 percent for the 50 mm (2 inches) gauge length specimen. Tensile strength may not exceed 1,069 MPa (155,000 psi). For round specimens, the minimum elongation must be at least 15 percent.

(5) *Impact tests.* (i) Three specimens must be impact tested per lot. Each specimen must be taken from the sidewall of the cylinder or test ring. The axis of the specimen must be perpendicular to the longitudinal axis of the cylinder, with the axis of the notch in the "T-L" orientation as illustrated in figure 3 of ASTM E 399. Each specimen must be Charpy V-Notch type, size 10

mm (.40 inch) × 5 mm (.20 inch) or 4 mm (.16 inch).
 (ii) For cylinders over 454 kg (1,000 pounds) water capacity, the axis of the specimen must be parallel to the longitudinal axis of the cylinder, with the axis of the notch in the "L-C" orientation as illustrated in figure 3 in ASTM E 399. Each specimen must be Charpy V-Notch type, size 10 mm (.40

inch) × 10 mm (.40 inch) if cylinder thickness permits. When only a reduced size specimen can be obtained, it must be the largest standard size obtainable but not smaller than 10 mm (.40 inch) × 5 mm (.20 inch).
 (iii) For cylinders constructed of Grade E material, the Charpy V-Notch impact properties for the three specimens must be tested at minus 50°C

(minus 60°F), or colder; and the values obtained may be not less than the values shown in the following table. For cylinders constructed of Grade B material, the Charpy V-Notch impact properties for the three specimens must be tested at minus 50°C (minus 60°F), or colder; and the values obtained must not be less than the values shown in the following table:

	Size of specimen (mm)	Average value for acceptance for 3 specimens		Minimum value for acceptance for one specimen only of the 3 specimens	
		(ft-lb)	(j/cm ²)	(ft-lb)	(j/cm ²)
		Grade B			
	10.0 × 10.0	25	42	20	34
	10.0 × 7.5	21	48	17	39
	10.0 × 5.0	17	58	14	47
Grade E					
	10.0 × 5.0	15	50	12	40
	10.0 × 4.0	12	40	9.5	32

59. Section 178.81 would be added to Subpart C to read as follows:
§ 178.81 Specification for DOT 4M; Welded metric-marked cylinders.
 (a) *General.* DOT specification 4M cylinders must meet the requirements contained in this section and § 178.69.

(1) The design test pressure for DOT specification 4M cylinders must be less than or equal to 140 bar (2030 psi).
 (2) [Reserved]
 (b) *Lot size.* For cylinders manufactured under the provisions of this section, in no case may a lot size exceed 500.

(c) *Authorized materials and identification of materials.* For an aluminum cylinder only Aluminum Association alloy 5154 is authorized. For a steel cylinder, stock must conform to a material listed in Table 1 as follows:

Table 1
SPECIFICATIONS FOR STEEL AND STAINLESS STEEL USED FOR WELDED LOW PRESSURE CYLINDERS HEAT ANALYSIS

Chemical Composition in Weight Percent

Material Type	Carbon		Manganese		Phosphorus	Sulfur	Silicon		Chromium		Molybdenum		Copper		Nickel		Columbium		Titanium	Iron
	Min	Max	Min	Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	
HSLA Steel (Cb)	---	0.25	0.50	1.00	0.040	0.050	---	0.30	---	---	---	---	---	---	---	---	0.01	0.04	---	Balance
Carbon Steel ¹	---	0.25	---	1.25	0.045	0.050	---	---	---	---	---	---	---	---	---	---	---	---	---	Balance
4130X	0.25	0.35	0.40	0.60	0.035	0.025	0.15	0.35	0.80	1.10	0.15	0.25	---	---	---	---	---	---	---	Balance
Stainless ² Steel	---	0.080	---	2.00	0.045	0.030	---	1.00	16.0	20.0	2.00 ³	3.00	---	---	8.0	15.0	---	---	---	Balance

Note 1: Other alloying elements may be added and shall be reported.
 Note 2: DOT 4M stainless steel cylinder must be made from fully annealed sheet metal with a maximum tensile strength of 660 Mpa (95,000 psi).
 Note 3: The minimum for molybdenum (2.00) shown, applies only to Stainless Steel type 316.

(d) *Manufacture.* (1) A DOT-4M specification cylinder must be manufactured only by a process specifically authorized by and conform to the applicable requirements of this section.

(2) The manufacturing process must produce cylinders that are free of defects which are likely to weaken the finished cylinder. Heads must be seamless, hemispherical or ellipsoidal in shape with the major diameter not more than two times the minor diameter, or a dished shape falling within these limits. For heads concave to pressure, the minimum head thickness may not be less than 90 percent of the required thickness of the sidewall. For heads convex to pressure, the minimum thickness must be not less than two times the required thickness of the sidewall. The 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. For cylinders with a wall thickness less than 2.5 mm (0.100 inch), the ratio of tangential length to outside diameter may not exceed 4.0.

(3) Welding processes and machine operators shall meet qualification standards and comply with operating procedures specified in CGA Pamphlet C-3.

(i) Circumferential seams must be butt welded with one member offset (joggle butt) or lapped with minimum overlap of at least four times wall thickness. Other butt joints must be authorized in writing by the Associate Administrator. Fillet weld beads must be flat or convex and the leg of any fillet weld subjected to shear stress must be at least 1.3 times the shell wall thickness. For spheres, the maximum joint efficiency for design calculations is 0.85. Heat affected zones are considered to extend a distance of six times the wall thickness from the center line of the weld.

(ii) Longitudinal seams must have complete penetration, and must be free from undercuts, overlaps or abrupt ridges or valleys. Misalignment of mating butt edges must not exceed 0.166 of the wall thickness or 0.8 mm (0.031-inch), whichever is less. For cylinders with nominal wall thickness up to and including 3.2 mm (0.125 inch), joints must be tightly butted. When wall thickness is greater than 3.2 mm (0.125 inch), the joint must be gapped with maximum distance equal to one-half the wall thickness or 0.8 mm (0.031 inch) whichever is less.

(iii) The joint efficiency is 1.0, .90 or .75, as appropriate, for welded joint described in paragraph (i)(6) of this section.

(iv) The tensile strength of welded joints must be equal to or greater than the minimum required tensile strength of the shell material of the finished cylinder.

(v) Attachments may not be welded to the sidewall of the cylinder. Welding of attachments must be completed prior to all pressure tests and prior to heat treatment when required. Attachments must be made of weldable material of an alloy which is compatible with the cylinder. The carbon content for steel attachments may not exceed 0.25 percent.

(e) *Wall thickness.* The minimum wall thickness of a DOT 4M cylinder must be the greater of the thickness as determined by the following criteria:

(1) The minimum wall thickness for a carbon steel, HSLA steel or stainless steel cylinder with an outside diameter greater than 127 mm (5 inches) must be 2.0 mm (0.078 inch) and for an aluminum cylinder with an outside diameter greater than 127 mm (5 inches) must be 4 mm (0.156 inch).

(2) The minimum wall thickness for a carbon steel, HSLA steel or stainless steel cylinder with an outside diameter less than or equal to 127 mm (5 inches) must be 1.5 mm (.058 inch) and for an aluminum cylinder 2.5 mm (0.097 inch).

(3) Each cylinder must have a wall thickness such that the wall stress calculated at test pressure using the formula listed in paragraph (e)(4)(i) and (ii) of this section may not exceed the following allowable stresses at test pressure:

(i) For DOT 4M cylinders made from HSLA steel, 260 Mpa (37,000 psi).

(ii) For DOT 4M cylinders made from carbon steel, 165 Mpa (24,000 psi).

(iii) For DOT 4M cylinders made from aluminum alloy 5154, 138 Mpa (20,000 psi).

(iv) For DOT 4M cylinders made from 4130X steel, 255 Mpa (70,000 psi).

(v) For DOT 4M cylinders made from stainless steel cylinders, 410 Mpa (60,000 psi).

(4) For minimum wall thickness calculations, one of the following formula must be used:

(i) For cylinders that are cylindrical in shape:

$$S(\text{MPa}) = (P(1.3D^2 + .4d^2))/E(10(D^2 - d^2))$$

Where:

S = Wall stress in MPa.

P = Minimum test pressure in bar, as prescribed for the hydrostatic test.

D = Outside diameter in mm.

d = Inside diameter in mm.

E = Joint efficiency of the longitudinal seam.

(ii) For cylinders that are spherical in shape:

$$S(\text{MPa}) = PD / 40tE$$

Where:

S = wall stress in MPa.

P = Minimum prescribed test pressure in bar.

D = Outside diameter in mm.

t = Minimum wall thickness in mm.

E = weld efficiency factor.

(f) *Openings.* Openings must conform to the following:

(1) Openings are permitted in heads only. The opening must be circular or elliptical.

(2) Openings must be provided with adequate fittings, bosses or pads, integral with or securely attached to the cylinder by welding. Each fitting, boss or pad must be compatible with the cylinder material. Method of attachment must be the same as the method of construction.

(3) When more than one opening exists in the head or bottom of the cylinder, these openings must be separated by ligaments of at least three times the average of their hole diameters.

(g) *Heat treatment.* When a completed cylinder is required to be heat treated, each cylinder in a lot must be uniformly and properly heat treated under similar conditions of time, temperature, cooling rate and atmosphere prior to all tests.

The furnace temperature for heat treatment must be controlled on a continuous basis by use of automated instrumentation to control performance.

(1) Heat treatment must follow all forming and welding operations.

(2) Each completed cylinder must be heat treated, as follows:

(i) Quench and temper heat treatment is authorized only for a DOT 4M cylinder made from 4130X steel.

(A) Tempering must be accomplished by reheating the quenched cylinder to a temperature below the transformation range, and holding at that temperature for at least one hour per 25 mm (1 inch) of thickness, based on the shell thickness of the cylinder. Each cylinder must then be air cooled under uniform conditions.

(B) The tempering temperature of the 4130X steel must be at least 538 °C (1000 °F).

(ii) Stress relieving heat treatment for HSLA steel and carbon steel cylinders must be at a temperature of at least 593 °C (1100 °F).

(iii) Normalizing heat treatment for HSLA steel and carbon steel cylinders must be at a temperature of at least 870 °C (1600 °F).

(iv) Heat treatment is not required for a stainless steel.

(v) For an aluminum alloy 5154 cylinder, heat treatment is not required.

(h) *Design qualification tests.* The following design qualification test described in § 178.69 apply. Burst test: five representative cylinders of each design, or any significant change to a previously tested design, must be burst tested. Each test cylinder must achieve the minimum burst pressure as specified in Table 2 of paragraph (i) of this section without leakage or rupture.

(i) *Production tests.* The following examinations and tests apply. Unless otherwise noted in this section, procedures and acceptable results are prescribed in § 178.69.

(1) *Pressure test.* Pressure testing must conform to the frequency, schedules and pressures as specified in Table 2 of this paragraph (i).

(2) *Leak test.* Each fully assembled cylinder must be subjected to a gas leakage test, using a dry inert gas, at one half the design test pressure while the cylinder is immersed in water, by coating it with a leak detecting solution, or by an alternate test method approved by the Associate Administrator. Table 2 follows:

TABLE 2

DOT spec.	Lot size	Volumetric ¹ expansion test		Proof test pressure ³	Minimum burst pressure ⁴
		Test pressure(TP)	Maximum permitted PVE/ TVE ²		
4M ⁵	500	As marked	10%	@ TP	2 x TP

¹ At least one cylinder per lot must be subjected to volumetric expansion test. If each cylinder is subjected to the volumetric expansion test the proof test is not required.

² PVE = permanent volumetric expansion; TVE = total volumetric expansion.

³ Each cylinder must be proof tested at the TP.

⁴ One cylinder per lot must be pressurized to destruction; minimum burst is expressed in multiples of TP.

⁵ See §§ 173.302b and 173.304b of this subchapter for fill (service) pressure of DOT 4M cylinders.

(3) *Mechanical tests.* Mechanical tests must be taken from a minimum of two sample cylinders per lot selected at random after pressure test and heat treatment, if required. Test specimens must be taken as depicted in figures 1 through 5 of Appendix C of this subpart for the specific design utilized for construction.

(i) For cylinders and spherical shapes which are not of sufficient size to secure test specimens, an alternate testing protocol must be approved in writing by the Associate Administrator.

(ii) A test cylinder need represent only one of the heats of material of construction in the lot, provided that other heats in the lot have been tested and passed when heat treated under similar conditions.

(iii) If, due to welded attachments on the heads, there is insufficient surface from which to take specimens, specimens may be taken from a cylinder prepared as a test cylinder which does not have the attachments but is the same as the other cylinders in the lot and is heat treated with the lot it represents.

(iv) Minimum elongations are specified in Table 3 or Table 4 of this paragraph (i), as appropriate.

(v) *Acceptable results.* The yield strength may not exceed 73 percent of tensile strength for carbon steel and 80 percent of tensile strength for aluminum alloy 5154.

(4) *Flattening test.* A flattening test must be performed on a test cylinder selected from each lot. Cylinders must be flattened, without cracking, between knife edges as specified in § 178.69(i)(1) to six times the wall thickness for steel cylinders and ten times the wall

thickness for aluminum cylinders. The minimum distance is to be measured between the knife edges or plates while the specimens are under compression. For spherical shapes, flattening is to be performed on a press, between parallel steel plates with the welded seam at right angles to the plates. Alternatively, a test ring cut from the sphere which includes the weldment and at least one inch of material on each side may be crushed between parallel steel plates with welded seam at right angles to the plates. Any projecting appurtenances may be removed prior to flattening. Removal must not produce a temperature exceeding 204 °C (400 °F).

(5) *Burst test.* For production testing one cylinder selected at random from each lot must be burst tested. Each test cylinder must achieve the minimum burst pressure as specified in Table 2 of this paragraph (i) without leakage or rupture.

(6) *Joint efficiency.* (i) The joint efficiency is 1.0 when all weld seams, both longitudinal and circumferential, are completely radiographically examined and defects removed. Weld repair areas must be reinspected to confirm that defects have been removed and the repaired area is of acceptable weld quality.

(ii) The joint efficiency is 0.90 when one cylinder from the first 10 production cylinders and one cylinder from each 100 consecutively welded cylinders thereafter are completely radiographically examined and show no defects. When defects are found in the sample cylinder all cylinders welded since the last acceptable sampling must

be inspected completely and defects removed and repaired. When welding operations are suspended for more than four hours one cylinder must be inspected completely from the first 10 production cylinders after resumption of welding.

(iii) The joint efficiency is 0.75 when there is no radiographic weld examination.

(iv) A cylinder which is less than 21.4 kg (48 lbs) water capacity and test pressure less than 34.5 bar (500 psig) manufactured to a two piece design has a joint efficiency of 1.0 and requires no radiographic examination.

(v) Radiographic examination is required for DOT 4M cylinders constructed from 4130X steel and all DOT 4M cylinders with design test pressure equal to or greater than 70 bar (1015 psi). Radiographic examination must be performed on all welded joints which are subjected to internal pressure.

(vi) As an alternative to radiographic examination, an ultrasonic examination may be used in accordance with Appendix B of this subpart.

(7) *Mechanical test of welds.* Tests must be performed on specimens taken, as illustrated in Figure 1 through 5 of Appendix C of this subpart, from a cylinder chosen at random from each lot. Acceptable results:

(i) Tensile test results must meet acceptance criteria specified in CGA Pamphlet C-3 with specimen failure at a stress of not less than two times the wall stress at test pressure, calculated using the actual wall thickness.

(ii) Guided bend test results must meet acceptance criteria specified in CGA Pamphlet C-3.

(iii) Alternate guided bend test results must meet acceptance criteria specified in CGA Pamphlet C-3 and § 178.69(i)(8)(iii). Tables 3 and 4 follow:

TABLE 3.—ELONGATION

Material	Minimum elongation (in percent)		
	Gauge length × width ((50 mm × ≤38 mm)(2 inch × ≤1.5 inch))	Gauge length × width ¹ ((200 mm × ≤38 mm)(8 inch × ≤1.5 inch))	Gauge length of 24t × Width ¹ of 6t
Aluminum, alloy 5154	12	12	12
Steel (tensile strength <3447 MPA (50,000 psi))	40	20	20

Note 1: A gauge length of at least 24 times shell thickness and a width of not greater than six times shell thickness is authorized when cylinder wall is not greater than 4.7 mm (0.188 inch) thick.

TABLE 4.—ALTERNATE MINIMUM ELONGATION

Alternate minimum elongation (in percent)				
Shell tensile strength		Having tensile strength >3447 MPA (50,000 psi)		
		Gauge length × width ((50 mm × ≤38 mm) (2 inch × ≤1.5 inch))	Gauge length × width ¹ ((200 mm × ≤38 mm)(8 inch × ≤1.5 inch))	Gauge length of 24t × width ¹ of 6t
MPA	PSI			
≤3964	≤57500	38	19	19
≤4482	≤65000	36	18	18
≤5000	≤72500	34	17	17
≤5520	≤80000	32	16	16

Note 1: A gauge length of at least 24 times shell thickness and a width of not greater than six times shell thickness is authorized when cylinder wall is not greater than 4.7 mm (0.188 inch) thick.

(j) [Reserved]
 (k) *Cylinder Rejection.* Each test cylinder or each lot represented by a test cylinder that does not meet the acceptable test results must be rejected. When a lot of cylinders is rejected, due to failure of the mechanical, flattening, or weld test, the lot may be reheat

treated and retested as if it were a new lot. Reheat treatment is limited to two times.
 (l) *Leakage test.* A spun cylinder rejected under paragraph (i)(2) of this section must be scrapped, condemned or rendered incapable of holding pressure.

(m) *Repairs.* A repair of weld seams is authorized using the same process as that used for the original welding. A rewelded cylinder must be reheat treated and pass all prescribed tests.
 60. Appendices A, B and C would be added to Subpart C of Part 178 to read as follows:

Appendix A to Subpart C of Part 178—Specifications for Steel, Nickel and Aluminum

TABLE 1.—STEEL AND NICKEL—HEAT ANALYSIS—CHEMICAL COMPOSITION IN WEIGHT PERCENT
 [For grades A–E, incidental elements to be within the limits specified in the AISI Manual 1for Semifinished Steel Products.]

Grade	Type of material	C min/max	Mn min/max	P max	S max	Si min/max	Cr min/max	Mo min/max	Ni min/max	B min/max	Fe
A	Carbon ³ Manganese	0.10/0.50	—/1.75	0.035	0.025	—/0.30	.....	.....	.....	.....	Bal.
B	Chrome Moly Type	0.25/0.50	0.40/1.05	0.035	0.025	0.15/0.35	0.80/1.15	0.15/0.25	.....	.....	Bal.
C	Stainless ²	—/0.080	—/2.00	0.035	0.030	—/1.00	16.0/20.0	2.00/3.00	8.0/15.0	.....	Bal.
D	Nickel .....	.....	.....	.....	.....	.....	.....	.....	99.0/—	.....	Bal.
E	Chrome ⁴ Moly Type	0.32/0.38	0.60/1.05	0.015	0.010	0.15/0.35	0.80/1.15	0.15/0.25	.....	.....	Bal.

¹ The AISI manual referenced in the heading means "American Iron and Steel Institute" Steel Products Manual—Alloy, Carbon, and High Strength Low alloy Steels; Semifinished: dated March 1986.
² The minimum for molybdenum (2.00) shown, applies only to Stainless Steel type 316.
³ Forging or drawing quality steel required; rimmed steel not authorized.
⁴ Forging or drawing quality steel required; produced to predominantly fine grain practice.

TABLE 2.—ALUMINUM—HEAT OR CAST ANALYSIS FOR ALUMINUM; SIMILAR TO "ALUMINUM ASSOCIATION"¹ ALLOY 6061 CHEMICAL ANALYSIS IN WEIGHT PERCENT²

Si min/max	Fe max	Cu min/max	Mn max	Mg min/max	Cr min/max	Zn max	Ti max	Pb max	Bi max	Other		Al
										Each max	Total max	
0.40/0.80	0.70	0.15/0.40	0.15	0.80/1.20	0.04/0.35	0.25	0.15	0.005	0.005	0.05	0.15	Bal.

¹ The "Aluminum Association" refers to "Aluminum Standards and Data 1993", published by the Aluminum Association Inc.

² Except for "Pb" and "Bi", the chemical composition corresponds with that of Table 1 of ASTM B221M for Aluminum Association alloy 6061.

MECHANICAL PROPERTIES

[Aluminum in conformance with the specification in Table 2 above, thermally treated to "T6" temper]

Tensile strength minimum (Mpa) ¹	Yield strength minimum (Mpa) ¹	Elongation, percent minimum, for 2 inch or 4D ² size specimen
262	241	14 ³

¹ MPA x 145 = psi.

² "D" represents specimen diameter. When the cylinder is over 3/16 inch thick, a retest without reheat treatment, using the 4D specimens is authorized, if the test using the 2 inch size specimen fails to meet elongation requirements.

³ "10 percent" minimum elongation is authorized, when using a 24t x 6t test specimen if the cylinder sidewall is not over 3/16 inch thick.

Appendix B To Subpart C of Part 178— Ultrasonic Examination of Cylinders

Ultrasonic examination (UT) includes straight beam pulse echo testing that measures 100 percent of the cylinder's sidewall thickness and angle beam (shear wave) pulse echo that identifies and measures cracks, pits, laminations, laps, and other defects.

a. *UT equipment.* The UT equipment shall consist of a pulse-echo test instrument that is capable at a minimum, of generating, receiving, and presenting high energy pulses in an A-scan presentation on a display. It must have a minimum frequency of 1.0 MHZ and a minimum frequency range of 1.0 to 5.0 MHZ.

1. The UT equipment must continually monitor the acoustic coupling to assure 100% cylinder sidewall coverage during the testing and automatically terminate the testing if the coupling is lost. The equipment also must be capable of providing a linear presentation of crack depth. The equipment calibration must be verified for each type of cylinder to be examined using the calibration standard in paragraph b of this Appendix prior to testing. At a minimum, the equipment calibration must be verified at the beginning of each work shift, not to exceed 10 continuous hours.

2. The UT equipment must have multiple focused array transducers to perform both straight beam and angle beam testing of the cylinder sidewall and sidewall to base transition. A straight-beam search unit consists of a piezoelectric crystal mounted to a fixture that is perpendicular to the longitudinal axis of the cylinder. A shear wave search unit consists of piezoelectric crystals mounted to a fixture that are angled at 45° or 60° to the longitudinal axis of the cylinder sidewall. The frequency and angle of each search unit must be determined during calibration based on material, diameter, and wall thickness of the cylinder.

A proper search unit must be selected to obtain a good resolution and a minimum accuracy of +/-5% of the defect depth. A search unit frequency of 2.25 MHZ to 10.0 MHZ must be used. The equipment used must be calibrated to detect a discontinuity 25.4 mm (1 inch) in length and a depth of 5 percent of the prescribed minimum wall thickness.

b. *Calibration standard.* A cylinder used as a calibration standard must be of the same diameter (+/- 10%), surface finish, metallurgical type, and specification as the cylinders to be tested, for example, a DOT 3FM calibrated cylinder must be used for 3FM cylinders. The calibration cylinder must be machined with features that simulate defects such as pits, fatigue cracks, and reduced wall thickness. The size of the defect feature shall be approximately the same as the applicable pass-fail criteria identified in Table II of § 180.207 of this subchapter for requalification of metric-marked cylinders, as identified in Table II of § 180.209 of this subchapter for requalification of nonmetric-marked cylinders or as identified in the applicable cylinder specification. The minimum wall thickness and defect sizes in the calibration cylinder must be confirmed by mechanical measurements and certified by a non-destructive testing (NDT) Level III in UT. The size of the defect features in the calibration cylinder shall be measured every five years to confirm that the defect sizes have not been changed. A certification statement signed by a person certified to NDT Level III in UT must be maintained for each calibration standard and made available for review, upon request, by an authorized RSPA representative.

c. *Couplant.* The same couplant must be used for both calibration and actual testing.

d. *UT procedure and reporting requirements.* The UT procedure and reporting requirements used must be in accordance with ASTM E 797 for wall thickness measurement and ASTM E 213 for sidewall defect measurement. The UT program must be approved in writing by the Associate Administrator.

1. The surface of the cylinder to be inspected shall be free of extraneous loose material such as scale, loose paint, and dirt.

2. The rotational speed of the cylinder under examination may not exceed the rotational speed used during calibration.

3. The UT results must be evaluated in accordance with pass-fail criteria identified in Table II of § 180.207 of this subchapter for requalification of metric-marked cylinders, as identified in Table II of § 180.209 of this subchapter for requalification of nonmetric-marked cylinders or as identified in the applicable cylinder specification.

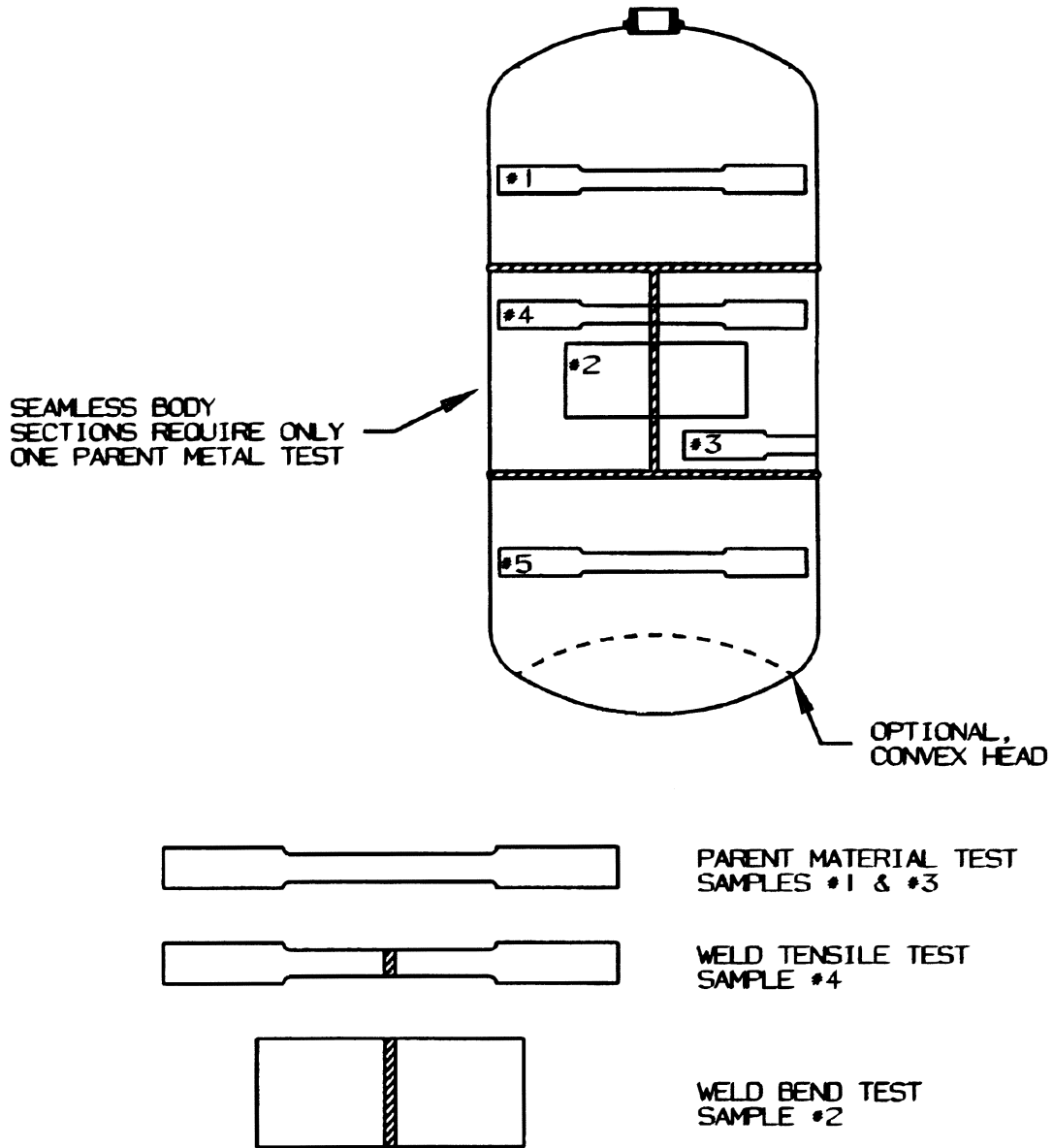
e. *Personnel Qualifications and Responsibilities:* Each facility where testing is to be performed must be under the managerial direction of a Senior Review Technologist (SRT).

1. The SRT must define the overall test program, provide supervisory training and technical guidance to operators, review and certify test results and maintain proof of qualifications for each "qualified tester". The SRT must have a Level III, UT Certification, in accordance with the ASNT Recommended Practice SNT-TC-1A and a thorough understanding of this subchapter pertaining to the qualification and use of DOT cylinders.

2. The person performing cylinder testing, the "qualified tester", must be at a minimum a qualified Level II, UT in accordance with ASNT-TC-1A. The "qualified tester" may perform system startup, calibrate the system, and review and validate the test results.

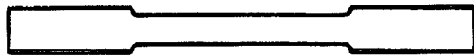
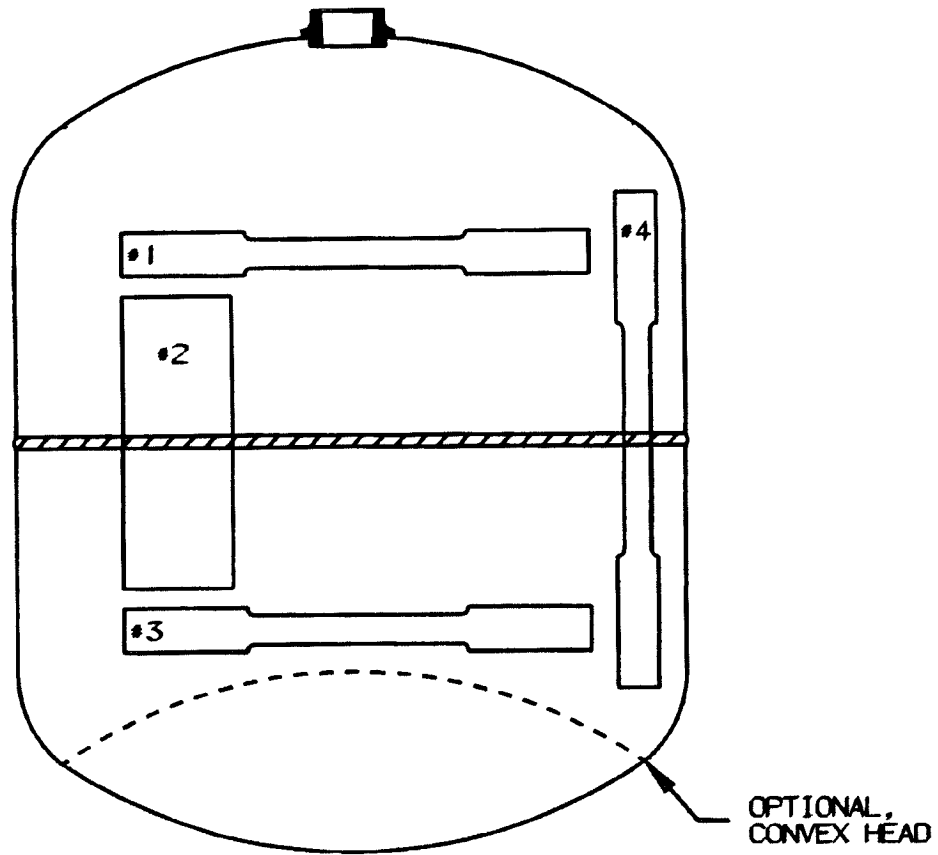
3. A person with Level I certification may perform a system startup, check calibration, and perform UT only under the direct guidance, supervision, and observation of a Level II or Level III Operator.

4. Each "qualified tester" must have written procedures for conducting UT, for operation of equipment, a copy of this subchapter, proof of qualifications, and records of all tests performed at the facility where testing is performed.

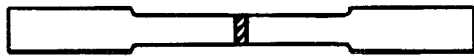


This Figure illustrates the proper tensile locations for a 3 piece cylinder with the heads having straight sidewall.

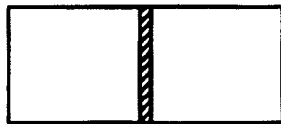
FIGURE # 1



PARENT MATERIAL TEST
SAMPLES #1 & #3



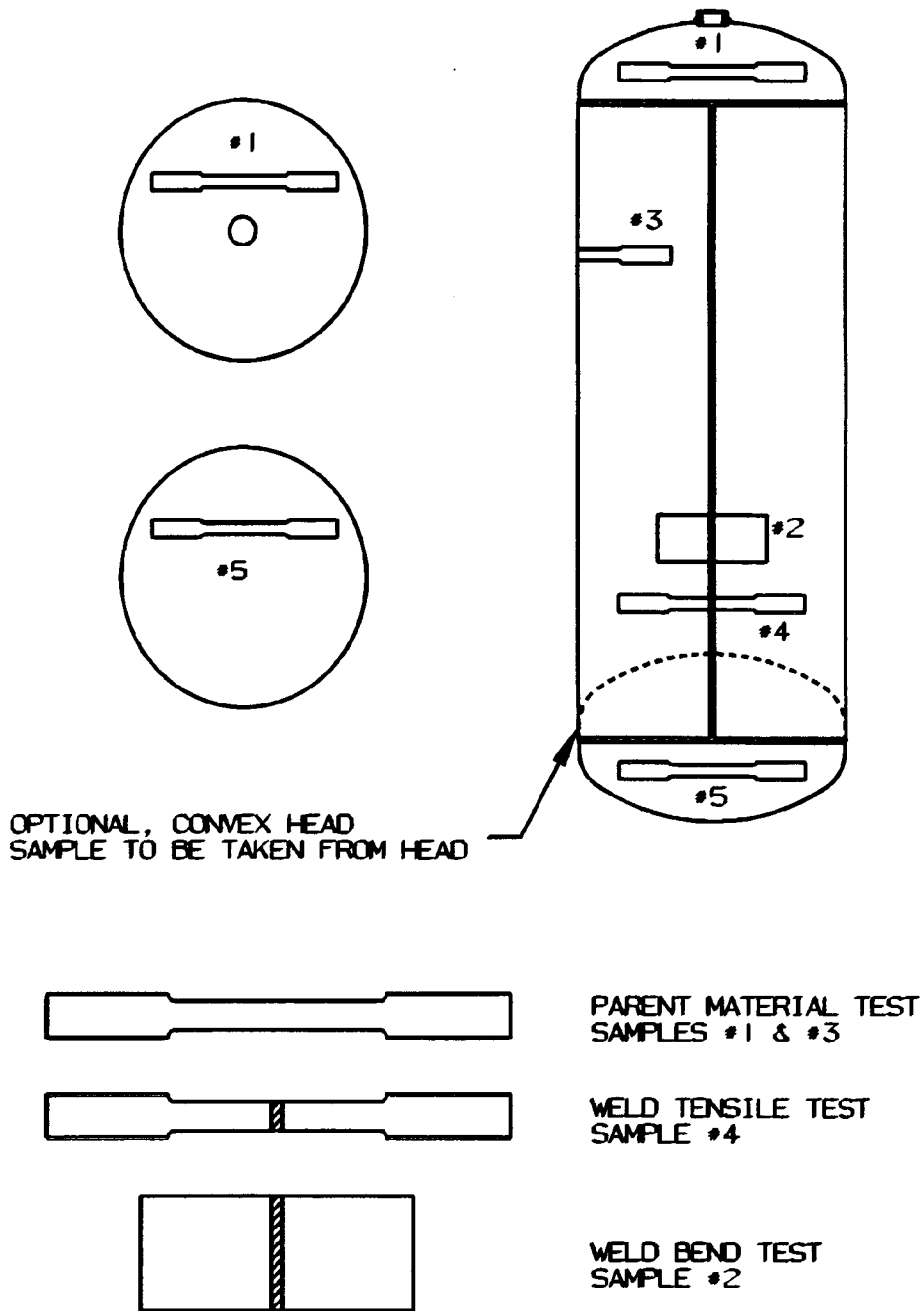
WELD TENSILE TEST
SAMPLE #4



WELD BEND TEST
SAMPLE #2

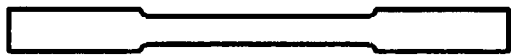
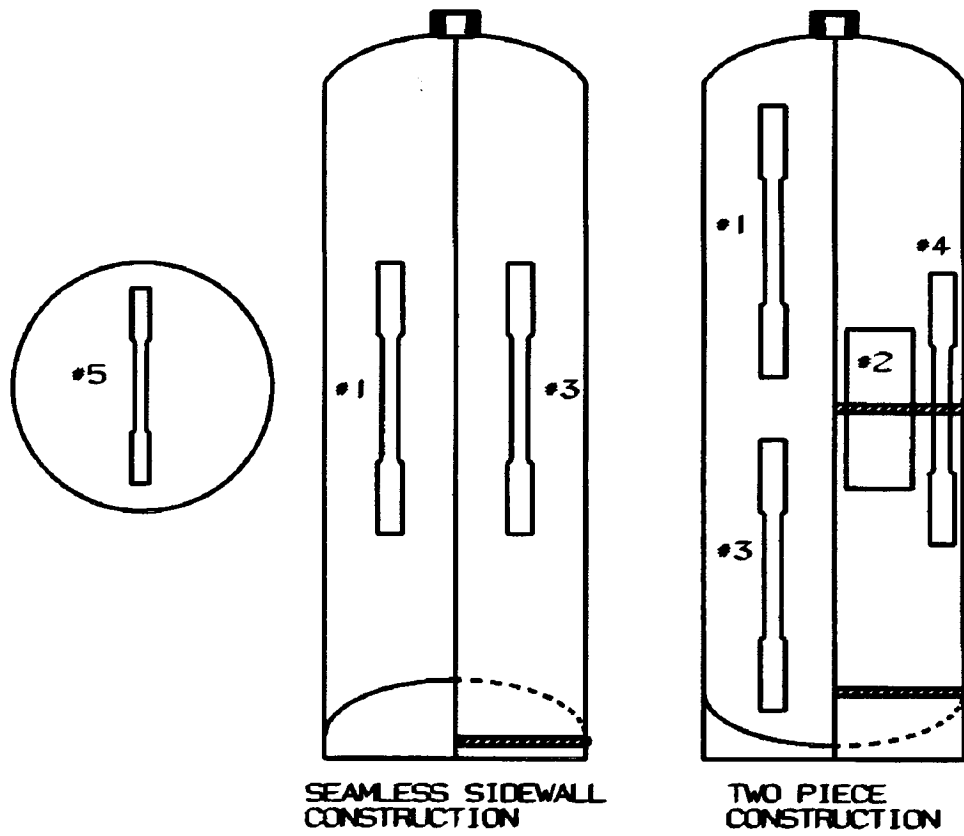
This Figure illustrates the proper tensile locations for a 2 piece cylinder with the heads having straight sidewall.

FIGURE #2

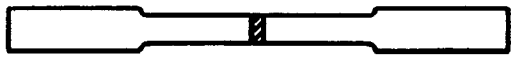


This Figure illustrates the proper tensile locations for a 3 piece cylinder with the heads not having straight sidewall.

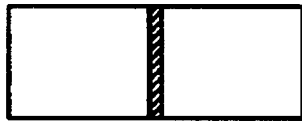
FIGURE #3



PARENT MATERIAL TEST
SAMPLES #1, #3 & #5



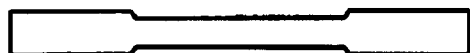
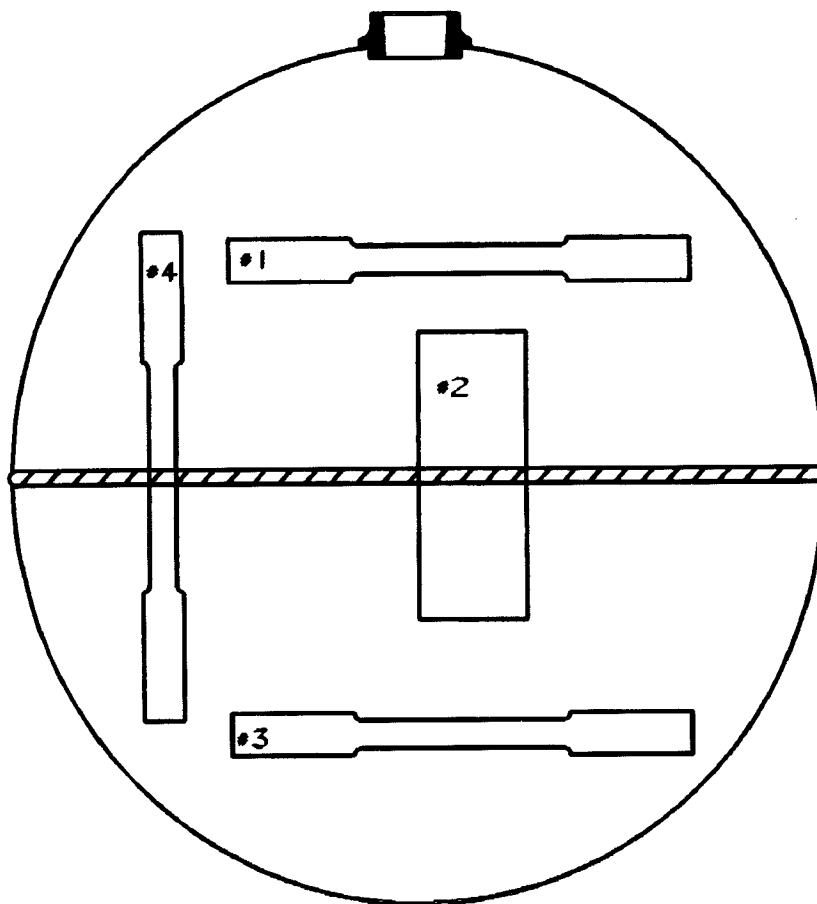
WELD TENSILE TEST
SAMPLE #4



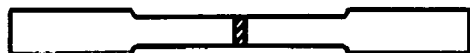
WELD BEND TEST
SAMPLE #2

This Figure illustrates the proper tensile locations for a 2 piece cylinder that have deep drawn heads.

FIGURE #4



PARENT MATERIAL TEST
SAMPLES #1 & #3



WELD TENSILE TEST
SAMPLE #4



WELD BEND TEST
SAMPLE #2

This Figure illustrates the proper tensile locations for a 2 piece spherical cylinder.

FIGURE #5

PART 180—CONTINUING QUALIFICATION AND MAINTENANCE OF PACKAGINGS

61. The authority citation for Part 180 would continue to read as follows:

Authority: 49 U.S.C. 5101–5127; 49 CFR 1.53.

62. Subpart C would be added to Part 180 to read as follows:

Subpart C—Qualification, Maintenance and Use of Cylinders

Sec.

- 180.201 Applicability.
- 180.203 Definitions.
- 180.205 General requirements for requalification of cylinders.
- 180.207 Requirements for requalification of metric-marked specification cylinders.
- 180.209 Requirements for requalification of nonmetric-marked specification cylinders.
- 180.211 Repair, rebuilding and reheat treatment of nonmetric-marked DOT-4 series specification cylinders.
- 180.213 Requalification markings.
- 180.215 Reporting and record retention requirements.

Subpart C—Qualification, Maintenance and Use of Cylinders

§ 180.201 Applicability.

This subpart prescribes requirements, in addition to those contained in Parts 107, 171, 172, 173 and 178 of this chapter, applicable to any person responsible for the continuing qualification, maintenance, or periodic requalification of DOT specification and exemption cylinders.

§ 180.203 Definitions.

In addition to the definitions contained in §§ 171.8 and 178.69 of this subchapter, the following definitions apply to this subpart:

Associate Administrator means Associate Administrator for Hazardous Materials Safety.

Commercially free of corrosive components means a hazardous material having a dew point at or below minus 46.7 °C (minus 52 °F) at 101kPa (1 atmosphere) and free of material that will adversely react with the cylinder (e.g. chemical stress corrosion).

Condemn means a determination that a cylinder is unserviceable for the continued transportation of hazardous materials in commerce and that the cylinder may not be restored by repair, rebuilding, requalification or any other procedure.

Defect means an imperfection that requires removal of a cylinder from service.

Elastic expansion means the temporary increase in a cylinder's

volume, due to application of pressure, which is lost when pressure is released.

Filled means an introduction or presence of a hazardous material in a cylinder.

Non-corrosive service means a hazardous material that is not corrosive to the materials of construction of a cylinder (including valve, pressure relief device, etc.) when moisture is introduced into the cylinder.

Over-heated means a condition in which any part of a cylinder has been subjected to a temperature in excess of 176 °C (350 °F).

Over-pressurized means a condition in which a cylinder has been subjected to an internal pressure in excess of 30% of its test pressure.

Permanent expansion means the permanent increase in a cylinder's volume after the test pressure is released (permanent expansion = total expansion minus elastic expansion).

Proof pressure test means a pressure test by interior pressurization without the determination of the cylinder's expansion.

Rebuild means the replacement of a pressure part (e.g. a wall, head or pressure fitting) by welding.

Rejected cylinder means a cylinder that can not be used for the transportation of a hazardous material in commerce without repair, rebuild or requalification.

Repair means a procedure for correction of a rejected cylinder and may involve welding.

Requalification means the completion of a visual inspection and or the test(s) that are required to be performed on a cylinder to determine its suitability for continued service.

Requalification identification number or RIN means a code assigned by DOT to uniquely identify a cylinder requalification, repair or rebuilding facility.

Test pressure means the pressure used for the requalification of a cylinder.

Total expansion means the total increase in a cylinder's volume due to application of the test pressure.

Visual inspection means an internal or external visual examination, or both, performed as part of the cylinder requalification process.

Volumetric expansion test means a pressure test by interior pressurization to measure a cylinder's expansion by using the water jacket or direct expansion methods:

(1) *Water jacket method* means a volumetric expansion test to determine a cylinder's total and permanent expansion by measuring the difference between the volume of water the cylinder externally displaces at test

pressure and the volume of water the cylinder externally displaces at ambient pressure.

(2) *Direct expansion method* means a volumetric expansion test to calculate a cylinder's total and permanent expansion by measuring the amount of water forced into a cylinder at test pressure, adjusted for the compressibility of water, as a means of determining the expansion.

§ 180.205 General requirements for requalification of cylinders.

(a) *General*. Each cylinder used for the transportation of hazardous materials must be an authorized packaging. To qualify as an authorized packaging, each cylinder must conform to this subpart, the applicable requirements specified in part 173 of this subchapter, and the applicable requirements of subpart C of part 178 of this subchapter.

(b) *Persons performing requalification functions*. No person may represent that a repair or requalification of a cylinder has been performed unless that person holds a current approval issued under the procedural requirements prescribed in subpart I of part 107 of this chapter. No person may mark a cylinder with a RIN and a requalification date or otherwise represent that a DOT specification or exemption cylinder has been requalified unless all applicable requirements of this subpart have been met. A person who requalifies cylinders shall maintain, at each location at which it inspects, tests or marks cylinders, the records prescribed in § 180.215.

(c) *Periodic requalification of cylinders*. Each cylinder bearing a DOT specification marking must be requalified and marked as specified in the Requalification Table in this subpart. Each cylinder bearing a DOT exemption number must be requalified and marked in conformance with this section and the terms of the applicable exemption. No cylinder may be charged or filled with a hazardous material and offered for transportation in commerce unless that cylinder has been successfully requalified and marked in accordance with this subpart. A cylinder may be requalified at any time during the month and year that the requalification is due. However, a cylinder that was charged or filled before the requalification became due may remain in service until it has been emptied.

(1) Each cylinder that successfully passes requalification specified in this section must be marked in accordance with § 180.213.

(2) Each cylinder that fails requalification must be:

(i) Rejected and may be requalified in accordance with § 180.211; or

(ii) Condemned in accordance with paragraph (i) of this section.

(3) For nonmetric-marked DOT specification cylinders, the marked service pressure may be changed upon application to the Associate Administrator and receipt of written procedures.

(4) For a metric-marked cylinder, the start-to-discharge pressure of a pressure relief device must not be less than the marked test pressure of the cylinder. For a nonmetric-marked DOT-3 series cylinder, the start-to-discharge pressure of a pressure relief device must be set to not less than 100% of the minimum required test pressure at the first requalification due on and after [EFFECTIVE DATE OF THE FINAL RULE]. To ensure that the relief device does not open below its set pressure, the allowable tolerances for all the pressure relief devices must range from zero to plus 10% of its setting.

(d) *Conditions requiring test and inspection of cylinders.* Without regard to any other periodic requalification requirements, a cylinder must be tested and inspected in accordance with this section prior to further use if—

(1) The cylinder shows evidence of dented, corroded, cracked or abraded areas, leakage, thermal damage or any other condition that might render it unsafe for use in transportation.

(2) The cylinder has been in an accident and has been damaged to an extent that may adversely affect its lading retention capability.

(3) The cylinder has been over-heated or over-pressurized.

(4) The Associate Administrator determines that the cylinder may be in an unsafe condition.

(e) *Cylinders containing Class 8 materials.* A cylinder that previously contained a Class 8 material may not be used to transport a Class 2 material in commerce unless the cylinder is—

(1) Visually inspected, internally and externally, in accordance with paragraph (f) of this section and the inspection is recorded as prescribed in § 180.215;

(2) Requalified in accordance with this section, regardless of the date of the previous requalification;

(3) Marked in accordance with § 180.213;

(4) Decontaminated and the decontamination removes all significant residue or impregnation of the Class 8 material.

(f) *Visual inspection.* Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external

visual inspection. When a pressure test is not performed, the cylinder must be given an external visual inspection.

(1) The visual inspection must be performed in accordance with the following CGA Pamphlets: C-6 for steel and nickel cylinders; C-6.1 for seamless aluminum cylinders; C-6.2 for fiber reinforced exemption cylinders; C-6.3 for low pressure aluminum cylinders; C-8 for DOT 3HT cylinders, and C-13 for DOT 8 series cylinders.

(2) Each cylinder with a vinyl or plastic coating must have the coating completely removed prior to performing the visual inspection.

(3) Each cylinder subject to visual inspection must be approved, rejected or condemned according to the criteria in the applicable CGA pamphlet.

(4) In addition to other requirements prescribed in this paragraph, DOT 3AL cylinders must be inspected for evidence of sustained load cracking in the neck and shoulder area in accordance with the cylinder manufacturer's written recommendations which have been approved in writing by the Associate Administrator.

(g) *Pressure test.* Unless otherwise excepted, the pressure test must be conducted in accordance with the procedures in paragraphs 4, 5 and 6 and Appendices A and B of CGA Pamphlet C-1. Bands and other removable attachments must be loosened or removed before testing so that the cylinder is free to expand in all directions.

(h) *Cylinder rejection.* A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.

(1) A cylinder that is rejected may not be marked as meeting the requirements of this section.

(2) The requalifier shall notify the cylinder owner, in writing, that the cylinder has been rejected and, unless requalified as provided in § 180.211, may not be filled with a hazardous material for transportation in commerce where use of a specification packaging is required.

(3) A rejected nonmetric-marked cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently inspected and tested in conformance with—

(i) The visual inspection requirements of paragraph (f) of this section;

(ii) Part 178 of this subchapter and this part;

(iii) Any exemption covering the manufacture, requalification, and or use of that cylinder; and

(iv) Any approval required under § 180.211.

(i) *Cylinder condemnation.* (1) A cylinder must be condemned when—
(i) The cylinder meets a condition for condemnation under the visual inspection requirements of paragraph (f) of this section;

(ii) The cylinder leaks through its wall;

(iii) Evidence of cracking exists to the extent that the cylinder is likely to be weakened appreciably;

(iv) A DOT specification cylinder (including 4M), other than a DOT 4E aluminum cylinder or an exemption cylinder, permanent expansion exceeds 10 percent of total expansion;

(v) A DOT 3HT cylinder—

(A) Yields an elastic expansion exceeding the marked rejection elastic expansion (REE) value during the pressure test. A cylinder made before January 17, 1978, and not marked with an REE in cubic centimeters near the marked original elastic expansion must be so marked before the next test date. The REE for the cylinder is 1.05 times its original elastic expansion;

(B) Shows evidence of denting or bulging; or

(C) Bears a manufacture or an original test date older than twenty-four years or after 4,380 pressurizations, whichever occurs first. If a cylinder is refilled, on average, more than once every other day, an accurate record of the number of rechargings must be maintained by the cylinder owner or the owner's agent;

(vi) A DOT 4E or 4M aluminum cylinder's permanent expansion exceeds 12 percent of total expansion;

(vii) A DOT exemption cylinder's permanent expansion exceeds the limit in the applicable exemption, or the cylinder meets another criterion for condemnation in the applicable exemption;

(viii) An aluminum or an aluminum-lined composite exemption cylinder is exposed to a temperature exceeding 177 °C (350 °F); or

(ix) A DOT specification cylinder requalified by ultrasonic examination that exceeds the minimum rejection criteria set forth in Table II of § 180.207 or § 180.209, as applicable.

(2) When a cylinder is required to be condemned, the requalifier shall stamp a series of X's over the DOT specification number and the marked pressure or stamp "CONDEMNED" on the shoulder, top head, or neck using a steel stamp. Alternatively, at the direction of the owner, the requalifier may render the cylinder incapable of

holding pressure. In addition, the requalifier 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.

(3) No person may remove or obliterate the "CONDEMNED" marking.

§ 180.207 Requirements for requalification of metric-marked specification cylinders.

(a) Each metric-marked cylinder that becomes due for periodic requalification as specified in Table I of this section must be inspected, tested, and marked in conformance with the requirements

of this subpart. The ultrasonic examination must meet the requirements in Table II of this section. The recordkeeping requirements for an ultrasonic examination must be in accordance with § 180.215. The ultrasonic examination procedures and equipment must be approved by the Associate Administrator and meet the requirements set forth in Appendix B of Subpart C of Part 178 of this subchapter. Other nondestructive examinations (NDE) may be used only if approved in writing by the Associate Administrator.

(b) Except as otherwise provided, DOT 3FM, 3ALM and 3M cylinders

must have 100% of the cylindrical section tested by straight-beam and angle-beam. For a DOT 4M cylinder with a marked test pressure greater than 70 bar or tensile strength greater than or equal to 830 Kpa (120,000 psi), 100% of the cylindrical section must be tested by straight-beam and angle-beam. For a DOT 4M cylinder with a marked test pressure of 70 bar or less and tensile strength less than 830 Kpa (120,000 psi), 100% of the cylindrical section must be tested by straight beam if an ultrasonic examination is performed.

Tables to § 180.207

TABLE I TO § 180.207.—REQUALIFICATION OF METRIC-MARKED CYLINDERS

Interval period (years)	Test of inspection	Specifications	Type of service	
			First	subseq.
External visual inspection.	DOT-3M, 3FM, 3ALM, 4M	External visual inspections in accordance with the applicable CGA pamphlet must be performed in conjunction with the ultrasonic examination.	.....	.....
INTERNAL and EXTERNAL VISUAL INSPECTION. Ultrasonic EXAMINATION.	DOT-4M	Except as otherwise provided, the internal and external visual inspections must be performed in conjunction with the pressure test and in accordance with the applicable CGA pamphlet.	.....	.....
	DOT 3M, 3FM, 3ALM, 4M	All, except cylinders used exclusively for the material listed below:.	5	5
	DOT 3M, 3FM, 3ALM	(1) Nonliquefied or liquefied, noncorrosive, nontoxic (the LC50 of the lading is not less than 5000 ppm) gases that are commercially free from corrosive components, and in cylinders protected externally by a suitable corrosion-resistant coating. A coating on a stainless steel or aluminum cylinder is optional. (2) Class 3 (flammable) liquids without pressurization that are nontoxic (except 6.1 PG III) and are commercially free from corroding components. (3) Class 8 (corrosive) liquids without pressurization that are nontoxic (except 6.1 PG III) and do not meet the criteria of § 173.137(c)(2) of this subchapter. See restriction in § 180.205(e).	10	10
	DOT 3M	Anhydrous ammonia commercially free from corrosive components, and in cylinders protected externally by a suitable corrosion-resistant coating.	10	10
	DOT 4M (DOT 4M cylinders with a test pressure of 70 bar or less may be tested by a volumetric expansion test).	(1) Nonliquefied or liquefied, noncorrosive, nontoxic (the LC50 of the lading is not less than 5000 ppm) gases that are commercially free from corrosive components, and in cylinders protected externally by a suitable corrosion-resistant coating. A coating on a stainless steel or aluminum cylinder is optional. (2) Class 3 liquids without pressurization that are nontoxic (except 6.1 PG III) and are commercially free from corrosive components. (3) Class 8 (corrosive) liquids without pressurization that are nontoxic (except 6.1 PG III) and do not meet the criteria of § 173.137(c)(2) of this subchapter. See restriction in § 180.205(e).	15	15
	DOT 3M and 4M (DOT 4M cylinders with a test pressure of 70 bar or less may be tested by a volumetric expansion test).	Specification cylinders used exclusively as fire extinguishers and meeting the limitations in special provision 18 in § 172.102(c)(1) of this subchapter.	12	12

TABLE II TO § 180.207.—CRITERIA FOR PERIODIC ULTRASONIC EXAMINATION OF METRIC MARKED CYLINDERS

DOT specification	Coverage area of cylinder by straight beam (longitudinal wave)	Coverage area of cylinder by angle beam (shear wave)	Rejectable crack depth in sidewall (% of wall thickness)	Rejectable crack length in sidewall (multiple of wall thickness)	Rejectable crack size in the circumferential welded joint (depth × length)	Rejectable pit size diameter (D) × depth	Rejected area for reduced wall thickness (t) reduced wall t=any value less than design min. wall t ¹ D=diameter of the cylinder
3FM	100% of sidewall.	100% of sidewall.	10% of Wall Thickness	4 times Wall Thickness	NA	3 mm × 1/3 of the Designed Wall Thickness.	161 mm ² or 0.002D ² .
3ALM	100% of sidewall.	100% of sidewall.	15% of Wall Thickness	5 times Wall Thickness	NA	3 mm × 1/3 of the Designed Wall Thickness.	323 mm ² or 0.004D ² .
3M	100% of sidewall.	100% of sidewall.	15% of Wall Thickness	5 times Wall Thickness	NA	3 mm × 1/3 of the Designed Wall Thickness.	323 mm ² or 0.004D ² .
4M with a marked test pressure >70 bar or tensile strength ≥830 MPa.	100% of sidewall.	100% of sidewall.	10% of Wall Thickness	4 times Wall Thickness	10% of Wall Thick (Depth) and 2 times of Wall Thick, (Length).	3 mm × 1/3 of the Designed Wall Thickness.	323 mm ² or 0.004D ² .
4M with a marked test pressure ≤70 bar or tensile strength <830 MPa.	100% of sidewall.	NA	NA	NA	NA	NA	323 mm ² or 0.004D ² .

¹ Term wall thickness in this table means the minimum design wall thickness provided in the manufacturers inspection report.

§ 180.209 Requirements for requalification of nonmetric-marked specification cylinders.

(a) *Periodic qualification of cylinders.* (1) Each nonmetric-marked cylinder that becomes due for periodic requalification, as specified in the following table, must be requalified and marked in conformance with the requirements of this subpart. The recordkeeping requirements must be in accordance with § 180.215. Table I follows:

TABLE I.—REQUALIFICATION OF NONMETRIC-MARKED CYLINDERS ¹

Specification under which cylinder was made ²	Minimum test pressure (p.s.i.) ³	Test period (years)
DOT-3	3,000 p.s.i.	5.
DOT-3A, 3AA	5/3 times service pressure, except noncorrosive service (see § 180.209(g)).	5, 10, or 12 (see § 180.209 (b), (f), (h) and (j)).
DOT-3AL	5/3 times service pressure	5 or 12 (see 180.209(j)).
DOT-3AX, 3AAX	5/3 times service pressure	5.
3B, 3BN	2 times service pressure (see § 180.209(g))	5 or 10 (see § 180.209(f)).
3E	Test not required.	
3HT	5/3 times service pressure	3 (see § 180.209(i) and 180.213(c)).
3T	5/3 times service pressure	5.
4AA480	2 times service pressure (see § 180.209(g))	5 or 10 (see § 180.209(e)(14)).
4B, 4BA, 4BW, 4B-240ET	2 times service pressure, except non-corrosive service (see § 180.209(g)).	5, 10 or 12 (see § 180.209(e), (f) and (j)).
4D, 4DA, 4DS	2 times service pressure	5.
DOT-4E	2 times service pressure, except non-corrosive service (see § 180.209(g)).	5.
4L	Test not required	
8, 8AL .....	.....	10 or 20 (See § 180.209(i)).
Exemption Cylinder Foreign cylinder (see § 173.301(j) for restrictions on use.	See current exemption as marked on the cylinder, but not less than 5/3 of any service or working pressure marking.	See current exemption 5 (see § 180.209(k) and § 180.213(d)(iii)).

¹ Any cylinder not exceeding two inches outside diameter and less than two feet in length is exempted from hydrostatic test.

² After January 1, 2005, DOT-3T and 3HT specification cylinders must be inspected by a non-destructive testing method approved by the Associate Administrator.

³ For cylinders not marked with a service pressure, see § 173.301(e)(1) of this subchapter.

(2) In lieu of a hydrostatic pressure test (i.e. volumetric expansion or proof pressure tests) as required by this section, each DOT specification cylinder that becomes due for periodic requalification, as specified in Table I of paragraph (a)(1) of this section, may be requalified by using one of the following methods:

(i) Ultrasonic examination: Ultrasonic examination must be in conformance with the requirements of the Appendix B of Subpart C of part 178 of this subchapter and Table II of paragraph (a)(2) of this section. Minimum wall

thickness of each cylinder examined by UT must be equal to or greater than the design minimum wall thickness. For each cylinder, the minimum wall thickness data from the cylinder manufacturer's inspection report must be available and used during UT examination. An external visual inspection in accordance with the applicable CGA pamphlet is required to be performed in conjunction with the ultrasonic examination. The recordkeeping requirements for an ultrasonic examination must be in accordance with § 180.215. The marking

requirements for an ultrasonic examination must be in accordance with § 180.213.

Note to paragraph (a)(2)(i): The test interval for the requalification of a nonmetric-marked DOT specification cylinder subjected to UT examination is the same as specified in Table I of paragraph (a)(1) of this section. The ultrasonic examination only replaces the hydrostatic pressure test.

(ii) Other nondestructive examinations (NDE) as approved in writing by the Associate Administrator. Table II follows:

TABLE II.—CRITERIA FOR PERIODIC ULTRASONIC EXAMINATION OF NON-METRIC MARKED CYLINDERS

DOT spec	Coverage area of cylinder by straight beam (longitudinal wave)	Coverage area of cylinder by angle beam (shear wave)	Rejectable defect depth in sidewall (% of wall thickness)	Rejectable defect length in sidewall (multiple of wall thickness)	Rejectable pit size diameter (D) × depth	Rejected area for reduced wall thickness (t) reduced wall t = any value less than design min. wall t ¹ D = diameter of the cylinder
3T	100% of sidewall.	100% of sidewall.	10% of Wall Thickness	4 times Wall Thickness	3 mm × 1/3 of the De-signed Wall Thickness.	161 mm ² or 0.002D ² .
3AL (mfg. after 1989)	100% of sidewall.	100% of sidewall.	15% of Wall Thickness	5 times Wall Thickness	3 mm × 1/3 of the De-signed Wall Thickness.	323 mm ² or 0.004D ² .
3AA,3A, 3AX, 3AAX	100% of sidewall.	100% of sidewall.	15% of Wall Thickness	5 times Wall Thickness	3 mm × 1/3 of the De-signed Wall Thickness.	323 mm ² or 0.004D ² .
4B,4BA,4BW4D,4DS,4DA	100% of sidewall.	NA	NA	NA	3 mm × 1/3 of the De-signed Wall Thick-ness.	323 mm ² or 0.004D ² .

¹ Term wall thickness in this table means the minimum design wall thickness provided in the manufacturers inspection report.

(b) DOT-3A or 3AA cylinders. (1) A cylinder conforming to 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 requalified every ten years instead of every five years, provided the cylinder meets all of the following—

(i) The cylinder was manufactured after December 31, 1945;

(ii) 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(d) of this subchapter), 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°F) at 1 atmosphere;

(iii) Before each refill, the cylinder is removed from any cluster, bank, group, rack or vehicle and passes the hammer test specified in CGA Pamphlet C-6;

(iv) The cylinder is dried immediately after hydrostatic testing to remove all traces of water;

(v) The cylinder is not used for underwater breathing; and

(vi) Each cylinder is stamped with a five-pointed star at least one-fourth of an inch high immediately following the test date.

(2) If, since the last required requalification, a cylinder has not been used exclusively for the gases specifically identified in paragraph

(b)(1)(ii) of this section, but currently conforms with all other provisions of paragraph (b)(1) of this section, it may be requalified every 10 years instead of every five years, provided it is first requalified and examined as prescribed by § 173.302a(b)(2), (3) and (4) of this subchapter.

(3) Except as specified in (b)(2) of this section, if a cylinder, marked with a star, is filled with a compressed gas other than as specified in paragraph (b)(1)(ii) of this section, the star following the most recent test date must be obliterated. The cylinder must be requalified five years from the marked test date, or prior to the first filling with a compressed gas, if the required five-year requalification period has passed.

(c) *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 requalified before being refilled and offered for transportation. (Refer to CGA Pamphlet C-6 or C-6.3, as applicable, regarding cylinder weakening.) After testing, the actual tare weight must be recorded as the new tare weight.

(d) *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 requalification becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.1. The cylinder may be hydrostatically tested without a water jacket and without determining total and permanent expansions. The test is successful if the cylinder, when examined under test pressure, does not display a defect described in § 180.205(i)(1)(ii) or (iii).

(e) *Proof pressure test.* A cylinder made in compliance with specification DOT 4B, DOT 4BA, DOT 4BW, DOT 4E 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 requalified 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 expansion, 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 proof pressure test method must be marked after a test or an inspection with the appropriate RIN and the date of requalification or reinspection on the cylinder followed by an "S".

(f) *Poisonous materials.* A cylinder conforming to specification DOT-3A, DOT-3AA, DOT-3B, DOT-4BA or DOT-4BW 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.

(g) *Visual inspections.* A cylinder conforming to a specification listed in the table in this paragraph and used exclusively in the service indicated may, instead of a periodic hydrostatic test, be given a complete external visual inspection at the time periodic requalification becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.3, as applicable. When this inspection is used instead of hydrostatic pressure testing, subsequent inspections are required at five-year intervals after the first inspection. Inspections must be made only by persons holding a current RIN and the results recorded and maintained in accordance with § 180.215. 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 footing or protective ring or fire damage); disposition of cylinder (returned to service, returned to cylinder manufacturer for repairs or condemned). A cylinder passing requalification by the external visual inspection must be marked in accordance with § 180.213. Specification cylinders must be in exclusive service as follows:

Cylinders made in compliance with—	Used exclusively for—
DOT-3A, DOT-3AA, DOT-3A480X, DOT-4AA480	Anhydrous ammonia of at least 99.95% purity.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA,	Butadiene, inhibited, which is commercially free from corroding components.
DOT-4BW.	Cyclopropane which is commercially free from corroding components.
DOT-3A, DOT-3A480X, DOT-3AA, DOT-3B, DOT-4AA480, DOT-4B,	Fluorinated hydrocarbons and mixtures thereof which are commercially free from corroding components.
DOT-4BA, DOT-4BW.	Liquefied hydrocarbon gas which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-4B, DOT-4BA, DOT-4BW,	Liquefied petroleum gas which is commercially free from corroding components.
DOT-4E.	Methylacetylene-propadiene, stabilized, which is commercially free from corroding components.
DOT-3A, DOT-3AA, DOT-3A480X, DOT-3B, DOT-4B, DOT-4BA,	Anhydrous mono, di, trimethylamines which are commercially free from corroding components.
DOT-4BW, DOT-4E.	Ethyleneimine, inhibited.
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW, DOT-	
4E.	
DOT-3A, DOT-3AA, DOT-3B, DOT-4B, DOT-4BA, DOT-4BW	
DOT-4B240, DOT-4BW240	

(h) *Cylinders containing anhydrous ammonia.* A cylinder made in compliance with specification DOT-3A, DOT-3A480X, 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 requalified every 10 years instead of every five years.

(i) *Requalification of DOT 8 series cylinders.* (1) Each owner of a DOT 8 series 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 years	Before January 1, 2011	Not required.
On or after January 1, 1991	10 years ¹	10 years	3 to 20 years 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.

(2) 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 current RIN.

(3) 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.

(4) The person performing a visual inspection, or requalification must record the results as specified in § 180.215.

(5) The person performing a visual inspection, or requalification must mark the cylinder as specified in § 180.213.

(j) *Cylinders used as a fire extinguisher.* Only DOT specification cylinders used as fire extinguishers and meeting Special Provision 18 in § 172.102(c)(1) of this subchapter may be requalified in accordance with this paragraph (j).

(1) A DOT specification 4B, 4BA, 4B240ET or 4BW cylinder may be tested as follows:

(i) For a cylinder with a water capacity of 12 pounds or less by volumetric expansion test using the water jacket method or by proof pressure test. A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(ii) For a cylinder having a water capacity over 12 pounds—

(A) *By proof pressure test.* A requalification must be performed 12 years after the original test date and at 7-year intervals; or

(B) *By volumetric expansion test using the water jacket method.* A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(2) A DOT specification 3A, 3AA, or 3AL cylinder must be requalified by volumetric expansion test using the water jacket method. A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(k) *Requalification of foreign cylinders filled for export.*

(1) A cylinder manufactured outside the United States, other than as provided in § 171.12a of this subchapter, that has not been manufactured, inspected, tested and marked in accordance with part 178 of this subchapter may be filled with compressed gas in the United States, and shipped solely for export if it meets the following requirements, in addition to other requirements of this subchapter:

(i) It has been inspected, tested and marked (with only the month and year of test) in conformance with the procedures and requirements of this subpart or the Associate Administrator has authorized the filling company to fill foreign cylinder under an alternative method of qualification; and

(ii) It is offered for transportation in conformance with the requirements of § 173.301(l) of this subchapter.

(2) [Reserved]

§ 180.211 Repair, rebuilding and reheat treatment of nonmetric-marked DOT-4 series specification cylinders.

(a) *General requirements for repair and rebuilding.* Any repair or rebuilding of a DOT 4B, 4BA or 4BW cylinder must be performed by a person holding an approval as specified in § 107.805 of this chapter. A person performing a rebuild function shall be considered a manufacturer subject to the requirements of § 178.2(a)(2) and subpart C of part 178 of this subchapter. The person performing a repair, rebuild, or reheat treatment must record the test results as specified in § 180.215. Each cylinder that is successfully repaired or rebuilt must be marked in accordance with § 180.213.

(b) *General repair requirements.* Any repair of a cylinder must be made in accordance with the following:

(1) The repair and the inspection of the work performed must be made in accordance with the requirements of the cylinder specification.

(2) The person performing the repair shall use the procedure, equipment, and filler metal or brazing material as authorized by the approval issued under § 107.805 of this chapter.

(3) Welding and brazing shall be performed on an area free from contaminants.

(4) A weld defect, such as porosity in a pressure retaining seam, shall be completely removed before rewelding. Puddling may be used to remove a weld defect only by the tungsten inert gas shielded arc process.

(5) After removal of a non-pressure attachment and before its replacement, the cylinder shall be given a visual inspection in accordance with § 180.205(f).

(6) Reheat treatment of DOT-4B, 4BA or 4BW specification cylinders after replacement of non-pressure attachments is not required when the total weld material does not exceed 8 inches. Individual welds must be at least three inches apart.

(7) After repair of a DOT 4B, 4BA or 4BW cylinder, the weld area is to be leak tested at the service pressure of the cylinder.

(8) Repair of weld defects must be free of cracks.

(9) When a non-pressure attachment with the original cylinder specification markings is replaced, all markings must be transferred to the attachment on the repaired cylinder.

(10) Walls, heads or bottoms of cylinders with defects or leaks in base metal may not be repaired, but may be replaced as provided for in paragraph (d) of this section.

(c) *Additional repair requirements for 4L cylinders.* (1) Repairs to a DOT 4L cylinder are limited to the following:

(i) The removal of either end of the insulation jacket to permit access to the cylinder, piping system, or neck tube.

(ii) The replacement of the neck tube. At least a 13 mm (0.51 inch) piece of the original neck tube must be protruding above the cylinder's top end. The original weld attaching the neck tube to the cylinder must be sound and the replacement neck tube must be welded to this remaining piece of the original neck tube.

(iii) The replacement of material such as, but not limited to, the insulating material and the piping system within

the insulation space is authorized. The replacement material must be equivalent to that used at the time of original manufacture.

(iv) Other welding procedures which are qualified by CGA Pamphlet C-3, and not excluded by the definition of rebuild, are authorized.

(2) After repair, the cylinder must be:

(i) Pressure tested in accordance with the specifications under which the cylinder was originally manufactured;

(ii) Leak tested before and after assembly of the insulation jacket using a mass spectrometer detection system; and

(iii) Tested for heat conductivity requirements.

(d) *General rebuilding requirements.*

(1) The rebuilding of a cylinder must be made in accordance with the following requirements:

(i) The person rebuilding the cylinder must use the procedures and equipment as authorized by the approval issued under § 107.805 of this chapter.

(ii) After removal of a non-pressure component and before replacement of any non-pressure component, the cylinder must be visually inspected in accordance with CGA Pamphlet C-6.

(iii) The rebuilder may rebuild a DOT 4B, 4BA or 4BW cylinder having a water capacity of 20 pounds or greater by replacing a head of the cylinder using a circumferential joint. When this weld joint is located at other than an original welded joint, a notation of this modification shall be shown on the Manufacturer's Report of Rebuilding in § 180.215(d)(2). Weld joint must be on the cylindrical section of the cylinder.

(iv) Any welding and the inspection of the rebuilt cylinder must be in accordance with the requirements of the applicable cylinder specification and the following requirements:

(A) Rebuilding of any cylinder involving a joint subject to internal pressure may only be performed by fusion welding;

(B) Welding shall be performed on an area free from contaminants; and

(C) A weld defect, such as porosity in a pressure retaining seam, shall be completely removed before rewelding. Puddling may be used to remove a weld defect only by the tungsten inert gas shielded arc process.

(2) Any rebuilt cylinder must be—

(i) Heat treated in accordance with paragraph (f) of this section;

(ii) Subjected to a volumetric expansion test on each cylinder as specified in CGA Pamphlet C-1, paragraphs 4 or 5, and Appendices A and B. The results of the tests must conform with the applicable cylinder specification;

(iii) Inspected and have test data reviewed to determine conformance with the applicable cylinder specification; and

(iv) Made of material that conforms to the specification. Determination of conformance shall include chemical analysis, verification, inspection and tensile testing of the replaced part. Tensile tests must be performed on the replaced part after heat treatment by lots defined in the applicable specification.

(3) A record of rebuilding must be completed for each cylinder rebuilt in the format presented in § 180.215(d).

(4) Rebuilding a cylinder with brazed seams is prohibited.

(5) When an end with the original cylinder specification markings is replaced, all markings must be transferred to the rebuilt cylinder.

(e) *Additional rebuilding requirements for DOT-4L cylinders.* (1) The rebuilding of a DOT 4L cylinder is:

(i) Substituting or adding material in the insulation space not identical to that used in the original manufacture of that cylinder;

(ii) Making a weld repair not to exceed 150 mm (5.9 inches) in length on the longitudinal seam of the cylinder or 300 mm (11.8 inches) in length on a circumferential weld joint of the cylinder; or

(iii) Replacing the outer jacket.

(2) Reheat treatment of cylinders is prohibited.

(3) After rebuilding, each inner containment vessel must be proof pressure tested at 2 times its service pressure. Each completed assembly must be leak-tested using a mass spectrometer detection system.

(f) *Reheat treatment.* (1) Prior to reheat treatment, each cylinder must be given a visual inspection, internally and externally, in accordance with § 180.205(f).

(2) Cylinders must be segregated in lots for reheat treatment. The reheat treatment and visual inspection must be performed in accordance with the specification for the cylinders except as provided in paragraph (f)(4) of this section.

(3) After reheat treatment, each cylinder in the lot must be subjected to a volumetric expansion test and meet the acceptance criteria in the applicable specification or be scrapped.

(4) After all welding and heat treatment, a test of the new weld must be performed as required by the original specification. The test results must be recorded in accordance with § 180.215.

§ 180.213 Requalification markings.

(a) *General.* Each cylinder that has been requalified in accordance with this

subpart with acceptable results must be marked as specified in this section. Required markings may not be altered or removed.

(b) *Placement of markings.* Each cylinder must be plainly and permanently marked into the metal of the cylinder as permitted by the applicable specification. Unless authorized by the cylinder specification, marking on the cylinder sidewall is prohibited.

(1) Required specification markings must be legible so as to be readily visible at all times. Markings that are becoming illegible may be remarked on the cylinder as provided by the original specification. The markings may be placed on any portion of the upper end of the cylinder excluding the sidewall. No steel stamping, engraving, or scribing may be made in the sidewall of the cylinder unless specifically permitted in the applicable cylinder specification. A metal plate if used, must be attached as provided by the original specification.

(2) Markings of previous tests may not be obliterated, except when the space originally provided for requalification dates becomes filled, additional dates may be added as follows:

(i) All preceding test dates may be removed by peening provided that—

(A) Permission is obtained from the cylinder owner;

(B) The minimum wall thickness is maintained in accordance with manufacturing specifications for the cylinder; and

(C) The original manufacturing test date is not removed.

(ii) When the cylinder is fitted with a footing, additional dates may be marked on the external surface of the footing.

(c) *Marking method.* The depth of markings may be no greater than that specified in the applicable specification. The markings must be made by stamping, engraving, scribing or any method approved in writing by the Associate Administrator.

(1) A cylinder used as a fire extinguisher (§ 180.209(j)) may be marked by using a pressure sensitive label.

(2) For a DOT 3HT cylinder, the test date and RIN must be applied by low-stress steel stamps to a depth no greater than that prescribed at the time of manufacture. Stamping on the sidewall is not authorized.

(d) *Requalification markings.* (1) Each cylinder that has successfully passed requalification must be marked with the RIN set in a square pattern, between the month and year of the requalification date. The first character of the RIN 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 requalified in September 1998, and approved by a person who has been issued RIN "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 (b) of this section:

A1

9 32 98

(2) Upon a written request, variation from the marking requirement may be approved by the Associate Administrator.

(3) *Exception.* A cylinder subject to the requirements of § 173.301(l) of this subchapter may not be marked with a RIN.

(e) *Size of markings.* The size of the markings must be at least 6.35 mm ($\frac{1}{4}$ in.) high, except that RIN characters must be at least 3.18 mm ($\frac{1}{8}$ in.) high.

(f) Illustrations of the required marking information for metric-marked cylinders and exemption cylinders after requalification are as follows:

(1) Ultrasonic examination:

9 A1 98 **UT**
32

(2) Volumetric expansion test:

9 A1 98
32

(g) Illustrations of the required marking information for nonmetric-marked cylinders and exemption cylinders after requalification are as follows:

(1) 5-year volumetric expansion test; 10-year volumetric expansion test (cylinders conforming to § 180.209(f) and (h)); or 12-year volumetric expansion test (fire extinguishers conforming to § 173.309(b) of this subchapter and cylinders conforming to § 180.209(e) and § 180.209(g)):

9 A1 98
32

(2) 10-year volumetric expansion test (cylinders conforming to § 180.209(b)):

9 A1 98 **☆**
32

(3) Special filling limits up to 10% in excess of the marked service pressure (cylinders conforming to § 173.302a(b) of this subchapter):

9 A1 98 **+**
32

(4) Proof pressure test (fire extinguishers conforming to § 173.309(b) of this subchapter and cylinders conforming to § 180.209(e)):

9 A1 98 **S**
32

(5) 5-year external visual inspection (cylinders conforming to § 180.209(g)):

9 A1 98 **E**
32

(6) Requalification after a repair procedure and volumetrically tested (cylinders conforming to § 180.211):

9 A1 98 **RP**
32

(7) Requalification after a repair procedure and proof pressure tested (cylinders conforming to § 180.211):

9 A1 98 **RPS**
32

(8) Requalification after a rebuilding procedure:

9 A1 98 **RB**
32

(9) DOT 8 series cylinder shell reinspection only:

9 A1 98 **S**
32

(10) DOT 8 series cylinder shell and porous filler reinspection:

9 A1 98 **FS**
32

§ 180.215 Reporting and record retention requirements.

(a) *Facility records.* A person who requalifies, repairs or rebuilds cylinders shall maintain the following records where the requalification is performed:

(1) Current RIN issuance letter;
(2) If the RIN has expired and renewal is pending, a copy of the renewal request;
(3) Copies of notifications to Associate Administrator required under § 107.805 of this subchapter;

(4) Current copies of those portions of this subchapter that apply to its cylinder requalification and marking activities at that location;

(5) Current copies of all exemptions governing exemption cylinders requalified or marked by the requalifier at that location; and

(6) The information contained in each applicable CGA or ASTM standard incorporated by reference in § 171.7 of this subchapter that applies to the requalifier's activities. This information must be the same as contained in the edition incorporated by reference in § 171.7 of this subchapter.

(b) *Requalification records.* Daily records of visual inspection, pressure test, and ultrasonic examination, as applicable, must be maintained by the person who performs the requalification until either the expiration of the requalification period or until the cylinder is again requalified, whichever occurs first. A single date may be used for each test sheet, provided each test 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; if present, manufacturer's name or symbol; if present, owner's name or symbol and test operator. Blank spaces may not be used to indicate repetition of a prior entry. The records must include the following information:

(1) *Pressure test records.* 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 test operator. The test operator must be able to demonstrate that the results of the daily calibration verification correspond to the hydrostatic tests that were performed on that day. The daily verification of calibration(s) may be recorded on the same sheets as, and with, test records for that date.

(2) *Pressure test and visual inspection records.* The date of requalification; serial number; DOT specification or exemption number; marked pressure; actual dimensions; 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 test, rejection or condemnation; and legible identification of test operator. For each cylinder marked pursuant to § 173.302a(b)(5) of this subchapter, the test sheet must indicate the method by which any average or maximum wall stress was computed. Records must be kept for all completed, as well as unsuccessful tests. The entry for a second test under CGA Pamphlet C-1 after a failure to hold test pressure, must

indicate the date of the earlier inspection or test.

(3) *Wall stress*. Calculations of average and maximum wall stress pursuant to § 173.302a(b)(3) of this subchapter, if performed;

(4) *Calibration certificates*. The most recent certificate of calibration must be maintained for each calibrated cylinder.

(5) *Ultrasonic examination records*. The information prescribed in ASTM E 797 or ASTM E 213 as applicable.

(c) *Repair, rebuilding or reheat treatment records*. (1) Records covering welding or brazing repairs, rebuilding or reheat treating shall be retained for a minimum of fifteen years by the approved facility.

(2) A record for rebuilding, in accordance with § 180.211(d), must be completed for each cylinder rebuilt. The record must be clear, legible, and contain the following information:

Cylinder Identification

Original Manufacturer _____
 Cylinder Specification Number and Service Pressure _____
 Cylinder Serial Number _____
 Date at Original Manufacturer _____
 Other Identification Marks _____

Chemical Analysis of Replacement Parts

Parts Being Replaced _____
 Heat Identification _____
 Steel Manufactured by _____
 Analysis Performed by _____

C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zn

Record of Physical Test of Replacement Parts

Yield PSI	Tensile PSI	Elongation in inches	Reduction in area %	Weld bend	Weld tensile

Record of Volumetric Expansion Test

Calculated volumetric capacity of the cylinder being rebuilt-_____ lbs.

Actual test pressure	Total expansion	Permanent expansion	Percent of total to permanent	Volumetric capacity

(Permanent expansion may not exceed 10% of the total expansion) (Volumetric capacity of a rebuilt cylinder must be within plus or minus 3% at the calculated capacity)

I certify that this rebuilt cylinder is accurately represented by the data above and

complies with all of the requirements in Subchapter C of 49 CFR.

Repair Technician _____

Date _____

Company Representative _____

Date _____

Issued in Washington D.C. on October 15, 1998, under authority delegated in 49 CFR Part 106, Appendix A.

Alan I. Roberts,

Associate Administrator for Hazardous Materials Safety.

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