

SECTION F: CARRIAGE OF HAZARDOUS MATERIALS

CHAPTER 3: CARRIAGE OF BULK LIQUID CHEMICALS

A. CRITERIA FOR REGULATION

The liquid chemicals regulated as "hazardous materials" under 46 CFR, Subchapter O (Certain Bulk Dangerous Cargoes) have one or more of the following properties:

- Unusual flammability (e.g., wider flammable limits, lower auto-ignition temperature), compared to normal petroleum products;
- Toxicity (chronic or acute);
- Corrosivity;
- Self-reactivity (polymerization);
- Instability or unusual reactivity;
- Pyrophoricity (auto-ignition); or
- Marine pollution (damage to marine resources, bio-accumulation, tainting of seafood, reduction of amenities).

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B. PRODUCT EVALUATION

1. Initial Review

Before a new liquid product (or "commodity") may be shipped in bulk, the shipper or manufacturer submits a completed Form CG-4355, Characteristics of Liquid Chemicals Proposed for Bulk Water Movement, or the International Maritime Organization (IMO) equivalent, Circular Letter No. 944, "Characteristics of Liquid Chemicals Proposed for Marine Transport in Bulk," to the Hazardous Materials Standards Division, Commandant (G-MSO-3). The data on this form, along with other information in available literature about the product, are then evaluated. Based on the properties of the product, a decision is made to place it in one of the following four categories:

- Flammable or combustible liquid regulated under 46 CFR, Subchapter D;
- Hazardous or polluting materials regulated under 46 CFR, Subchapter O;
- Too dangerous to be shipped in bulk; or
- "Unregulated."

2. Authorization for Shipment

If a product that is offered for shipment is not included within one of these categories and the shipper cannot produce written authorization for shipment, Commandant (G-MSO-3) can be contacted by telephone (commercial/FTS: 202/8-267-0103). Until the product has been evaluated and authorized for shipment, it is considered prohibited for bulk carriage. If the product is within the purview of Subchapter O, tentative minimum requirements for its safe carriage are developed. Commandant (G-MSO-3) advises the shipper and all district commanders (m) and the Marine Safety Center (MSC) of these requirements by letter or telex. This facilitates movement of the product, prior to adoption of the minimum requirements as a final rule. Eventually, the product is included in 46 CFR Table 151.05, Table I of 46 CFR 153, or Table 4 of 46 CFR 154.

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3. **Regulatory Control** If the product has no significant hazards, other than flammability or combustibility, it is regulated under 46 CFR, Subchapter D. If it possesses one or more of the properties listed in section F3.A above, it is regulated under Subchapter O.

NOTE: The definitions of "flammable" and "combustible" in Subchapter D differ from those in 49 CFR, Subchapter C.

A list of products regulated by neither Subchapter D nor Subchapter O is given in Appendix I to 46 CFR 153. Cargoes that have been reviewed but are presently not permitted in bulk in U.S. waters are:

- Acrolein;
- Chlorine (on self-propelled vessels);
- Ethylenimine;
- Hydrofluoric Acid;
- Hydrogen;
- Hydrogen Chloride;
- Hydrogen Fluoride;
- Methylcyclopentadienyl Manganese Tricarbonyl;
- Nitric Acid (greater than 70 percent concentration);
- Nitrogen Tetroxide;
- Oxygen;
- Phosphorus Trichloride; and
- beta-Propiolactone.

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C. PRODUCT CLASSIFICATION

1. **General Requirements**

Generally, products should not be shipped under trade names, but rather under one of the names in the four categories given in paragraph F3.B.1 above. The only exception is a mixture consisting solely of products listed in Subchapter D or "unregulated" products. Among the characteristics of interest in classifying a particular product and developing minimum requirements for its carriage in bulk are:

- Flashpoint;
- Vapor pressure;
- Flammable limits;
- Auto-ignition temperature;
- Temperature of carriage;
- Boiling and freezing points;
- Toxicity of liquid and vapor;
- Reactivity with itself, air, water, or materials of construction;
- Corrosivity to human skin and materials of construction; and
- Marine pollution potential.

These and other chemical and physical properties are evaluated to determine requirements for safe carriage, such as hull type, temperature and pressure of carriage, vent height, gauging and venting types, firefighting media, materials of construction restrictions, and electrical class and group. The overriding principle used in developing requirements is containment of the product, commensurate with its hazards.

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- 2. Sample Evaluations** Caustic soda (sodium hydroxide) is highly corrosive to human skin. It is also nonflammable and nontoxic, has virtually no vapor pressure, and is not corrosive to mild steel. Accordingly, this product has minimum requirements for carriage in a single-hull vessel, with open gauging and venting, no specified vent height, no special firefighting media, and no special electrical equipment requirements. However, aluminum is not allowed in construction due to its corrosion by caustic soda and the associated generation of hydrogen. By contrast, allyl chloride is highly flammable and toxic, becomes more corrosive when wet, and has a relatively high vapor pressure. Accordingly, the requirements for its carriage specify separation from the vessel's hull, closed gauging and controlled venting (pressure-vacuum valves), a high vent, and special firefighting media and electrical equipment. The pressure-vacuum valve is required to be set at or above 21 kilopascal (kPa) gauge (3 psig) to minimize the venting of cargo due to tank breathing.
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- 3. Awareness** Data on the properties of these products is important to merchant mariners and to marine inspectors as well. For their own safety, inspectors obviously must be aware of the properties of cargoes handled while they are aboard a vessel. Also, particular cargo properties may influence the officer in charge, marine inspection (OCMI) requirements for correction of deficiencies found during routine inspections.
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- 4. Sources of Information** The inspector can usually find all necessary information on product properties in the latest editions of the Chemical Data Guide for Bulk Shipment by Water, Commandant Instruction (COMDTINST) M16616.6, and the Chemical Hazards Response Information System (CHRIS) Manuals, COMDTINST M16465.11 and .12. For more information on product properties or advice on certain requirements, Commandant (G-MSO-3) may be contacted at 202-267-0103.
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D. POLYMERIZATION

1. Introduction Certain chemical products, called monomers, are required to be "inhibited" to prevent polymerization during transportation. A polymerization reaction is generally exothermic (characterized by the release of heat) and usually leads to the formation of a solid. Depending on the rate of reaction, polymerization may occur violently, causing severe structural damage by over-pressurization, or very slowly, resulting only in blocked transfer lines. Unfortunately, it is not precisely known which monomers will behave violently in specific instances. Accordingly, the possibility of cargo polymerization must always be viewed as a serious matter.

2. Use of Inhibitors Inhibitors are chemicals added to the monomer to help prevent its self-reaction. The regulations identify which cargoes need inhibitors, although they do not specify types or amounts. They also require the shipper to furnish a cargo certificate identifying the inhibitor used, the amount, the duration of its effectiveness, any temperature limitations, and actions to be taken if the length of the voyage exceeds the duration of the inhibitor (see 46 CFR 153.912 and 154.1818).

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E. CHEMICAL TANKSHIPS

1. Introduction The modern chemical tankship is a small, sophisticated vessel, usually of 20-30,000 deadweight tons (dwt) and having up to 42 tanks. These tanks are often coated, lined, or constructed of stainless steel. Such protective measures enable the carriage of cargoes that normally attack mild steel, and ensure product purity. Piping and pumping systems are more highly segregated on these vessels than on conventional tankships, and deep well or submerged pumps are used in lieu of the traditional pumproom. The tanks are generally smaller, since most chemical cargoes are shipped in relatively small parcels. Hence, the terms "parcel tankers" and "drugstore ships" have been used to refer to this class of ships.

2. Chemical Tankship Operations The nature of the chemical trade is such that chemical tankship operations differ somewhat from those of conventional petroleum product tank vessels. Because of the small size of most cargoes, the parcel tanker usually visits many ports, sometimes moving among several berths in each port on a voyage. Others, however, are dedicated to a particular cargo carried on a regular route. As a result, some parcel tankers are approved for only one or two products, although most may carry many products. In general, chemical tankships carry chemicals that are flammable and similar to petroleum products in some respects, and they often carry "clean products." Consequently, U.S. chemical tankers are certificated under 46 CFR, Subchapter D and endorsed to carry products under 46 CFR, Subchapter O. The requirements in Subchapter O supplement, rather than supersede, the requirements of Subchapter D, unless stated otherwise.

3. Applicable Regulations The regulations for chemical tankships are contained in 46 CFR 153 (Safety Rules for Self-Propelled Vessels Carrying Hazardous Liquids). In accordance with the IMO Bulk Chemical Code, they became fully effective for existing tankers on 12 April 1978. The only provisions of the regulations with which existing tankers need not comply are:

Subject	CFR Cite
Damage stability	46 CFR 172.130 and 133
Door location	46 CFR 153.202
Tank location	46 CFR 153.230 and 231
Accommodation space location	46 CFR 153.234

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- 4. Miscellaneous Considerations** The damage stability requirements for existing chemical tankers are described in paragraph F3.F.4 below. Tank location requirements are relaxed for existing tankers, except that the distance between a Type II containment system and the vessel's bottom may not be less than 760mm (30 inches). These considerations are handled by the MSC and Commandant (G-MSO). However, the inspector will be concerned with the relaxed provisions for accommodation spaces and door locations. Currently, the regulations do not prescribe specific standards for accommodation spaces in midship deckhouses on existing parcel tankers. It also has been found impractical to demand compliance aboard existing ships with the door location requirements of 46 CFR 153.202. The Coast Guard and other IMO administrations have agreed to guidelines for the treatment of midship houses and door locations on existing ships. These are provided in paragraph F3.F.3 below.
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**F. SAFETY RULES FOR SELF-PROPELLED VESSELS CARRYING HAZARDOUS LIQUIDS
(46 CFR 153)**

1. Introduction As with any set of regulations, several areas in 46 CFR 153 have been modified, interpreted, and clarified, as problems in their application were encountered. The following guidance was developed to ensure uniformity in the interpretation and application of 46 CFR 153. Technical problems in applying these regulations should be brought to the attention of Commandant (G-MSO-3) at 202-267-0103.

2. Applicability Inquiries have been made concerning the application of 46 CFR 153 to a parcel tanker carrying cargoes regulated under Part 153 only in a limited area of the cargo containment/tank section of the vessel. Many people have supposed that 46 CFR 153 would not apply to any areas of the cargo containment/tank section, if subject cargoes were not carried in these areas. An extension of this logic would lead to the treatment of individual tanks and piping systems as separate zones, subject to either 46 CFR 153 or Subchapter D. This approach, however, was never intended by the Commandant. While some situations may warrant special considerations, and although cargoes regulated under 46 CFR 153 may be carried in only some of the cargo tanks, Part 153 standards for fire protection, ballast piping and equipment, electrical equipment, personnel safety, and operational requirements shall be applied to the entire cargo containment section of the vessel.

3. Standards for Midship and After Deckhouses Aboard Existing Vessels (46 CFR 153.7(c)(3)-(5)) Under 46 CFR 153.7(c)(3), (4), and (5), allowances have been made for existing vessels not meeting 46 CFR 153.234 requirements (i.e., vessels that have midship deckhouses). Additionally, such vessels often cannot comply with 46 CFR 153.200 and 153.202 (General Vessel Arrangements) requirements. The IMO Chemical Code made allowances for existing vessels with midship deckhouses, but did not specify initially how such vessels would be treated. The IMO later adopted a U.S. proposal for uniform interpretation of this topic. As a result, existing chemical tankers having an accommodation space in a midship deckhouse within the boundaries of the cargo area, may continue to operate with this arrangement. When toxic cargoes (those for which 46 CFR 153.526 is given as a special requirement in Table I of 46 CFR 153) or flammable cargoes are carried in the cargo tanks below the midship house, the following standards shall be applied:

- | | | |
|-----------------------------------------------|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cargo Tank and Accommodation Space Boundaries | a. | Accommodations are not allowed in the space bounded by the tops of the cargo tanks and the first deck of the midship deckhouse (referred to as the "bridge space"). |
| No Through Deck Penetrations | b. | Cargo tank tops forming a boundary of the bridge space shall be free of any through deck penetrations, such as cargo tank hatches, Butterworth openings, deep well pumps, ullage openings, and sounding tubes. |

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Deck Penetrations

- c. Electrical cables, pipe runs, and other penetrations in the first deck of the midship deckhouse, immediately above the cargo tank tops, are allowed, provided they are made gastight. Doors, hatches, and other access openings in this deck of the midship house are not permitted.

Ventilation Systems

- d. When the bridge space is bounded by a bulkhead at either side at the fore or aft end, the ventilation system must meet the requirements of 46 CFR 153.312 and 110.15-1(b)(16). The increased ventilation rate prescribed in 46 CFR 153.316 does not apply to the bridge space, regardless of the cargo carried.

Electrical Installations

- e. Electrical installations within the bridge space shall meet the requirements of 46 CFR, Subchapter J.

Non-Welded Fixed Cargo Piping Joints

- f. Except for approved connections to shut-off valves and expansion joints, runs of fixed cargo piping with non-welded joints shall not be permitted in the bridge space.

Equivalencies

- g. For existing vessels that are unable to meet the requirements of 46 CFR 153.200 and 153.202, the following measures are considered to provide an equivalent standard of safety, and are acceptable in accordance with 46 CFR 153.10. These measures apply to the carriage of any cargo listed in Table I of 46 CFR 153, in any tank on the vessel:

- (1) Portlights located on the forward bulkhead of the aft deckhouse accommodation and on the midship house bulkheads facing the cargo area, except for wheelhouse windows, shall be fixed (i.e., incapable of being opened) and gastight. Wheelhouse windows shall meet the requirements of 46 CFR 153.200. Doors in the forward bulkhead of the aft deckhouse accommodation, that access the cargo tank deck, shall be permanently sealed. Where existing arrangements preclude this, a suitable airlock arrangement at the door location shall be provided. This installation must include a gastight, self-closing metal outer door and a "substantially gastight," self-closing inner door (the inner door shall be at least a metal joiner door). The airlock space between the doors shall be mechanically ventilated from a nonhazardous location and maintained at overpressure to the space outside the airlock. An audible and visual alarm system shall be provided to give warning on both sides of the airlock, if both doors are open simultaneously.
- (2) Portlights on the side of the after deckhouse must also be fixed and gastight, if they are located:
 - (a) On the first deck (tier) above the cargo deck; and
 - (b) Within 10 feet of the forward bulkhead, or within that distance aft of the forward bulkhead to the first side door, whichever is less.

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- (3) Doors located more than 2.4 meters above the cargo tank deck and facing the cargo tank area shall be "substantially gastight" and self-closing. This provision applies to doors on the aft deckhouse accommodation, as well as the midship house (the Commandant has determined that solid metal or wooden joiner doors, except those having screens or louvers, will fulfill this requirement).
- (4) Because accommodations are not allowed in the bridge space, doors accessing the cargo tank deck from the bridge space are exempt from these requirements.
- h. Some existing chemical tankers have been constructed so that the after accommodation spaces partially extend over a cargo pumproom (which forms the after end of the cargo tank area). If this pumproom services tanks that carry cargoes regulated under 46 CFR 153, the ventilation requirements of 46 CFR 153.312 and 153.316 for the pumproom must be met. The pumproom ventilation system must be in operation at the following times:
 - (1) During all phases of cargo handling and transfer;
 - (2) During tank cleaning and gas-freeing; and
 - (3) Whenever work involving equipment within the pumproom is undertaken.

**4. Damage
Stability
Requirements
for Existing
Vessels**

- General
- a. General. 46 CFR 153.7(c)(3) and (5) permit the endorsement of an existing vessel's cargo containment system as Type II or Type III, if the vessel has a Load Line Certificate and meets any additional requirements listed. Existing vessels need not meet the damage stability requirements of the IMO Chemical Code. Since 46 CFR 153 was developed from the Chemical Code, 46 CFR 153.7(c)(3) and (5) provide a similar waiver for existing vessels. Accordingly, such vessels need not meet the damage stability standards of 46 CFR 172.130, 172.133, and 153.231(b).

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Endorsements for Type II Containment b. Endorsements for Type II Containment. 46 CFR 153.7(c)(3) imposes tank shell separation requirements for the endorsement of Type II systems. A valid Load Line Certificate does not guarantee that an existing vessel meets any particular damage stability standard, or that damage stability calculations were ever made. Consequently, the requirement for the Load Line Certificate under 46 CFR 153.7(c)(3) and (5) should be considered in this context.

Requirements for Conversions c. Requirements for Conversions. 46 CFR 153.7(c)(4) stipulates that existing vessels undergoing conversions, by addition of double bottoms or wing tanks, for upgrading to a Type II containment system, must meet the damage standards of 46 CFR 153.135 and 153.150 in all areas of the vessel, except the machinery spaces. Damage stability calculations are required for modifications of this nature and other structural modifications.

5. IMO Certificates A vessel that meets the definition of an existing vessel under 46 CFR 153.7(a)(2), and whose keel was laid after 12 April 1972, is considered a "new" vessel under the IMO Chemical Code. If the owner of such a vessel applies for an IMO Chemical Code Certificate of Fitness (COF), the vessel is required to meet the requirements of 46 CFR 153 and the recommendations of the IMO Chemical Code as applicable to new ships. (46 CFR 153.12)

6. Hull Type Calculations and General Vessel Arrangements For existing vessels see paragraph F3.F.4 above regarding damage stability standards and paragraph F3.F.3 above concerning standards for midship and aft deckhouses. (46 CFR 153.19, 172.130-150 & 46 CFR 153.200-202)

7. Personnel Emergency and Safety Equipment

a. 46 CFR 153.214(a). Under section 3.16.9 of the IMO Chemical Code, only one stretcher is required (see paragraph F3.F.29 below).

b. 46 CFR 153.214(c). 46 CFR 153 contains no standards for evaluating first aid kits; any first aid equipment will be sufficient to meet this requirement.

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- 8. Access to Void Spaces** Access to Void Spaces (46 CFR 153.217) and Cargo Tank Access (46 CFR 153.254).
- a. General. Different criteria apparently have been applied in several cases to distinguish an access opening and an access trunk to a cargo tank or void space. For example, access openings to void spaces and cargo tanks having 24-inch high coamings are not considered to be access trunks under 46 CFR 153.254(d). Access trunks are larger to account for internal projections, such as side-mounted ladders, that decrease the effective cross-sectional area of the opening. Whether or not an access opening to a cargo tank or void space is considered as an access trunk depends upon the placement of mounted ladders and the resultant cross-sectional area.
 - b. Access Requirements. Horizontal access openings (e.g., hatches and manholes) must be of sufficient size to allow a person wearing a breathing apparatus to ascend or descend any ladder without obstruction. Minor relaxations of these standards will be permitted for existing vessels, if the existing horizontal access openings allow a person wearing a breathing apparatus to enter or leave a space freely. Enlarging an access opening to the dimensions required under 46 CFR 153.254, might impair the structural integrity of the tank or space. The intent of this section will be met if such an access opening is enlarged, as much as possible, without impairing the structural integrity of the space.

- 9. Type II Containment Systems** → See paragraph F3.F.4 above concerning the damage stability requirements for existing vessels. (46 CFR 153.231(b))

- 10. Fore and Aft Location** → See paragraph F3.F.3 above. (46 CFR 153.234)

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11. Piping System Design (46 CFR 153.280) Under 46 CFR 56.10-5(d), plastic pipe and fiber glass-reinforced plastic (FRP) pipe, such as "Bonstrand," shall not be used in transfer systems for flammable or combustible cargoes. Acceptable materials and specifications for piping systems are given in 46 CFR 56.60. The Commandant has recognized the need aboard parcel tankers to load relatively small quantities of hazardous cargoes, without using the usual manifold or pumproom arrangements. "Direct loading" with portable piping and hoses is considered a suitable alternative. When loading larger quantities (i.e., one cargo is loaded into more than two tanks), fixed piping is required. Direct loading through a fixed drop line or deep well pump stack from a portable piping system must comply with the following requirements:

- a. All connections between hoses, pipes, fixed drop lines, and deep well pumps shall be made in accordance with 33 CFR 156.130. Any connection between hose or pipe sections that have a reduced portable containment below must have a tightened bolt in each hole of the flange to secure the connections.
- b. After disconnection, pipes and hoses shall be drained and cleaned before removal from the containment area.
- c. Not more than one "Y" piece may be used for each cargo loaded (i.e., not more than two tanks may be loaded with any one cargo using this method).
- d. Hoses shall meet the requirements of 33 CFR 154.500 or 46 CFR 153.940, according to the cargo being transferred. A portable hose line may not consist of more than four sections, or exceed 100 feet in length.
- e. Portable pipes must be constructed of materials in accordance with the requirements of 46 CFR 56.
- f. When loading or discharging a cargo that is required by 46 CFR 153 to have closed or restricted gauging, the fixed drop line or deep well pump connection must have a stop valve. After transfer, the valve should be left in place, closed, and blanked.

12. Cargo Filling Lines The cargo tank filling lines on existing vessels that terminate near the bottom of the tank will meet the intent of this provision, and do not warrant modification. (46 CFR 153.282)

13. Emergency Shutdown Stations 46 CFR 153.296(a) requires two emergency shutdown stations. Section 2.11.1 of the Chemical Code requires only that remote shutdown devices be installed for all cargo pumps and similar equipment (see paragraph F3.F.29 below).

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14. Ventilation Standards and Rates Ventilation Standards and Rates (46 CFR 153.312 and 316). See paragraph F3.F.3 above.

15. Hoisting Arrangements The Chemical Code does not specify a minimum lifting capacity for the pumproom hoisting arrangement. Specifications prescribed by home administrations are acceptable for foreign vessels possessing COF's (see paragraph F3.F.29 below). (46 CFR 153.332)

16. Bilge Pumping Bilge Pumping Systems (46 CFR 153.334(b)(2)). The Chemical Code does not require a bilge alarm in cargo pumprooms (see paragraph F3.F.29 below).

17. Venting System Outlets This provision does not refer to flame screens. Additionally, the IMO Chemical Code does not contain specifications for mesh flame screens. Whenever foreign vessels carry flammable or combustible cargoes, flame screens must be installed in accordance with 46 CFR 30.10-25, 32.55-20, and 35.30-10. (46 CFR 153.352)

18. Venting System Flow Capacity Section 2.13.2 of the Chemical Code has been revised to include the standards of 46 CFR 153.358. The pressure differential specified in the Code, however, is 20 kPa gauge (2.9 psig) in lieu of 28 kPa gauge (4.06 psig).

NOTE: The unit kPa equals 0.145 psi; see Appendix III to 46 CFR 153.

A COF is sufficient to document that a foreign vessel meets these requirements. (46 CFR 153.358)

19. Venting System Restriction Rupture discs may be used in series with pressure-vacuum valves. (46 CFR 153.360)

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20. Required Closed Gauges Many foreign and U.S. parcel tankers use float type closed gauging devices as portable gauging equipment. Portable closed gauging is considered acceptable, in lieu of a permanent installation, provided the gauge manufacturer's installation and operating instructions are followed. Some float type gauges require the installation of guide wires to ensure proper operation; others have been designed so that guide wires are not necessary. The manufacturer's installation and operating manual shall be maintained aboard vessels equipped with these gauges for reference should a question arise over the need for guide wires. Documentation from the manufacturer confirming that gauges can be used without guide wires is required. 46 CFR 153.404(d) also contains specifications for cargo sampling systems (although it does not require such installations).

21. Heat Transfer Systems Foreign vessels shall comply with the standards of their classification societies or home administrations (see paragraph F3.F.29 below). (46 CFR 153.430)

22. Heat Transfer Fluid This requirement is intended to ensure that the heating medium and the cargo are compatible. Foreign vessels shall comply with section 2.15.2 of the Chemical Code, which is equivalent to this section. (46 CFR 153.436)

23. Cargo Pressure or Temperature Alarms All foreign and U.S. vessels are required to meet either 46 CFR 153.438(a)(1) or (2) and 153.438(b). Section 2.15.5 of the Chemical Code refers only to a temperature measuring system.

NOTE: Section 153.438(b) exceeds section 2.15.5 of the Code, which does not require an alarm on the bridge.

The temperature and pressure sensing arrangements required by this section must be independent of other temperature or pressure sensing arrangements, in accordance with 46 CFR 153.438(c). Under 46 CFR 153, alarms are required only for cooling systems, while IMO requires alarms if overcooling or overheating could result in a dangerous condition.

24. Inert Gas Systems This section of the regulations is equivalent to section 2.19.3 of the Chemical Code with regard to inert gas generation (see paragraph F3.F.29 below). (46 CFR 153.500)

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25. Special

Requirements For Unusually Toxic Cargoes 46 CFR 153.525(c). There are major differences between this requirement and the IMO Chemical Code, which does not require pumps and valves for unusually toxic cargoes to be operable from the weather deck. Sections 2.10.4 and 4.13.3 of the Code address standards for pumps and valves, but do not impose a standard equivalent to 46 CFR 153.525(c) (see paragraph F3.F.29 below).

46 CFR 153.525(d). This requirement corresponds to section 2.15.6 of the Chemical Code. Its intent is to minimize the contamination of potable water, feedwater, other cargoes, and fuel by toxic cargoes. The most common heating system found on existing ships uses low-pressure steam, produced by the main propulsion boilers or by cargo-heating boilers located in the engine room. Condensate drainage from the cargo tank heating coils is returned to the feedwater system by an inspection tank. Section 2.15.6(c) of the Code provides for this type of heating system. Although systems meeting 46 CFR 153.525(d)(1) or (2), or sections 2.15.6(a) or (b) of the Code, are preferable, the steam heating system previously described is acceptable, provided the heating coil drainage returns to an inspection tank located on deck, within the cargo containment area. The inspection tank must be fitted with a drain valve to facilitate sampling of returns for cargoes that are clear and soluble in water, and therefore virtually impossible to detect visually. If a vessel owner elects this or a similar system, the owner must demonstrate that the necessary safeguards have been incorporated in the design.

26. Toxic Vapor Detectors

Vapor detection equipment may be unavailable for some cargoes to which this regulation applies. If the required equipment is unavailable for a particular toxic cargo that is transferred through a pumproom, the requirements of 46 CFR 153.336(b) shall be applied. A vessel carrying a toxic cargo that is not piped through pumprooms, but rather through in-tank pumps, need not have the additional vapor detection equipment required by 46 CFR 153.336(b) (see paragraph F3.F.29 below). Questions concerning the commercial availability of toxic vapor detectors for specific cargoes should be directed to Commandant (G-MSE). (46 CFR 153.526)

F3. Special

Requirements for Alkylene Water spray requirements for propylene oxide are found in section 4.7.21 of the IMO Chemical Code. Under 46 CFR 153.530(p), the water spray system must operate automatically (section 4.7.21 of the Code does not require automatic operation of the water spray system). All foreign and U.S. vessels that handle alkylene oxides must comply with 46 CFR 153.530(p) (see paragraph F3.F.29 below).

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28. Special Requirements for Acids Litmus paper or similar indicators will satisfy these requirements. (46 CFR 153.554(c))

29. Examination for Letter of Compliance (LOC) Foreign vessels shall be examined for compliance with the IMO Chemical Code. The following are the design and equipment requirements of 46 CFR 153 that must be met by foreign flag vessels even though the vessel possesses an IMO Chemical Code COF:

- a. 46 CFR 153.370, 153.371, and 153.438 for a vessel transporting a cargo whose vapor pressure exceeds 100 kPa absolute at 37.8o C (See 153.9(a)(2) and MSM F3.F.23)).
- b. 46 CFR 153.530 (b), (d) and (p)(1) for a vessel transporting alkylene oxides (See 153.9(a)(1) and MSM F3.F.F3).

The requirements of 46 CFR 153 Subpart C apply to all foreign flag vessels. For areas in which the Code's intent is unclear, 46 CFR 153 shall be used as guidance. Questions should be referred to Commandant (G-MOC). (46 CFR 153.808)

30. Certificate Endorsements Before a U.S. vessel is permitted to carry a cargo listed in Table I of 46 CFR 153, the vessel must have either a Certificate of Inspection (COI) (Form CG-841) or a COI Amendment specifically endorsed for each cargo. The endorsement shall list each cargo by name and the cargo tank(s) in which carriage is permitted. Hull type classification must also be shown on the form as "TANKSHIP/HULL TYPE (I, II, or III, as appropriate)." (46 CFR 153.900(a))

31. Cargo Information Cards Possible sources of cargo information include the shipper or manufacturer of the chemical, the CHRIS Manuals, and the I.C.S. Tanker Safety Guide. Printing may be done on both sides of the card. (46 CFR 153.907)

NOTE: 46 CFR 153.907 will be revised in future rulemaking to reflect this.

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32. Protective Clothing Required

This requirement applies only to persons on the vessel forward of the after deckhouse, who are engaged in the jobs listed in 46 CFR 153.933. Therefore, this requirement would apply to terminal employees and personnel aboard the vessel, who are engaged in any of those tasks.

33. Entry Into Spaces

This section requires the master to ensure that personnel wear protective equipment with a self-contained breathing apparatus, if they enter cargo tanks, pumprooms, or void spaces that are not freed of toxic vapors, or that lack sufficient oxygen to support life. It applies to all cargoes listed in Table I of 46 CFR 153. (46 CFR 153.934(b))

34. Standards for Marking of Cargo Hose

These requirements apply only to cargo hoses used to transfer cargoes listed in Table I of 46 CFR 153 to or from a parcel tanker, including terminal hoses that are involved in the transfer of Table I cargoes (see paragraph F3.F.11 above). (46 CFR 153.940)

35. Connecting a Cargo Hose

This provision requires the person in charge of cargo transfer to use a hose that meets 46 CFR 153.940 requirements. (46 CFR 153.972)

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36. Plugged Scuppers for Inorganic Acids (33 CFR 155.310)

This regulation requires deck scuppers to be plugged as a condition to approve or continue bulk liquid hazardous material cargo transfer operations. It had been suggested that this prohibition against open scuppers may be inappropriate for certain cargoes. For example, inorganic acids are considered very corrosive to ordinary ferrous metals and alloys. The spill or leak procedures cited in the Chemical Data Guide for Bulk Shipment by Water recommend that certain inorganic acids (e.g., phosphoric acid) be flushed with large amounts of water. Thus, the argument follows that if an inorganic acid spill occurred on deck and could not be washed off due to plugged scuppers, then the vessel's deck plating might be harmed.

- a. Following careful consideration of the matter, it has been determined that the prohibition against open scuppers remains appropriate for inorganic acid carriers. Inorganic acids are considered noxious liquid substances (NLS) under MARPOL, Annex II (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk). Annex II regulates the discharge of NLS according to their category of hazard classification. Discharge of even the least harmful NLS, Category D, is impermissible unless it has been diluted to a concentration of one part of the substance in ten parts of water. Therefore, scrupulous attention to duty during the cargo transfer process by cognizant personnel, in combination with the cargo discharge containment equipment required by 33 CFR 155.310(b)(3), are the primary means for protection from incidental spillage. Unplugged scuppers would potentially allow the release of spilled acid directly into a waterway before it could be adequately diluted.
- b. Although inorganic acids do pose a corrosion hazard to ferrous materials, the potential for corrosion damage can be minimized by quickly diluting the spill, or neutralizing it with appropriate agents. In only the most catastrophic scenarios might an untreated spill remain on deck long enough to cause significant damage to a vessel's deck plating. On balance, the environmental consequences resulting from an inadequately diluted inorganic acid spill entering a waterway through open scuppers greatly exceed the threat of structural damage to the vessel.
- c. Accordingly, the requirement to plug deck scuppers applies irrespective of the type of cargo being carried. In addition, although discharge of a diluted inorganic acid may be acceptable within the parameters established in MARPOL, Annex II, responsible personnel should bear in mind the obligation to comply with the hazardous material discharge reportable quantities criteria specified in 33 CFR, Subpart B.

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G. CHEMICAL BARGES

1. General

The regulations for barges carrying certain bulk dangerous cargoes, 46 CFR 151, became effective on 1 June 1970. They required upgrading of existing barges not previously certificated under 46 CFR 36, 38, 39, 40, and 98. Operating requirements in 46 CFR 151 apply to all barges. The intent of the regulations is the same as that for ships; containment of products to a degree commensurate with their hazards. Barges carrying chemical products that are flammable or combustible are certificated under 46 CFR, Subchapter D (Tank Vessels). Those carrying only nonflammable products can be certificated under either Subchapter D or I (Cargo and Miscellaneous Vessels), at the owner's option. If the owner does not indicate a choice, the barge shall be certificated under Subchapter D. The COI is then endorsed for the carriage of specific cargoes under 46 CFR 151.

2. Barges

The barge regulations follow the same general format as for ships (i.e., general requirements for all chemical barges and a table of minimum and special requirements for individual products). Commandant (G-MSO) establishes tentative minimum requirements for new cargoes. The shipper, all district commanders (m), and the MSC are notified of these by letter.

3. Clarification

Since 46 CFR 151 was published, some problem areas in interpretation or application have arisen. To clarify these points, and to specifically address manned barges, a regulatory project has been initiated to revise 46 CFR 151. In the interim, questions involving manned barges or other areas open to interpretation in 46 CFR 151 should be referred to Commandant (G-MSO-3) at: 202-267-0103. Questions regarding minimum requirements for cargoes that are not listed in 46 CFR Table 151.05 should be referred to Commandant (G-MSO) at: 202-267-0214. An index for 46 CFR 151 is contained in Navigation and Vessel Inspection Circular (NVIC) 5-71.

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H. COMPATIBILITY OF CARGOES (46 CFR 150, SUBPART A)

1. General

Cargo compatibility information is contained in 46 CFR 150, Subpart A, Compatibility of Cargoes. This subpart applies to all U.S. and foreign vessels subject to inspection. It gives a yes or no answer to the question of whether two chemical cargoes are compatible and, therefore, whether they may be carried in adjacent tanks. Mixing of incompatible chemicals in a tank or pipe may cause a chemical reaction that generates significant heat or gas which can be very hazardous to personnel and property. It is important to note that 46 CFR 150.150 allows the Commandant to grant exceptions to the compatibility chart, according to experimental data submitted to support exception requests.

2. Testing Procedures

Appendix III describes the test procedure to be followed by a shipper or manufacturer developing such data. 46 CFR 150.160 requires the operator of a vessel carrying a cargo excepted under 46 CFR 150.150, but not listed in Appendix I, Exceptions To The Chart, to:

- a. Verify that Commandant (G-MSO) has authorized, by letter or message, the pairing of cargoes as an exception to the compatibility chart; and
 - b. Maintain a copy of the authorization letter or message aboard the vessel.
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I. INSPECTION OF VESSELS CARRYING HAZARDOUS LIQUID CARGOES

1. Introduction The numbers and varieties of unconventional, hazardous liquid cargoes being transported in bulk by water are steadily increasing. Although the transportation and inspection hazards of petroleum products are generally well understood, newer commodities often have unusual properties, e.g., wide flammability limits, low ignition temperatures, foam incompatibility, or increased toxicity and reactivity. Marine safety personnel should be aware of special circumstances that may be involved in the shipment of hazardous materials in the marine environment.

2. References Concerning Hazardous or Dangerous Cargoes All marine safety personnel who inspect vessels carrying hazardous/dangerous cargoes in bulk shall become familiar with the chemical and physical properties of these products, and the requirements of 46 CFR 150, 151, 153, 154, and 154a. Chemical and physical property information can be obtained from the publications listed in paragraph F3.C.4 above.

3. Venting Systems Inspection Venting Systems Inspection.

Solids Shipped in Molten Form (Sulphur, Phenol) a. There are a number of products transported in tank vessels that may plug or coat flame screens and, in some instances, vent lines and pressure relief valves in cargo transfer piping. One such class of chemicals includes solids shipped in molten form, such as sulfur or phenol. Hot vapors from these molten materials rise and can condense and solidify in cooler vent pipes, vent lines, and flame screens. Plugged lines may eventually occur if such deposits are not cleaned when they build up. In severe cases, heating system trace lines may be necessary for cargo, relief, and vent lines.

Monomer Substances b. Another class of chemicals causing similar problems are the monomers, i.e., styrene, ethyl acrylate, methyl methacrylate, and vinyl acetate. Although these substances are inhibited in the liquid phase to help prevent self-reaction, the vapors are uninhibited and may polymerize (i.e., form chains of macro-molecules from smaller, reactive molecules) on the walls of the vent lines and flame screens. Buildup can occur after several years of service, in some cases much faster. Overfilling of a tank or sloshing of product in the tank during a voyage can also deposit liquid in the horizontal runs of a vent system; the liquid will solidify after depletion of the inhibitor. Specialized inspection scopes have been devised which will allow detection of polymer deposits in vent lines and should be employed.

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Caution During Inspections

c. Because of the potential problems of coated flame screens and blocked vent lines, these systems should be examined at each scheduled inspection to determine whether chemical buildup is occurring. Cleaning will be necessary if substantial coating is detected. Buildup caused by polymerization may be very difficult to remove, requiring special solvents, scraping, or exposure to high temperatures. The owner or operator should be advised that an active maintenance program is needed to maintain safety equipment against polymer buildup. Safety of personnel must also be considered. Toxic product vapors that condense or are heavier than air may fall to the deck and endanger personnel. In many cases, the first loading and discharge of toxic cargoes should be witnessed by Coast Guard personnel, to ensure that all recognizable factors of personnel safety have been considered in the design of the system.

Toxic Cargoes

d. The regulations of 46 CFR 151.50-5(e) require toxic cargo vapors from gravity type tanks to be controlled by using a pressure/vacuum (PV) valve. The minimum pressure setting of the PV valve is .21 kg/cm² gauge (3 psig) but not to exceed the design pressure of the cargo tank. The intent of this requirement is to reduce the probability of the cargo tank venting during operations other than transfers. The minimum setting of the PV valve and design pressure of the cargo tank should not be less than .21 kg/cm² gauge (3 psig). The installation of the proper PV valve should be verified for barges authorized to carry toxic cargoes in gravity type cargo tanks. The pressure and vacuum setting of this PV valve should be entered in the Marine Safety Information System (Vessel File Cargo System product set).

4. Carriage of Alkylene Oxides

Carriage of Alkylene Oxides.

General Concerns

a. General Concerns. The dangers presented by alkylene oxides, such as ethylene oxide or propylene oxide, are threefold:

- (1) They present a severe explosion hazard;
- (2) They are carried under a nitrogen pad because they polymerize in the atmosphere. Any residual cargo can react in this manner and foul piping and fittings; and
- (3) They are highly reactive, and may not be compatible with the alternate cargo. Saturated hydrocarbons (e.g., propane, butane, pentane, hexane) present no compatibility problems. However, alkylene oxides can react violently, sometimes explosively, with acids, bases, alcohols, aldehydes, amines, and other compounds.

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Tank Cleaning Standards

- b. Tank Cleaning Standards. For the reasons cited above, the importance of thorough cleaning of alkylene oxide tanks cannot be overemphasized. Methods recommended for the satisfactory cleaning of such tanks are provided in NVIC 5-79, "Inerting and Tank Cleaning Procedures for Alkylene Oxide Containment Systems." Under 46 CFR 153.1011(a), tanks being taken out of propylene oxide service, or being returned to such service from carriage of other cargoes, must be cleaned to the satisfaction of the marine inspector. Prior to inspection, the inspector should be familiar with the procedures planned for cleaning a particular tank.

Alternate Cleaning Methods

- c. Alternate Cleaning Methods. Proposed methods that differ from those outlined in NVIC 5-79 may be employed, provided they are consistent with good cleaning practices, as outlined by a recognized authority, such as the National Fire Protection Association (NFPA). In this regard, there should be no evidence of residue and a marine chemist certificate should be provided. When the cleaning is completed to the inspector's satisfaction and the tank is inerted, alkylene oxide may be loaded (See MSM II-A5 concerning the role of the marine chemist).