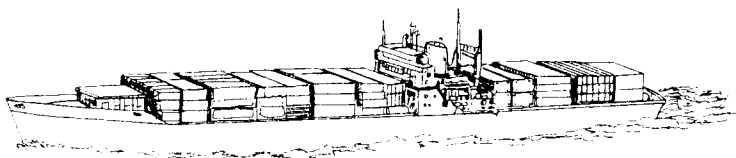


# Shippers' Guide for **Proper Stowage of Intermodal Containers for Ocean Transport**



U.S. Department  
of Transportation

**Maritime  
Administration**

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All of the technical information contained in this publication was prepared by the National Cargo Bureau, Inc., New York. The Maritime Administration wishes to express its gratitude to the National Cargo Bureau for its assistance in the production of this booklet.

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The National Cargo Bureau, Inc. is a non-profit, membership organization dedicated to the safe stowage, securing and unloading of cargo and the safety of shipboard cargo handling gear aboard vessels.

*Cargo Surveyors Since 1820*

## ***This Guide***

has been prepared in an effort to further the successful intermodal carriage of cargo in answer to the requests of shippers. This method of shipping has numerous advantages but like everything else, it has to be done right. We believe if care is taken, claims can be reduced significantly and in many cases eliminated. This booklet has been compiled as a generalized approach to intermodal transport and door-to-door shipments which include rail, highway and ocean.

Whenever the word "container" appears in this publication, it is a reference to an intermodal freight container. The same principles of stowage outlined for such containers may be applied to typical highway trailers that are carried on a roll-on/roll-off ship.

If cargo is shipped in any way other than door-to-door, or if the cargo is to be containerized at some point enroute, use complete export packing.

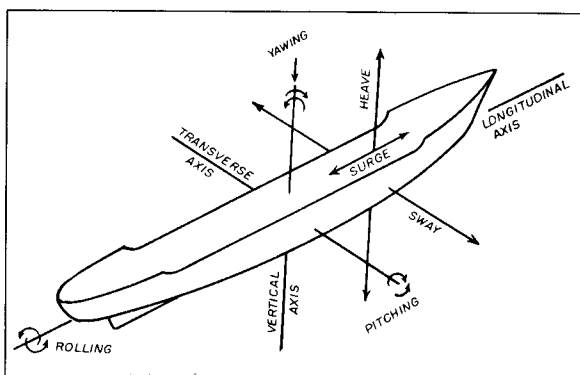
## ***The Goals***

- (1) The safe shipment of cargoes is a primary objective, of course. This is especially important when hazardous cargoes are carried.
- (2) A related goal is the delivery of the cargo in complete, clean and undamaged condition. The information in this booklet may help to assure that outturn.

## ***How***

This requires informed action by all, starting with the shipper who initially offers the cargo for transportation. The shipper should realize that the container will be subject to a variety of motions and forces. (Protection from extreme weather conditions, including ice, snow and a driving rain is effective in a closed container in good condition.) When shipped by highway or rail, cargo may be especially subjected to longitudinal impacts associated with rail car "humping".

The freight container will be lifted from the pier and lowered into position on board a vessel. On a sea passage, it will be subjected to six distinct, basic ship motions: rolling, pitching, yawing, heaving, sway, and surge. (See illustration.) A ship's movement at sea can be a single motion or a complex combination of all of those motions, not duplicated by the other surface modes.



Upon arrival at the final discharge port, the container is again lifted, lowered and then subjected to a repetition of motions associated with the land modes.

## Why

Traditionally, trucks and trailers have been loaded so the cargo will not shift forward or to the rear. From the previous reference to a ship's motion at sea, it is apparent that containerized cargoes loaded for ocean transport must be so loaded (stowed) that the cargo can not move in *any* direction.

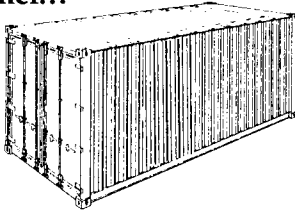
To properly utilize containerization in inter-modal transport, it is necessary for the shipper not only to see that his cargo is properly packaged for containerization, but also that it is properly stowed and secured in the container. If it is not, there may be damage to cargo, container, the vessel or perhaps the carrier's equipment.

**The key person is the shipper and/or the person responsible for loading (packing/stuffing) the container. They should:**

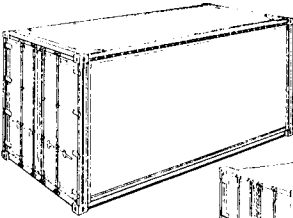
1. Select the right container for the job: Does the cargo need refrigeration, ventilation, special handling equipment, securing devices or special dunnaging in the container? Is it for exclusive use? If in doubt, consult your ocean carrier or container leasing firm.

**You can usually use a General Purpose Container...**

**GENERAL PURPOSE**

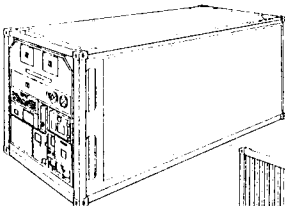
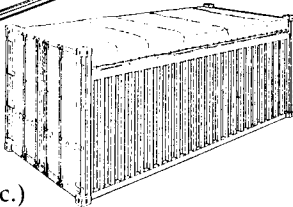


**for special purposes, you may need a particular type such as...**



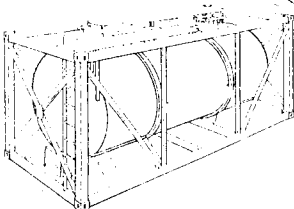
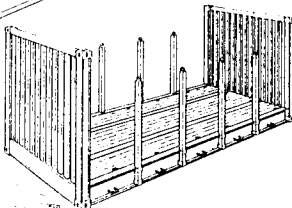
**OPEN TOP**  
(Heavy, large or awkward pieces, etc.)

**VENTILATED**



**REFRIGERATED**

**FLAT**



**PORTABLE TANK  
TANK CONTAINER**  
(Bulk Liquid)

2. Check what the container will hold in volume and weight, and to what standards it has been constructed. (Several major carriers have such information available in booklet form.)

## *Strength Standards*

International uniform strength standards for construction and testing of containers were developed and approved by the Container Safety Convention. The International Organization of Standardization (ISO) recommends that they be constructed so that:

- (1) The **floor** of the freight container should be capable of withstanding a **uniformly distributed** load of not less than the maximum gross weight of the container.
- (2) Each **end** should be capable of withstanding distributed load of not less than 0.4 times the maximum payload.
- (3) Each **side** (length dimension) should be capable of withstanding a uniformly distributed load of not less than 0.6 times the maximum payload.

**CAUTION:** Some containers in use may not be constructed to as high a strength standard. Unless adequately designed and maintained, the ends, doors, or side walls of container should not be relied on to prevent the shifting of loads. (See AAR Bureau of Explosives Pamphlet 6c and circulars no. 43B and 45.)

## *Stresses Encountered On Wheels*

Your container must be properly stowed so that the cargo will not shift. Acceleration and deceleration and railcar "humping" may put extreme pressure on the container ends. Traveling around curves at high speeds will probably cause pressure on the container's sides. Vibration can cause your cargo to "walk" within the container, with a resulting damage to the cargo's packaging that could result in release of cargo.

## *On Board Ship*

If the container is stowed fore and aft, (i.e., so the container length parallels the ship's length)

pressures will be exerted on the end walls when the vessel is pitching. (See previous illustration of vessel motions.) The side walls of the container will undergo extreme pressure internally because the vessel may roll 40° from side to side through arcs of 70 ft. **several times a minute.**

Thus, pressure will be exerted on the sides of the container at the low point of the roll when the vessel then starts its return to an upright position. If the container is stowed crossways, so its length is at right angles to the vessel's length ("athwartships"), then the pressure will be against the end wall and doors of the container. **The cargo must be block-stowed, if in uniform packaging units, or thoroughly secured within the container to withstand that pressure.**

The inside of the typical, modern container is smooth. If your cargo units are also smooth-surfaced, you must use rough dunnage paper or similar coarse material to prevent them from sliding. It may also be necessary to distribute the pressure away from the sidewalls of the container by the use of lumber extending to its top and bottom strength members.

On passenger ships, the staterooms located where there is the least motion are the more expensive ones. However, space on a container ship is not booked like a passenger ship, **thus all cargo in containers should be stowed for the most extreme conditions they may encounter.** On the fully containerized ship, approximately 1/3 of the cargo is on deck above the rolling center and subject to greater accelerations than cargo on general cargo, non-containerized vessels.

## *Container Condition*

**Check your container when it arrives: Is it the type you ordered? Examine it for:**

- (a) Cleanliness. Is it odor free? Is it weather-proof? If it happens to be raining (or there is melting snow on top) that's a good time to check for leaks. Otherwise a visual check can be made by inspecting the freight container from within. If any light enters, then

water will. (If in doubt, spray it with a hose.) Take particular note of the door gaskets and how well the doors close. This is often a vulnerable point.

- (b) If it is fitted with cargo restraint devices, are they in good condition and in sufficient supply?
- (c) Examine the container carefully for physical condition just as if you were buying it. (You are, in a sense – even if only for one trip.) Has it been repaired? If so, does the repair quality restore the original strength and weather-proof integrity? Container repair guides are available from the IICL (see back cover).
- (d) Look at the sides. Examine them carefully to see if any rivet heads have popped. Is the container racked (twisted) or out of line? If so, it has been misused and will probably be inadequate for the safe carriage of your cargo. (Distorted containers are unlikely to fit properly with chassis and handling equipment that must lock into *all* corner fittings.) Have *all* placards and markings applicable to previous hazardous cargoes, precautions or destinations been removed from sides and doors?

**If it doesn't pass these tests, call for another container.**

**Remember:** If you do not give your cargo the right start, it has little chance of arriving in good condition.

(Note: If the containerized cargo is to be class 1 explosives, then U.S. Coast Guard requirements must also be met. [See 49CFR, sections 176.170 and 176.172] National Cargo Bureau is regularly requested to inspect and verify the acceptable condition of freight containers for such cargoes.)

## *Packaging and Marking*

Details for packaging and marking motorized freight are contained in National Motor Freight Classification ATA 111, and those for railroad movement are in the Uniform Freight Classification Rating, Rules and Regulations.

Those packaging details are sufficient for motor freight and rail but are not always adequate for



**ocean** shipments of containerized cargoes. Be sure that the cargo is so packaged that it can not move or be damaged within the package. Package design and construction should also ensure that the bottom tier of packages will not be crushed during transportation, when stacked about eight feet high in the freight container.

Recognized symbols of the American National Standards Institute (ANSI) for marking liquids, sensitive instruments, etc., should be used.

**(If cargo consists of DOT regulated hazardous materials or IMO covered dangerous goods requiring hazard labels, see the "Hazardous Cargoes" section in this pamphlet for package labeling and container placarding requirements.)**

### *Ventilated or Refrigerated Cargo*

Cargoes requiring ventilation or refrigeration need specially constructed containers that meet their environmental requirements during all phases of transportation.

The shipper must state those special ventilation and temperature requirements when ordering freight containers from the container lessor and when booking the cargo with the ocean carrier. Loading such cargoes can present many complexities which experienced personnel are well aware of. This subject is not covered in this brief overview. Additional information may be found in other references such as American President Lines' "Handbook On Shipping Perishable Commodities" and Sea-Land's "Shipping Guide for Perishables."

### *About Stowing and "Stuffing"*

In a sense, the shipper is now stowing the ship because a container ship is loaded with hundreds of small portable cargo "compartments" (i.e., freight containers) offered by numerous shippers of many containerized cargoes.

"Stuffing" has become a commonly used term for the loading of cargo into freight containers. That operation is referred to as "packing" by the International Maritime Organization, IMO. "Stow" is to place or arrange compactly and put

safely in place. This is a traditionally seafaring word meaning to make things ready for sea – to prepare and place cargo and equipment properly for the sea voyage. “Load”, as used by the railroad and trucking industries, is generally synonymous with “stow”.

Whatever you call it, “STOW” your cargo properly in the correct freight container and secure it well. (“Stow” and “secure” are two distinct operations you’ll note.)

## *Weight Distribution and Space Utilization*

**IMPORTANT:** Pre-plan the stowage of the cargo in container. The weight should be spread evenly over the entire length and width of the floor of the container.

For example, if you have a 40’ container with a cargo capacity of 55,000 pounds and a cubic capacity of 2090 cubic feet, and your cargo weighs 55,000 pounds but measures only 1000 cubic feet, it should be stowed about half the height of the container over the entire floor, rather than to the top for one half the length.

If you are stowing cargoes of uniform density (other than heavily concentrated packages), then a proper, even weight distribution is not a problem. Cargoes of various densities are more of a problem.

## *Compatibility of Cargoes*

If the container is loaded with packages of various commodities, give careful attention to their proper segregation and stowage. The commodities physical characteristics (such as weight, size, density) must be considered, as well as whether they are liquids or solids.

Cargo can be of high density, physically hard-to-damage commodities such as galvanized metal sheets, or low density – but also hard-to-damage goods such as mineral wool. Cargoes can be high density, easily damaged electronic components or low density items such as lamp shades. There are numerous possibilities.

A shipper should be aware of previous commodities stuffed in the container, especially if foodstuffs are to be in it.

**Improper stowage** can cause damage to any cargo, including so-called hard-to-damage commodities. For an extreme example, heavy machinery and television tubes would not be considered compatible in the same container. That combination would be risky even if each group was well secured and thoroughly protected from the other by proper blocking, bracing, dunnage or cargo separation devices.

Cargo can be damaged by contamination or taint, either by contact with oil, dirt or dust or by taint or moisture absorbed from other cargo nearby. Damage claims are likely as the result of failure to clean a freight container that previously carried dirty or odorous cargo. Dust from bagged cargo such as cement, sulphur or chemicals, or the use of unclean, green or wet dunnage could also result in damage claims. The mixed stowage of bagged flour and tires would not be considered compatible because it would result in rubber-flavored bread. If an insecticide could contaminate a food-related commodity, for example, the result could be illness and even death. Watch for packaging units bearing "Corrosive", "Poison" or "Harmful – Stow Away From Foodstuffs" labels. They are hazardous commodities that must be segregated from foodstuffs; i.e., any edible commodity used for human or animal consumption.

Each commodity must be considered on the basis of its characteristics and properties when planning its packaging and stowage in containers for shipment. The commodity's compatibility with other cargo in the same container must always be considered.

In order to achieve the proper cube utilization, a compatible configuration of cargo packaging units is also essential. Exposure to damage by chafing, crushing, odor or fume taint and wetting by condensed moisture or leakage must be avoided too.

Segregation of hazardous materials/dangerous

goods within the same or adjacent containers is regulated. Compatibility with other hazardous commodities (and certain nonregulated cargoes) must be in compliance with general and sometimes also specific segregation requirements. (See "Hazardous Cargoes" section that follows.)

## *Hazardous Cargoes*

The U.S. regulations applicable to the transportation of packaged hazardous materials are contained in Title 49, Code of Federal Regulations, Parts 100-178. Those regulations apply to **all** modes.

The international recommendations for such shipments, but as applicable only to the water mode, are published in the International Maritime Dangerous Goods Code. That IMDG Code takes on the force of regulations in each of the countries that have adopted the IMDG Code into their own laws. Thus it should be regarded as a set of international "regulations".

The above-referenced U.S. regulations, usually referred to as "49CFR", apply to packaged hazardous materials for all modes of transportation. Regulations specifically applicable to "Carriage by Vessel" are contained in Part 176 of 49CFR, Parts 100-177.

Both the 49CFR and the IMDG Code specify the regulatory requirements for packaged hazardous materials (the U.S. term) and dangerous goods (the international term) with regard to their:

1. **Classification** by specific hazard class, or class and division numbers, as applicable. (Examples: class 3.3, for high flashpoint, 3.2 for medium flashpoint, 3.1 for low flashpoint flammable liquids; class 6.1 for poison liquids and solids; class 8 for corrosive liquids and solids.)
2. **Description** by selection of appropriate "proper shipping names", hazard classes, four-digit UN numbers and packaging group numbers (for purposes of documentation, package markings and labeling, plus freight container placarding.)

3. **Packaging** in accordance with DOT packaging specifications and/or conformance to UN (United Nations) performance standards. (Effective Jan. 1, 1991, U.S. exports of packaged dangerous goods to "IMO countries" had to meet UN packaging standards and be so marked.)
4. **Marking and labeling** of packaging units to indicate the proper shipping name, UN number and other required information – plus hazard class(es) of their contents. (Numerous materials may have more than one hazard to be identified during their transportation.)
5. **Stowage, segregation and securing** of hazardous materials/dangerous goods within the freight container and aboard ship. (Ref. 49CFR, Part 176, "Carriage by Vessel" and IMDG Code, volume I, Sections 14 and 15. Note, especially, the IMO Container Packing Certificate requirements in para 12.3.7.)
6. **Placarding** of freight containers and tank containers to indicated hazard class(es) of their contents. (49CFR and IMDG Code also require that tank containers/portable tanks be marked with the UN identification number of their contents. The IMDG Code also calls for such UN number markings on freight containers having a single hazardous commodity as a full container load. Note too, that containers may also require markings to indicate "Marine Pollutants" and/or "Inhalation Hazard" type contents.)

In 49CFR the "Carriage by Vessel" part (Part 176) is of particular importance. It also includes a section naming National Cargo Bureau, Inc. as being authorized to assist the Coast Guard. That "Assignment and certification" section, 176.18 states:

"a) National Cargo Bureau, Inc. is authorized to assist the Coast Guard in administering this subchapter with respect to the following:

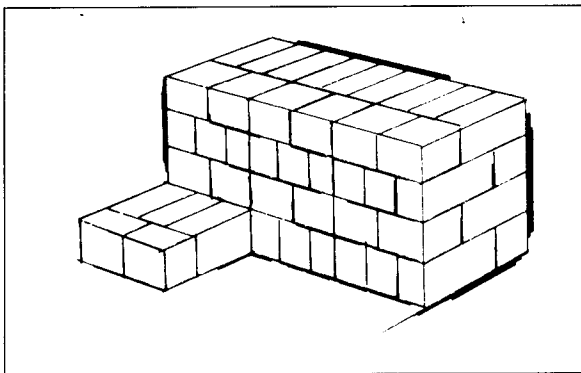
1. Inspection of vessels for suitability for loading hazardous materials;
2. Examination of stowage of hazardous materials;
3. Making recommendations for stowage requirements of hazardous materials cargo; and

4. Issuance of certificate of loading setting forth that the stowage of hazardous materials is in accordance with the requirements of this subchapter.

“b) A certificate of loading issued by National Cargo Bureau, Inc., may be accepted by the Coast Guard as prima facie evidence that the cargo is stowed in conformity with the requirements of this subchapter.” (Reference to “this subchapter” in section 176.18 refers to Subchapter C, Hazardous Materials Regulations of 49CFR, Parts 100-177. A similar “Assignment and certification” section, 148.01-13, is also in 46CFR (Parts 140-155), applicable to solid hazardous materials in bulk.)

### *Stowage of Regular Size Boxes*

The stowage of regular size boxes (including fibreboard) is best accomplished by using the “bonded block method”. To start the block two tiers of boxes are used, one laid sideways and the other lengthways. On starting the second height, the first tier is laid lengthways on top of the sideways tier, and the other is laid sideways on the lengthways tier.



If the box size does not permit a tight stow, tier-for-tier against the sides of the container, the void space in each tier should be staggered with the top tier being secured by filling the void spaces with wooden dunnage, fibreboard filler or other suitable materials to prevent its movement. If boxes are filled with light density material, it may be necessary to fill voids on two top tiers.

Where boxes are stowed in vertical tiers, a floor of plywood dunnage or its equivalent should be laid at half height in the container and the stow continued as before. This is particularly important when stowing small fibreboard or smooth-sided boxes to solidify the stow. It is also necessary in many cases to protect the boxes from crushing.

When boxes are made of a smooth material, rough dunnage paper or similar coarse material should be used between tiers to prevent them from moving, especially under the top tier. It is also important to prevent crushing and chafing.

### *Stowage of Bags and Bales*

The stowage of bagged and baled cargo in containers requires the use of the "cross tier" method in order to minimize pressure on the sides and ends of the container and also to unitize the surface friction against the bottom.

The "cross tier" method is accomplished by alternating the direction in which the successive tiers are laid. In this manner each tier binds the tier below it and the whole block is formed into a unit.

When bales or bags are uneven in size, the tiers should be separated by dunnage or a suitable equivalent to maintain an even stow.

When cotton is carried, it is important to fully comply with 49CFR, Part 176 ("Carriage by vessel") sections 176.900 through 176.904, which include, for example, requirements for fire fighting systems such as CO<sub>2</sub>, steam smothering or water sprinkler type in each hold or compartment in which cotton or fibers are stowed. Ventilation spark screens and numerous other precautions are also called for.

In the case of baled products, care should be exercised to prevent metal bands from chafing, either on each other or on the metal portions of the container. Such chafing can be a potential source of fire, especially when the bales consist of rags, waste paper, fibers or similar combustible or flammable products.

## *Stowage of Drums*

The following recommendations should be noted when metal drums are loaded in freight containers.

Avoid metal-to-metal contact of the rims of drums with floor and sides of containers and between tiers. The use of soft dunnage or plywood is generally suitable for floor and sides.

Four standard 55-gallon drums across the container in one row will normally fit tight against both sides. If slack space remains at one side, drums can be loaded alternately against sides in a recessed pattern. Dunnage or other chafing-preventive materials can be used to fill voids in space between drums and sides of container. There are some cases where the weight of the contents of the drum is too great to permit the above stowage. In such cases, the stowage will depend on the distribution of the weight on the floor of the container.

If a standard container is used for the transport of drums, it is recommended that drums be loaded one high, and the second tier be filled out with other suitable cargo, if available. Otherwise, drums can be loaded two tiers high using wood dunnage (honeycomb board, ideally) or plywood lengthwise between tiers and extending beyond the last row.

**CAUTION:** Don't overload. Check lifting capacity of container. (It is required to be marked on the container doors.) In any case, the second tier of drums should not be loaded so as to cause the container to be unduly heavy at one end.

If only a few drums are loaded in the second tier, they may be blocked off with other suitable cargo using plywood against drums to protect other cargo. (Note: drums should be stowed upright, *not on their side.*)

All drums should be inspected prior to loading. Any showing signs of leakage or significant damage should not be shipped.

Any special instructions on handling of drums and contents should be attached inside the container. (For further information refer to



AAR Pamphlet No. 4 for Recommended Methods of Loading Drums and Kegs .)

## *Stowage of Palletized Cargo Unit Loads*

Handling of palletized cargo or unit loads of bags, boxes or packages of uniform size is a rapid method of stowing a container, but it may not attain maximum cube space utilization, depending upon the commodity being loaded.

Cargo should not overhang the pallets. Only flush pallets should be used. The cargo on pallets should bear on the container's ends and sides to minimize void spaces.

The cargo must be *securely* strapped, shrinkwrapped or overpacked strongly to the pallet to prevent chafing and to keep the stow from shifting. The weight of the cargo on the pallet should *not* be relied on to hold the pallet in place during transport.

There are a variety of ways in which the unit package can be stowed. The ideal situation would require a pallet size that would fit the allotted space with a minimum of chocking. In practice, the pallets should be stowed along each side of the container in rows from front to rear. Any void spaces between should be filled or chocked with suitable material. (For example, high density palletized firebricks can be stowed in two rows inside the container, one down each side. The rows should be shored apart by inner fencing and cross-shoring.)

The importance of filling void spaces in the stowage of palletized packages, not only between pallets, but between the entire unit, cannot be overstressed.

Palletized cargo can be tiered in the container according to the density of the packages. However, if irregular, soft or bagged goods are in the lower tier, plywood dunnage is recommended to level off the top of the lower tier. It may be necessary to construct an intermediate deck or floor to protect delicate or similar cargoes from crushing.

Palletized packaging units of hazardous cargoes, if overpacked, should have their hazard class labels and other required markings visible through the overpack material. If they are not, then the U.S. regulations require that those applicable labels and markings be applied also to the exterior of the overpack materials. (49CFR, 173.25)

## ***Stowage of Wet and Dry; Heavy and Light Cargo***

### **Wet and Dry Cargo**

When the container is to be stowed with both packaged wet and dry cargo, the wet goods should never be stowed above the cargo that is liable to damage from moisture or leakage, nor in an adjacent position where leakage might spread along the floor. The dry goods should either be stowed over the wet or, if on the same level, raised off the floor by an extra layer of dunnage. Leakage is most likely to occur in cargoes of barreled or drummed goods. Due care must always be given to proper stowage and securing of drums to prevent movement within the container. (See section on Stowage of Drums)

### **Heavy and Light Cargo**

Improper stowage of heavy and light cargo together causes crushing and damage to contents. Heavy packages, such as cases of machinery parts and heavy, loose or skidded pieces, should always be stowed on the bottom or floor of the container with lighter goods on top.

Each tier should be kept as level as possible. Lateral crushing should be avoided by carrying the stow out to the sides and ends of the container and filling void spaces with dunnage or an adequate substitute.

Chafing damage is likely to occur due to the motion or vibration of the truck, train or ocean vessel, if packages are loosely stowed. They can rub against each other and against boundaries of the container unless secured from movement. Cargo with little or no covering is especially susceptible to chafing damage. A

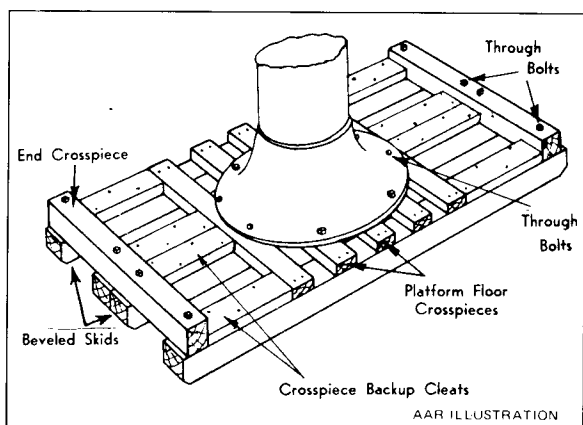
cushioning material should be used to protect against this type of damage.

## *Stowage of Heavy Machinery*

### **Unboxed Machinery**

There are too many different sizes and types to offer a particular procedure to cover all machinery. However, the following information must be obtained on each shipment:

1. Overall size and weight of the piece.
2. Maximum allowable load, cubic capacity and internal dimensions of the available freight containers.
3. Availability of special handling equipment to get the machinery properly into the container (at the loading location) and out of it (at the ultimate destination) without damage.
4. Selection of the suitable container, as based on review of freight container specifications available from ocean carriers and container leasing firms.



In order to distribute weight of the piece, it must be bolted on a skid made of heavy timbers bolted together so that the lower members extend in a fore and aft direction in the container. If the skid is constructed so that it just fits through the container door, it will be easier to chock it to the container side frames (and/or steel container walls) and will afford better weight distribution. If the shape of the piece is such that it cannot be skidded as above to

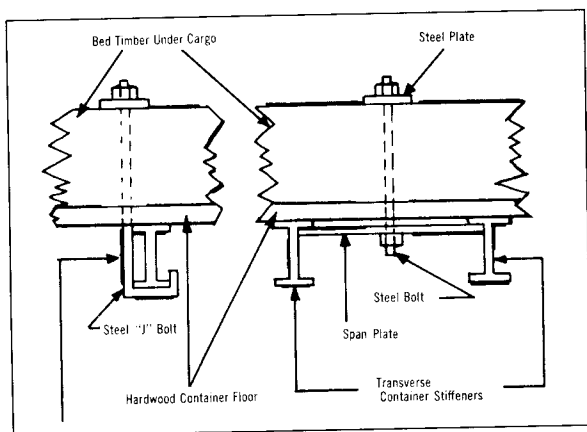
properly distribute the weight, then additional bedding must be laid in the container prior to loading.

The construction of containers requires that any shoring must contact the structural members (side rails) only, and the pressures thus formed be distributed by additional longitudinal members placed along the lower sides. Any vertical shoring should be to corners and roof rails only.

An effective method of immobilizing the piece in the container is to bolt the skid through the floor using "J" bolts where structural cross members can be utilized without projecting below the lowest extremity of the container. An alternate system employs thru bolts and spanner plates, as shown in the accompanying diagram. The use of bolts will cause less damage to the floor than spikes. Any holes required can be easily plugged after the machinery is removed.

In securing machinery, it should be borne in mind that a heavy piece with a high center of gravity on a narrow skid will require more securing than a similar piece on a wide skid.

### Suggested Methods of Securing Bed Timbers to Container



**IMPORTANT:** This method can only be used if the Transverse Stiffener on which the J Bolt is secured is not as deep as other frames or stiffeners. This is to prevent the J bolt from holing the top of the container stowed below.

Sizes and quantity of bolts, timbers and plates will depend on the weight and size of the piece of machinery being secured.

### ***Boxed and Crated Machinery***

When stowing boxed or crated machinery, the same guidelines relative to weight distribution and total weight should be observed, as with any containerized cargo.

As with unboxed machinery, all shoring or bracing should bear on only the strength members of the container.

Heavy crates or boxes should be stowed on the bottom with lighter ones on top. Care should be taken that any concentrated weights in the upper tier are distributed by the generous use of dunnage or plywood separation of sufficient thickness. This is especially applicable when it becomes necessary to stow units of smaller base dimension over larger ones.

Particular care should be exercised to insure that the machinery is well secured within its individual package. Any void spaces between cases should be filled or cases chocked to prevent movement in any direction.

### ***Stowage of Heavy Concentrated Weight***

When planning the stowage of heavy concentrated weights, careful consideration must be given to the maximum permissible weight and the floor loads allowed in the container. The bedding required to properly spread the weight should be arranged with weight distribution factors in mind.

This bedding should consist of lumber of sufficient thickness that will not deflect under the planned load, with the bottom bearers placed longitudinally in the container. The cargo piece or pieces should be bolted to cross members resting on the longitudinals. The cross members must be adequately bolted or fastened to the bottom pieces with backup cleats placed where necessary.

If the outer longitudinals are not snug to the lower side rails, they should be blocked to them

with long timbers placed as a filler pieces along the lower container side to distribute the pressure.

Where cargoes have high centers of gravity, they should be either lashed or banded – if padeyes are available or the bedding is bolted through the container floor – as discussed under “Stowage of Heavy Machinery.”

Flat pieces with low centers of gravity should be floored off and chocked using steel banding, if necessary, for securing.

The same principles of securing can be adapted to side-loading containers, or flats for cargo that does not require protection from the weather.

## *Securing*

Fill it or secure it. Use dunnage or retainers in box. Block it out. Leave no void spaces or loose packages on top. Smooth metal-to-metal contact should be avoided as this causes a slippery surface. The slogan, “Stick it tight to ride right,” is a good one. Remember, typical trucking and railroad cargo securing guides stress stowing to prevent the longitudinal movement in the container. For ocean transport, however, the same rules should be applied to prevent additional sideways movement.

Avoid direct pressure on doors, use a proper fence or gate to fill any void space. (See AAR Pamphlet 6C, and Circulars nrs. 43B & 45.)

When stowing or loading the cargo in the container, you have a regulatory responsibility to do it right. The securing techniques and materials used should be more than just “adequate”, when ocean shipments are involved.

Check that package hazards labels and container placards, if required, have been applied. (See “Hazardous Cargoes” section.)

Finally, secure the doors, lock and seal them, note the seal numbers for insertion on the Bill of Lading.

National Cargo Bureau, Inc. is available to help you in such matters.

## AN OVERVIEW

### General Guidelines in Checklist Format for THE CONTAINERIZATION Of Packaged Hazardous Materials/Dangerous Goods

- I. **BASIC VISUAL INSPECTIONS** prior to packing (stuffing) the freight container:
  - A. Inspect the container to be used. Check for structural defects, including door seals, holes in roof, and projecting screws, nails or bolts in floor; and check CSC Safety Approval Plate (Convention for Safe Containers) on container doors.
  - B. Remove remaining labels, marks and placards that are no longer relevant for the containers next load.
  - C. Make certain that there are no residues of prior cargoes that may cause contamination, odors, tainting, or health and safety risks for stuffing personnel. The container should be clean, dry, free of residue and odors and fit for use when received from the container lessor or carrier.
  - D. Check all hazmat items against shipping papers and physically examine all packages to be loaded. Check for damage, signs of leaking or loss of contents, and verify marks and labels on all hazmat commodities, as required by hazmat regulations.
- II. **CHECK SEGREGATION REQUIREMENTS** prior to stuffing.
  - A. Determine if there is a *general* class segregation requirement applicable to the various hazard classes of the hazmat items. (Ref. IMDG Code Segregation Table 15.1.16 in vol. I, Section 15, pg. 0117—or the comparable “General Segregation Table” table in 49CFR, sect. 176.83(b).) If two different hazard labels are on a package, then *both* of the hazards involved must be considered in determining if segregation is required.
  - B. If there are no class (i.e., general) segregation requirements, check the individual pages of the respective hazmat commodities to see if a *specific* segregation requirement may apply. If so, it has precedence.

Example: some poison (6.1) Cyanide compounds require specific segregation "away from" or "separated from" acids. Class 6.1 poisons, however, have *no general* segregation from class 8, Corrosives – which would typically include acids.

Comparable requirements are indicated in 49CFR, sect. 176.84 where column 10B ("Other stowage provisions") of the HM Table 172.101 are listed and explained

- C. An exception to the segregation regulations applies if the hazmat commodity requiring separation from the others is offered and documented on the shipping papers as a "limited quantity". ("Ltd. Qty" is the abbreviation permitted by DOT in 49CFR.) Example: a class 3 flammable liquid and a class 2.1 flammable gas are not permitted in the same freight container because of the general segregation requirements. If, however, either the class 3 or the 2.1 (or both) qualify as and are documented as being "limited quantities", then they are allowed to be stowed in the same freight container.
- D. Foodstuffs – broadly considered as any edible products intended for human or animal (including pets) consumption, or for use as an ingredient in such – should generally not be stowed in the same freight container with chemicals, simply as a matter of sound stowage practice.

When hazardous materials/dangerous goods are involved, then food-related commodities are obviously not to be stowed with hazmat items bearing "Harmful – Stow Away From Foodstuffs" labels or, either as primary or subsidiary risk, a "Poison" label.

Less well known are the 49CFR (Part 176) requirements to also stow foodstuffs away or separated from hazmats packagings with labeling as "Corrosive" or "Poison Gas". There is no regulatory segregation exception for "limited quantities", when foodstuffs are concerned.

### **III STOWING and SECURING PACKAGED HAZARDOUS MATERIALS WITHIN the CONTAINER**

- A. Plan the stowage before starting the loading operation. Consider the physical properties



and chemical characteristics of the various commodities as well as the type packaging used.

Calculate, as closely as possible, the total weight of the intended cargo and verify that it is within the permitted payload weight, according to the containers CSC Safety Approval Plate.

Weight should be evenly distributed over the entire floor area. Drums should be stowed upright, normally not on their sides. Liquids should be always stowed upright according to the package orientation marks or arrows on the packaging units. Gas cylinders must have steel safety caps over the valves.

- B. A tight stow from wall to wall should be attempted to minimize the potential for shifting or movement during transit—especially for an ocean voyage. When securing packaged, containerized cargoes with use of air bags, do not use them at the door end.

Note, especially, the requirements of 49CFR, Part 176, Carriage by Vessels, sect. 176.76 which includes, for example, requirements to: (1) secure *all* packages in the container to prevent movement in any direction, (2) use dunnage to the level of the cargo, if cargo doesn't extend to the sides or ends of the container, (3) secure dunnage to the floor when cargo consists of "dense materials or heavy packages", (4) slack spaces between packages must be filled with dunnage.

#### **IV PLACARDING THE FREIGHT CONTAINER**

- A. *Placards* are the enlarged version (10.8" x 10.8") of the smaller (approx. 4" x 4") diamond-shaped labels applied to the hazmat packaging units. The placards are to be applied to both sides and both ends of the container. They are to correspond to the hazard class labeling on the hazmat packaging units inside the container, but 49CFR Placarding Tables 1 and 2 in section 172.504 should also be consulted.
- B. Placarding requirements are found in 49CFR, Part 172, Subpart F, starting with section 172.500 which states that DOT placarding requirements in subpart F do *not* apply to:

(1) Infectious substances, (2) ORM-D classed hazardous materials, (3) *Limited Quantities*, when properly identified on shipping papers, (4) "small quantities", as covered in 173.4, (5) Combustible liquids in non-bulk packagings.

Section 8 of the IMDG Code provides IMO placarding-related information. The minimum dimensions of IMO size placards are 10" x 10", which is about 3/4 inch small than the DOT size. Note, however, that placarding of containers moving under IMDG Code provisions in the U.S. is allowed by the DOT in 49CFR, sections 171.12(b), 172.502(b) and 172.519(f).

(The 49CFR Subpart F illustrates placards but not in color. DOT's label and placard chart #10 is expected to be available in the Fall of 1993.)

- C. Although often referred to as a placard, the container *marking* requirement as "Marine Pollutant" must also be applied near each hazard placard when dangerous goods qualifying as such are in the container in any quantity. Such marking requirements in the IMDG Code (Section 7.4) will also become DOT requirements on October 1, 1993.

When all of the container's packaged dangerous goods consist "of a single commodity" which "constitute a full load", then the UN number should also be displayed either in the lower half of the placard or on an orange rectangular panel near the placard, as detailed in 7.4.4 of the IMDG Code, page 0027. (Not applicable to explosives.)

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#### Suggested references.:

- IMDG Code, vol. I, para 12.3, Container Packing & Certification and especially 12.3.7
- "IMO/ILO Guidelines for Packing Cargo in Freight Containers or Vehicles" (included in IMDG Code "Supplement" volume)
- 49CFR, Sect. 176.76
- "Shipper's Guide to Loading and Securing of Packaged Hazardous Materials in Intermodal Equipment—Rail, Highway, Water", 1986, Delvalco

Publications referred to in this brochure  
(and/or related information) are available  
from the following sources:

**AAR-Association of American Railroads,  
and AAR Publications Service**  
50 F. Street, NW, Washington DC 20001, U.S.A.  
Tel. (201) 639-2100

**ANSI-American National Standards  
Institute**  
1430 Broadway, Oakland CA 94607, U.S.A.  
Tel. (212) 642-4900

**APL-American President Lines**  
1111 Broadway, New York NY 10048, U.S.A.  
Tel. (510) 272-8387

**ATA-American Trucking Association**  
2200 Mill Road, Alexandria VA 22314, U.S.A.  
Tel. 1-800-ATA-LINE

**DOT-Department of Transportation**  
RSPA, Nassif Bldg., Washington DC 20590-0001, U.S.A.  
Attn.: International Standards Coord.  
Tel. (202) 366-0656

**GPO-US Government Printing Office**  
Superintendent of Documents, Washington DC 20402, U.S.A.

**IIL-Institute of International  
Container Lessors**  
Box 605, Bedford NY 10506, U.S.A.  
Tel. (914) 234-3696

**IMO-International Maritime Organization**  
4 Albert Embankment, London SE 1 7SR, ENGLAND

**ISO-International Organization  
of Standardization**  
Case Postale 56, CH-1211, Geneva 20, SWITZERLAND

**Lykes Bros. S.S. Line, Inc.**  
300 Poydras Street, New Orleans LA 70130, U.S.A.  
Tel. (504) 528-1250

**Matson Terminals Corporation**  
1001 New Dock Street, Terminal Island  
Long Beach CA 09731, U.S.A.  
Tel. (310) 519-6414

**NCB-National Cargo Bureau, Inc.**  
(See inside front cover for details.)

**Sea-Land Service, Inc.**  
P.O. Box 1050, Elizabeth NJ 07207, U.S.A.  
Bulk/Hazardous Commodities  
Tel. (908) 820-7183

**U.S. Coast Guard**  
Marine Technical & Hazardous Materials  
Branch (G-MTH-1), Washington DC 20593-0001, U.S.A.  
Tel. (202) 267-1577; Fax (202) 267-4816