

RESOLUTION A.212(VII) adopted on 12 October 1971  
CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS  
CARRYING DANGEROUS CHEMICALS IN BULK

INTER-GOVERNMENTAL MARITIME  
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CODE FOR THE CONSTRUCTION AND EQUIPMENT  
OF SHIPS CARRYING DANGEROUS  
CHEMICALS IN BULK

RESOLUTION A.212(VII)  
adopted on 12 October 1971

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

RECOGNIZING that the rapid increase in sea transport of hazardous or noxious chemicals in bulk gives rise to the need for international measures to ensure their safe carriage, with a view to minimizing the risk to ships' crews and the environment,

HAVING CONSIDERED the Recommendation by the Maritime Safety Committee at its twenty-third session,

ADOPTS the Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk, the text of which is set out at Annex to this Resolution,

INVITES all governments concerned to take appropriate steps to give effect to the Code as soon as possible,

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RECOGNIZING the need for further elaboration of the Code and in addition for extension of the Code or development of separate codes to cover the carriage of hazardous gases (compressed or liquefied) in bulk and non-propelled vessels engaged in international seagoing and inland water navigation,

REQUESTS the Maritime Safety Committee to continue its study on this subject,

AUTHORIZES the Maritime Safety Committee to amend the Code and draw up additional codes as necessary in the light of further studies.

#### ANNEX

#### CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING DANGEROUS CHEMICALS IN BULK

#### PREAMBLE

1. This Code has been developed to provide an agreed international standard for the safe carriage by sea of dangerous chemicals in bulk by prescribing the constructional features of ships involved in such carriage and the equipment they should carry with regard to the nature of the products involved.

The basic philosophy is one of ship types related to the hazards of the various chemicals covered by the Code.

2. The United States publication "Evaluation of the Hazards of Bulk Water Transportation of Industrial Chemicals" was used as the basic guide in evaluating the hazards of the products considered in the Code and supplemented by other hazard rating systems.

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3. It is intended that either the Code will be extended or further codes will be drawn up to cover hazardous gases in bulk (compressed or liquefied) and the carriage of dangerous chemicals in non-propelled vessels.
4. It is recognized that the subject of cargo size limitation warrants consideration in the context of the Code. However, in this respect, it is considered that a further study in depth is necessary before any comprehensive provisions can be incorporated. The figures for cargo size limitation which are currently detailed in Chapter V of the Code have therefore been agreed as "holding figures" and it is intended that a deeper study in connexion with this requirement will be undertaken.
5. In order to ensure uniform interpretation and application of the subdivision and damage stability requirements by Administrations the relevant section has to be reviewed.
6. It is recognized that the section on fire protection is at present incomplete and it is intended to await the results of relevant studies currently being undertaken before expanding these provisions. In the meantime, advice should be sought from Administrations with regard to detailed fire protection arrangements.
7. It is intended to re-examine that part of the Code dealing with electrical requirements when work on this subject has been completed by the International Electrotechnical Commission and considered by Administrations.
8. The transitional period for full compliance with the Code by existing ships is not intended to replace any controls over existing ships which may already be in operation in certain countries. During the transitional period, existing ships should comply with the Interim Recommendation for Existing Ships.

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9. A list of products which are not considered to come within the scope of the Code is reproduced in Chapter VII. This list may be used as a guide when consideration is being given to the bulk carriage of products whose hazards have not yet been evaluated.

10. The Code will be kept under constant review taking into account both experience and future developments with regard to the bulk carriage of dangerous chemicals.

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CHAPTER I - GENERAL

1.1 Purpose

The purpose of the Code is to recommend suitable design criteria, construction standards and other safety measures for ships transporting dangerous chemical substances in bulk so as to minimize the risk to the ship, its crew and the neighbourhood.

1.2 Scope

1.2.1 Products - The Code applies to bulk cargoes of dangerous chemical substances, other than petroleum or similar flammable products as follows:

- (a) Products having significant fire hazards in excess of those of petroleum products and similar flammable products.
- (b) Products having significant hazards in addition to or other than flammability.

The Code is at present limited to the liquids shown in Chapter VI, Summary of Minimum Requirements. Products that have been reviewed and determined not to come within the scope of the Code are found in Chapter VII.

1.2.2 Ships - The Code is at present limited to tankships.

1.3 Hazards

Hazards of chemicals and other substances considered in this Code are:

- (a) Fire hazard defined by flashpoint, boiling point, explosion limit range and auto-ignition temperature of the chemical.

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- (b) Health hazard defined by:
- (i) irritant or toxic effect on the skin or to the mucous membranes of the eyes, nose, throat and lungs in the gas or vapour state combined with vapour pressure; or
  - (ii) irritational effects on the skin in the liquid state; or
  - (iii) toxic effect via skin absorption, taking into account values of LC 50, LD 50 oral, and LD 50 skin.
- (c) Water pollution hazard defined by human toxicity, water solubility, volatility, odour or taste, and specific gravity.
- (d) Air pollution hazard defined by:
- (i) Emergency Exposure Limit (E.E.L.) or LC 50;
  - (ii) Vapour pressure;
  - (iii) Solubility in water;
  - (iv) Specific gravity of liquid;
  - (v) Relative density of vapour.
- (e) Reactivity hazard defined by reactivity with
- (i) other chemicals, or
  - (ii) water, or
  - (iii) the chemical itself (including polymerization).

1.4 Definitions

1.4.1 Liquids covered by this Code are those having a vapour pressure not exceeding  $2.8 \text{ kp/cm}^2$  (40 psia) at a temperature of  $37.8^\circ\text{C}$  ( $100^\circ\text{F}$ ).

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1.4.2 Vapour pressure is equilibrium pressure of the saturated vapour above the liquid expressed in  $\text{kp/cm}^2$  (psia) or mm Hg absolute at a specified temperature.

1.4.3 Flashpoint is the temperature in  $^{\circ}\text{C}$  ( $^{\circ}\text{F}$ ) at which a liquid will give off enough inflammable vapour to be ignited. Values given in this Code are both "open cup" and "closed cup" which indicate two different types of test equipment.

1.4.4 Boiling point is the temperature at which a liquid exhibits a vapour pressure equal to the atmospheric barometric pressure.

1.4.5 Explosive range is the range of gas or vapour concentrations (per cent by volume in air) which will burn or explode if an ignition source is present.

1.4.6 Specific gravity is the ratio of the weight of a certain volume of a substance to the weight of an equal volume of water. For liquids of limited solubility, the specific gravity will predict whether the product will sink or float on water.

1.4.7 Vapour density is the relative density or the ratio of the weight of a vapour or gas (with no air present) to the weight of an equal volume of air at the same pressure and temperature. Values less than 1 indicate that the vapour or gas is lighter than air, while values greater than 1 show that the gas is heavier than air.

1.4.8 Viscosity is the shearing resistance of a liquid film which separates two horizontal plates, one of which is being moved across the other. The absolute viscosity of a substance is the force in dynes which will move one square centimetre of a plane surface with a speed of one centimetre per second relative to another parallel plane

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surface from which it is separated by a layer of the substance one centimetre thick. The kinematic viscosity of a substance is the ratio of the absolute viscosity to the density of the substance at the temperature of measurement.

1.4.9 Corrosive aggression is the property of a substance having a destructive effect on the environment by entering into an electrochemical reaction with it.

1.4.10 Cargo tank area is that part of the ship that contains cargo tanks and cargo pump rooms and includes cofferdams, void spaces and deck spaces adjacent to and above all such spaces.

1.4.11 Toxicity limits

- (i) LD 50 Oral: a dose which is lethal to 50 per cent of the test subjects when administered orally;
- (ii) LD 50 Skin: a dose which is lethal to 50 per cent of the test subjects when administered to the skin;
- (iii) LC 50: the concentration which is lethal by inhalation to 50 per cent of the test subjects.

1.5 Equivalents

1.5.1 Where the Code requires that a particular fitting, material, appliance or apparatus, or type thereof, should be fitted or carried in a ship, or that any particular provision should be made, the Administration may allow any other fitting, material, appliance or apparatus, or type thereof, to be fitted or carried, or any other provision to be made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus, or type thereof, or provision, is at least as effective as that required by the Code.

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1.5.2 When an Administration so allows any fitting, material appliance, apparatus, item of equipment, or type thereof, or provision, procedure, or arrangement, or novel design or application to be substituted hereafter, it should communicate to the Inter-Governmental Maritime Consultative Organization (IMCO), referred to hereafter as the Organization, the particulars thereof together with a report on the evidence submitted that the Organization may circulate the same to other participating governments for the information of their officers.

1.6 Certification

1.6.1 The Administration, after having satisfactorily inspected a ship should issue an appropriate certificate. The certificate should contain the following information:

- (a) name of ship;
- (b) port of registration;
- (c) ship type;
- (d) cargoes which the ship is permitted to carry;
- (e) the conditions of carriage;
- (f) any authorized exemptions permitted by the Code.

The ship should be surveyed in respect of the safety equipment provisions of the Code at intervals not exceeding 2 years and the constructional provisions at intervals not exceeding 5 years and the certificate should be suitably endorsed if the ship continues to comply with the appropriate provisions of the Code.

1.6.2 Certificates issued by Administrations in accordance with 1.6.1 should be accepted by other Administrations for all purposes covered by the Code and should be regarded by other Administrations as having the same force as certificates issued by them.

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1.7 Effective date

1.7.1 The effective date of the Code is 6 months after the Code has been adopted by the IMCO Assembly.

1.7.2 The Code is applicable to vessels whose keel is laid or which are at a similar stage of construction or to vessels whose conversion is begun on or after the effective date.

1.7.3 The Code should also be applicable to existing ships carrying cargoes covered by the Code. Taking into account availability of equipment and services, existing ships should comply with the following provisions of the Code for the cargoes to be carried within the time periods after the effective date as follows:

- (a) immediately: all operational requirements of Chapter V including those stated in paragraph 5.6;
- (b) within one year: 3.11 and 3.16;
- (c) within two years: 2.13, 2.14, 3.8, 3.9, 3.10, 3.13, 3.14, 3.15;
- (d) as soon as possible but in any case within 6 years: all other requirements not listed in sub-paragraphs (a) to (c) above such as for requiring alterations or fitting of bulkheads, double bottoms, piping, etc. However, full compliance with 2.2.4(a)(ii), (b)(ii) and (c), and 2.7.1 would not be expected, but with the intent of 2.2.4(a)(iii) and (b)(iii) where relaxations from required distances may be allowed for existing structures provided that cargo tanks in Type II ships are located at least 760 mm (30 inches) from the bottom shell.

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1.8 New products

Where it is proposed to carry in bulk dangerous liquid chemicals which may be considered to come within the scope of the Code but are not at present designated in Chapter VI, Summary Table of Minimum Requirements, the Administrations involved in such carriage should establish suitable conditions of carriage based on the principles of the Code and notify such conditions to the Organization. During the periodical review of the Code these submissions will be considered for inclusion.

## CHAPTER II - CARGO CONTAINMENT

### A. Physical Protection (Siting of cargo tanks; floatability and damage stability)

#### 2.1 General

The probability of damage resulting from collision, stranding or other circumstance, to a ship carrying a dangerous chemical in bulk leading, sooner or later, to uncontrolled release of the cargo cannot be discounted. Therefore, the siting of the cargo tanks in relation to the ship's side and bottom (which would afford a degree of protection from external damage to the cargo containment), and the extent to which the ship should be capable of remaining afloat subsequent to such damage should be related to the extent to which escape of that cargo, taking into account the nature and severity of its hazard to the environment, could be tolerated.

2.1.1 Three degrees of physical protection are employed. The highest standard of such protection - Type I - is required for the substances considered to have the greatest environmental hazard, with reduced standards - Types II and III - for substances of progressively lesser hazard.

2.1.2 The required degrees of physical protection for the transport of individual substances are shown in column b of the Summary of Minimum Requirements, Chapter VI.

2.1.3 Where it is intended to transport more than one substance, the requirements for ship survival of damage should correspond to the most dangerous substance, but the cargo containment requirement need only conform to the specified minimum requirements for the chemicals taken individually.



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2.2 Ship Types

2.2.1 General Ships subject to this Code may be assigned the minimum freeboard permitted by the International Convention on Load Lines, 1966. The additional requirements in 2.2.4, taking into account any empty or partially filled tank as well as the specific gravities of cargoes to be carried, however, should govern the allowed operating draught for any actual condition of loading. To this end all ships engaged in the transport of chemicals in bulk should be supplied with loading and stability manuals for the information and guidance of the master. These manuals should contain details concerning the loaded conditions of full and empty or partially empty tanks, the position of these tanks in the ship, the specific gravities of the various parcels of cargoes carried, and any ballast arrangements, in critical conditions of loading. Provisions for evaluating other conditions of loading should be contained in the manuals.

2.2.2 Damage assumption In establishing criteria in regard to siting of cargo tanks and ships stability, it is necessary to define the assumed damages and to state the conditions of survival and of cargo containment. The following main assumed damage conditions will apply. In those cases where the machinery space is to be treated as a floodable compartment, a permeability of 0.85 is to be assumed therein. The permeability of other spaces subject to flooding should be so determined as to reflect the limitations of cargo, fuel or ballast loaded. Such limitations should be included in the information to be supplied to the master.

(a) Collision damage

- (i) Longitudinal extent:  $\frac{1}{3}L^{\frac{2}{3}}$  or 14.5 m ( $0.495L^{\frac{2}{3}}$  or 47.6 feet), whichever is less
- (ii) Transverse extent:  $\frac{B}{5}$  or 11.5 m (37.7 feet), whichever is less  
 (inboard from the ship's side at right angles to the centre-line at the level of the load line)
- (iii) Vertical extent: from the base line upwards without limit

(b) Stranding

- |   |   |   |
|---|---|---|
|   | For 0.3L from the forward perpendicular of ship       | Any other part of ship                              |
| (i) Longitudinal extent:                  | $\frac{L}{10}$  | $\frac{L}{10}$ or 5 m (16.4 feet) whichever is less |
| (ii) Transverse extent:                   | $\frac{B}{6}$ or 10.0 m (32.8 feet) whichever is less | 5 m (16.4 feet)                                     |
| (iii) Vertical extent from the base line: | $\frac{B}{15}$ or 6 m (19.7 feet) whichever is less   |   |

where: L, B in metres (feet) for any part of the ship and perpendicular are as defined in Regulation 3 of the International Convention on Load Lines, 1966

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(c) Minor side damage

Damage from tugs, piers, etc., should be taken as:

Transverse extent: 760 mm (30 inches)

(inboard from the  
ship's side at right  
angles to the centre-  
line at the level of  
the deepest load line)

2.2.3 Survival assumption The ship is considered to survive the conditions of damage specified for each Ship Type (see 2.2.4) if she remains afloat in a condition of stable equilibrium and satisfying the following stability criteria:

- (a) The stability in the final condition of flooding may be regarded as sufficient if the righting lever curve has a minimum range of  $20^{\circ}$  beyond the position of equilibrium in association with a residual righting lever of at least 100 mm (4 inches). The unflooded volume of the poop superstructure around the machinery space casing, provided the machinery casing is watertight at this level, may be taken into consideration in which case the damage waterline should not be above the after end of the top of the poop superstructure deck at the centreline.
- (b) The angle of heel in the final condition of flooding should not exceed  $15^{\circ}$ , except that if no part of the deck is immersed, an angle of heel up to  $17^{\circ}$  may be accepted. For ships less than 150 m (492 feet) in length, the Administration may accept an angle of heel not exceeding  $25^{\circ}$  provided it is positively shown that a lesser limit is not reasonably obtainable, and that all other provisions stated in sub-paragraph (a) of this paragraph are complied with.

2.2.4 Ship Type requirements

(a) Type I ship

(i) General

A Type I ship is designed to transport products which require maximum preventive measures to preclude escape of such cargo.

(ii) Ship capability

The ship should be capable of sustaining anywhere in her length collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) and surviving as specified in 2.2.3.

(iii) Cargo tank location

Tanks intended for carriage of cargoes which are required to be transported in a Type I ship should be located outside the extent of the damage specified in 2.2.2(a) and 2.2.2(b), and should nowhere be closer to the ship's shell than 760 mm (30 inches).

(b) Type II ship

(i) General

A Type II ship is designed to transport products which require significant preventive measures to preclude the escape of such cargo.

(ii) Ship capability

(1) A ship of 150 m (492 feet) in length or less should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length

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except involving either of the bulkheads bounding a machinery space located aft, and surviving as specified in 2.2.3.

- (2) A ship of more than 150 m (492 feet) in length should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length and surviving as specified in 2.2.3.

(iii) Cargo tank location

Tanks containing cargoes which are required to be transported in a Type II ship should be located outside the extent of damage specified in 2.2.2(b) and 2.2.2(c).

(c) Type III ship

(i) General

A Type III ship is designed to carry products of sufficient hazard to require a moderate degree of containment to increase survival capability in a damaged condition.

(ii) Ship capability

- (1) A Type III ship of 125 m in length and over should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length except involving either of the bulkheads bounding a machinery space located aft and surviving as specified in 2.2.3.

- (2) A Type III ship below 125 m in length should be capable of sustaining collision damage (2.2.2(a)) or stranding damage (2.2.2(b)) anywhere in her length and surviving as specified in 2.2.3 with the exception of damage to the machinery space. In addition to the foregoing the ability to survive flooding of the machinery space should be determined by the Administration.

(iii) Cargo tank location

No special requirements.

2.2.5 Special considerations for small ships In the case of small ships intended for the carriage of cargoes requiring Type I or Type II containment which do not comply in all respects with the requirements in 2.2.4(a)(ii) and 2.2.4(b)(ii) above special dispensations may only be considered by the Administration where alternative measures can be taken which maintain the same degree of safety. In the approval of the design of a ship for which a dispensation has been granted, the nature of the alternative measures prescribed should be clearly stated and be available to the Administration in the countries the ship will visit and any such dispensation should be duly noted on the Certificate (1.6).

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B. Tank types

2.3 Installation

2.3.1 Integral tank A cargo containment envelope which forms part of the ship's hull and may be stressed in the same manner and by the same loads which stress the contiguous hull structure. An integral tank is essential to the structural completeness of its ship's hull.

2.3.2 Independent tank A cargo containment envelope which is not a contiguous part of the hull structure. An independent tank is built and installed so as to eliminate whenever possible (or in any event, to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. An independent tank is not essential to the completeness of its ship's hull.

2.4 Design and construction

Gravity tank Tanks having a design pressure not greater than  $0.7 \text{ kp/cm}^2$  (10 psig) at the top of the tank. Gravity tanks may be independent or integral. Gravity tanks should be constructed and tested according to the standards of the Administration.

2.5 Requirements for individual substances

Tank type requirements (covering both installation and design) for individual substances are shown in column c of the Summary of Minimum Requirements, Chapter VI.

C. Ship Arrangements

2.6 Cargo segregation

2.6.1 A cargo subject to the provisions of the Code should be segregated from machinery and boiler spaces, accommodation and service spaces and drinking water and stores for human consumption by means of a cofferdam, void space, pump room, empty tank, fuel tank or other similar space, except where otherwise excluded by the Code.

2.6.2 Cargoes which react in a hazardous manner with other cargoes should:

- (a) be separated from such other cargoes by means of a cofferdam, void space, pump room, empty tank, or a mutually compatible cargo;
- (b) have separate pumping and piping systems which should not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and
- (c) have separate tank vent systems.

2.6.3 Cargo piping should not pass through any accommodation or machinery space, other than pump rooms.

2.6.4 A cargo subject to the provisions of the Code should not be stowed either in the fore or after peak tanks.

2.7 Accommodation spaces

2.7.1 No accommodation spaces should be located over cargo tanks or pump rooms and no cargo tanks should be aft of the forward end of accommodation.

2.7.2 In order to guard against the danger of hazardous vapours, due consideration should be given to the location of air intakes and openings into accommodation and machinery spaces in relation to cargo piping and tank vent systems.



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2.7.3 Doors and air ports in the accommodation should be on the house sides at least  $L/25$  and not less than 3.05 m (10 feet) aft of the forward end of the house and the cargo tank area. Port lights located on the forward bulkhead or along the house sides within  $L/25$  but not less than 3.05 m (10 feet) aft of the forward bulkhead should be of the fixed type. Wheelhouse windows may be non-fixed and wheelhouse doors may be located within the above limits. However, they are to be so designed that a rapid and efficient gas- and vapour-tightening of the wheelhouse can be ensured.

2.8 Cargo pump rooms

2.8.1 Pump rooms should be so arranged as to ensure unrestricted passage at all times from any ladder platform and from the floor.

2.8.2 Permanent arrangements should be fitted for hoisting an unconscious person with a rescue line whilst avoiding any projecting obstacles.

2.8.3 Pump rooms should be so arranged as to ensure unrestricted access to all valves necessary for cargo handling for a person wearing the required personnel protective equipment.

2.8.4 Guard railings should be installed on all ladders and platforms.

2.8.5 Normal access ladders should not be fitted vertical, and should incorporate platforms at suitable intervals.

2.8.6 Arrangements should be installed to deal with drainage and any possible leakage from cargo pumps and valves in pump rooms. The bilge system serving the pump

room should be operable from outside the pump room. One or more slop tanks for storage of contaminated bilge water or tank washings should be provided. A shore connection with a standard coupling or other facilities should be provided for transferring contaminated water to on-shore slop tanks.

2.8.7 Pump discharge pressure gauges should be provided outside the pump room.

2.8.8 For cargo pump requirements for certain products see column j of the Summary of Minimum Requirements, Chapter VI.

2.9 Access to void spaces, cargo tanks and other spaces in the cargo tank area

Arrangements for void spaces, cargo tanks and other spaces in the cargo tank area should be such as to ensure adequate access for complete inspection of any such space while the required personnel protective equipment is being worn and, in the event of injury, to allow unconscious personnel to be removed from the space. Access to cargo tanks should be direct from the open deck.

D. Cargo Transfer

2.10 Piping arrangements

Cargo piping systems should be designed, arranged and fabricated in accordance with the standards of the Administration taking into account the following provisions.

2.10.1 All piping system components should have a pressure rating not less than the maximum pressure to which the system may be subjected. Piping which is not protected against over pressure by a pressure relief valve, or which can be isolated from its relief valve should be designed to

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withstand the greatest pressure the piping would experience in service, taking into consideration:

- (a) cargo vapour pressure at the appropriate reference temperature;
- (b) pressure rating of the cargo tank;
- (c) maximum discharge pressure of the associated pump and its relief valve setting; and
- (d) maximum hydrostatic pressure that could be generated in the piping during normal operations.

2.10.2 Piping connections to tanks should be protected against mechanical damage and tampering. Other than for approved connections to shut-off valves and expansion joints cargo piping should be joined by welding.

2.10.3 Cargo piping should not be installed under deck between the outboard side of the cargo containment spaces and the skin of the ship unless clearances required for damage protection (see 2.1 and 2.2) are maintained; but such distances may be reduced where damage to the pipe would not cause release of cargo provided that the clearance required for inspection purposes is maintained.

2.10.4 Runs of cargo piping, located below the main deck, may run from the tank they serve and penetrate tank bulkheads or boundaries common to adjacent (longitudinally or transversally) cargo tanks, ballast tanks, empty tanks, or pump rooms, provided that inside the tank they serve they are fitted with a stop valve operable from the weather deck and provided cargo compatibility is assured in the event of piping failure.

2.10.5 In any pump room where a pump serves more than one tank, a stop valve should be fitted in the line to each tank.

2.10.6 Runs of cargo piping installed in pipe tunnels should also comply with the requirements of 2.10.4 and 2.10.5 and should satisfy all tank requirements for construction, location and ventilation and electrical hazard requirements. Cargo compatibility should be assured in the event of a piping failure. The tunnel should not have any other openings except to the weather deck and the pump room.

#### 2.11 Cargo transfer control systems

2.11.1 For the purpose of adequately controlling the cargo, cargo transfer systems should be provided with the following:

- (a) One stop valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if individual deepwell pumps are used to discharge the contents of each cargo tank a stop valve at the tank is not required on the discharge line.
- (b) One stop valve at each cargo hose connection.
- (c) Remote shutdown devices for all cargo pumps and similar equipment.

2.11.2 For certain products additional cargo transfer control requirements are shown in column j of the Summary of Minimum Requirements, Chapter VI.

#### 2.12 Cargo hoses carried aboard the ship

Transfer hoses for liquid and vapour cargoes should be constructed of suitable material resistant to the action of the cargoes. Design, construction and testing of hoses should be to the standards of the Administration but in no case should the burst pressure of the hose be less than five times its service pressure.

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E. Tank Vent Systems

2.13 General

2.13.1 All cargo tanks should be provided with a venting system appropriate to the cargo being carried. Tank vent systems should be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation and machinery spaces, and, in the case of flammable vapours, other spaces containing sources of ignition. They should also be designed to minimize possible spraying onto the decks of those cargoes offering a significant skin contact health hazard. Vent outlets should be arranged to prevent entrance of water into the cargo tanks and, at the same time, should direct the vapour discharge upwards in the form of unimpeded jets. Provision should be made to ensure that the liquid head in any tank does not exceed the test head of that tank.

2.13.2 Vent pipes should be of sufficient size allowing for flame screens if fitted, to permit loading at the design rate without over pressuring the cargo tanks.

2.13.3 Any flame screens fitted to the discharge openings of vent systems should be easily accessible and removable for cleaning.

2.13.4 Suitable provision should be made for drainage of vent lines.

2.13.5 Tank vent piping connected to cargo tanks of corrosion-resistant material, or which are lined or coated to handle special cargoes as required by the Code should be similarly lined or coated, or constructed of corrosion-resistant material.

## 2.14 Types of tank vent systems

2.14.1 Open venting An open venting system is one which offers no restriction, except for friction losses and flame screens if fitted, to the free flow of cargo vapours to and from the cargo tanks during normal operations and should only be used for those cargoes with a flashpoint above 60°C (140°F) and not offering a significant inhalation health hazard. An open venting system may consist of individual vents from each tank, or such individual vents may be combined into a common header or headers, with due regard for cargo segregation. However, in no case should shut-off valves be fitted either to the individual vents or to the header.

2.14.2 Controlled venting A controlled venting system is one in which pressure-vacuum relief valves are fitted to each tank to limit the pressure or vacuum in the tank and should be used for cargoes other than those for which open venting is permitted. A controlled venting system may consist of individual vents from each tank, or such individual vents, on the pressure side only, as may be combined into a common header or headers with due regard for cargo segregation. In no case should shut-off valves be fitted either above or below pressure-vacuum relief valves but provision may be made for bypassing the pressure-vacuum relief valves under certain operating conditions. The heights of vent exits should not be less than 4 m (13.1 feet) above the weather deck or above the fore and aft gangway if fitted within 4 m of the gangway. Lesser vents heights may be employed where comparable cargo vapour dispersion is obtained with high velocity vent valves. The vent exits should also be

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arranged at a distance of at least 10 m (32.8 feet) from the nearest air intake or openings to accommodation and service spaces and ignition sources. Flammable vapour outlets should be provided with readily renewable and effective flame screens or safety heads of an approved type.

F. Cargo Temperature Control

2.15 General

2.15.1 When provided, cargo heating or cooling systems should be constructed, fitted and tested to the satisfaction of the Administration. Materials used in the construction of temperature control systems should be suitable for use with the cargo to be carried.

2.15.2 Heating or cooling media should be approved for use with the specific cargo. Where cargo is highly water reactive, water or steam should not be used as the media. Consideration should be given to the surface temperature of heating coils or ducts to avoid dangerous reactions from localized overheating of cargo.

2.15.3 For any heating or cooling system means should be provided to isolate the system for each tank and to regulate the flow.

2.15.4 In any heating or cooling system means should be provided to ensure that, when in any other but the empty condition, a higher pressure is maintained within the system than the maximum pressure head that could be exerted by the cargo tank contents on the system.

2.15.5 Means should be provided for measuring the cargo temperature. When overheating or overcooling could result in a dangerous condition an alarm system which monitors the cargo temperature should be provided.

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2.15.6 Where products with a significant toxic hazard are being heated or cooled, the heating or cooling media should operate:

- (a) in a circuit independent of other ship's services; or
- (b) in a system external to the tank; or
- (c) in a circuit where the liquid is sampled to check for the presence of cargo before it is recirculated in the heater or cooler. The sampling device should be located within the cargo area.

2.16 Additional requirements

For certain products additional requirements are shown in column j of the Summary of Minimum Requirements, Chapter VI.

G. Materials of Construction

2.17 General

Structural materials used for tank construction, together with associated piping, pumps, valves, vents and their adjoining materials, should be suitable at the carriage temperature and pressure, for the cargo to be carried to the satisfaction of the Administration. Steel is assumed to be the normal material of construction. Where applicable the following should be taken into account in selecting the material of construction:

- (a) notch ductility at the operating temperature;
- (b) corrosive effect of the cargo;
- (c) possibility of hazardous reactions between the cargo and the material of construction; and
- (d) suitability of linings and coatings.

2.18 Additional requirements

For certain products additional requirements are shown in column j of the Summary of Minimum Requirements, Chapter VI.



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H. Environmental Control of Vapour Space in Cargo Tanks and Void Spaces Surrounding such Tanks

2.19 General

2.19.1 Vapour spaces within cargo tanks and in some cases spaces surrounding cargo tanks, may require to have specially controlled atmospheres.

2.19.2 Three different types of control are:

- (a) Inerting - by filling and maintaining the cargo tank and associated piping systems (and, where necessary, the spaces surrounding the tanks) with a gas or vapour which will not support combustion and which will not react with the cargo.
- (b) Padding - by filling and maintaining the cargo tank and associated piping system (and, where necessary the spaces surrounding the tanks) with a liquid, gas or vapour which separates the cargo from the air.
- (c) Ventilation - forced or natural.

2.19.3 Arrangements required in connexion with (a) and (b) above are:

- (a) An adequate supply of inert gas for use in filling and discharging should be carried or should be manufactured on board unless a shore supply is available;
- (b) In addition, sufficient inert gas should be available on the ship to compensate for normal losses and arrangements should be made so that a small positive pressure is maintained in the space concerned.
- (c) Where padding is used similar arrangements for supply of the padding medium should be made as required for inert gas in (a) and (b) of this paragraph.

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- (d) Means should be provided for monitoring ullage spaces containing a gas blanket to ensure that the correct atmosphere is being maintained; and
- (e) Inerting and/or padding arrangements where used with flammable cargoes should be such as to minimize the creation of static electricity during the admission of the inerting media.

2.20 Environmental control requirements for individual substances

The necessity for environmental control for certain products is shown in column e of the Summary of Minimum Requirements, Chapter VI.

2.21 Ballast and slop tank arrangements

2.21.1 Permanent ballast tanks Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks should be isolated from similar equipment serving cargo tanks and from cargo tanks themselves. Permanent ballast tanks should not be used if adjacent cargo tanks contain dangerously water-reactive cargo. Discharge arrangements for permanent ballast tanks sited immediately adjacent to cargo tanks should be outside engine room and accommodation spaces. Filling arrangements may be in the engine room provided that such arrangements ensure filling from tank deck level and non-return valves are fitted.

2.21.2 Slop tanks and cargo tanks used for ballast or slops Cargoes which are dangerously water-reactive should not be placed in tanks adjacent to slop tanks and cargo tanks containing ballast or slops. Pumps, pipes or vent lines serving such tanks should be isolated from similar equipment serving tanks containing cargo dangerously

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reactive with water. Slop tank lines or ballast lines should not pass through tanks containing cargoes which are dangerously reactive with water unless encased in a tunnel.

2.22 Bilge pumping arrangements from spaces within the cargo tank area

Bilge pumping arrangements for pump rooms, void spaces, slop tanks, double bottom tanks and similar spaces should be situated entirely within the cargo tank area except where such spaces are separated from cargo tanks by a double bulkhead.

2.23 Pump and pipeline identification

Provisicns should be made for the distinctive marking of pumps, valves and pipelines to identify the service and tanks which they serve.

CHAPTER III - SAFETY EQUIPMENT AND RELATED CONSIDERATIONS

A. Ventilation in Cargo Handling Spaces

3.1 Spaces normally entered during cargo handling operations

3.1.1 General Pump rooms and other closed spaces which contain cargo handling equipment and similar spaces in which work is performed on the cargo should be fitted with mechanical ventilation systems which should be capable of being controlled from outside such spaces. Provision should be made to ventilate such spaces prior to entering the compartment and operating the equipment.

3.1.2 Mechanical ventilation systems

- (a) Mechanical ventilation inlets and outlets should be arranged to ensure sufficient air movement through the space to avoid the accumulation of toxic and/or flammable vapours (taking into account their vapour densities) and to ensure sufficient oxygen to provide a safe working environment but in no case should the ventilation system have a capacity of less than 30 changes of air per hour based upon the total volume of the space. For certain products increased ventilation rates for pump rooms are prescribed in 4.13.
- (b) Ventilation systems should be permanent and should normally be of the extraction type. Extraction from above and below the floor plates should be possible. In rooms housing motors driving cargo pumps, the ventilation should be of the positive pressure type.
- (c) Ventilation exhaust ducts should discharge upwards in locations well away from ventilation intakes, accommodation working or other similar spaces.

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- (d) Ventilation intakes should be so arranged as to minimize the possibility of re-cycling hazardous vapours from any ventilation discharge opening.
- (e) Ventilation ducts should not be led through engine rooms, accommodation, working or other similar spaces.
- (f) Ventilation fans should be approved by the Administration for operation in explosive atmospheres when flammable cargoes are carried aboard the ship.
- (g) Sufficient spare parts should be carried for each type of fan on board.
- (h) Flame screens should be installed in ventilation ducts when flammable cargoes are carried aboard the ship.

3.2 Spaces not normally entered

Cofferdams, duct keels, pipe tunnels, spaces containing cargo tanks and other spaces where cargo may accumulate should be capable of being ventilated to ensure sufficient air to avoid the accumulation of toxic and/or flammable vapours and to ensure sufficient oxygen to provide a safe environment. Where a permanent ventilation system is not provided for such spaces, approved portable means of mechanical ventilation should be provided.

B. Electrical Requirements in Respect of Flammable Cargoes

3.3 General

Electrical installations should be such as to minimize the risk of fire and explosion from flammable cargoes. Care should be taken to exclude sources of ignition from areas where flammable vapours may be present.

3.4 Installations in pump rooms and spaces containing cargo tanks or pipes

3.4.1 Generally no electrical installations should be permitted in spaces containing cargo tanks or pipes.

3.4.2 Only gauging and monitoring equipment of intrinsically safe design should be used in cargo tanks or in spaces containing cargo tanks or pipes. Consideration for the use of submerged motors and pumps may be given by the Administration.

3.4.3 Only lighting equipment of explosion proof design should be used in pump room.

3.5 Installation in enclosed spaces immediately aft of - forward of - or above the cargo tank area

3.5.1 Any electrical gauging or monitoring equipment should be of intrinsically safe design.

3.5.2 Electrical equipment of explosion proof design may be used in spaces where forced ventilation is fitted.

3.5.3 Electrical equipment of enclosed ventilated design may be used provided the spaces may be regarded as non-hazardous, and to which entrances and ventilation openings are situated at a safe distance from gas vents, exhaust outlets, etc.

3.6 Installations on open decks

3.6.1 Electrical equipment of explosion proof design only should be used on the cargo deck.

3.6.2 Electrical equipment of enclosed ventilated design may be used on decks other than the cargo deck provided the equipment is situated at a safe distance from gas vents, exhaust outlets, tank openings, pipe flanges or cargo valves and at a safe height above the deck.

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3.7 Bonding

Independent cargo tanks should be electrically bonded to the hull.

3.8 Electrical requirements for individual substances

Electrical requirements for individual substances are shown in column f of the Summary of Minimum Requirements, Chapter VI.

C. Gauging

3.9 General

Cargo tanks should be fitted with one of the following types of gauging devices:

- (a) Open device which makes use of an opening in the tank and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.
- (b) Restricted device which penetrates the tank and which, when in use, permits a small quantity of cargo vapour or liquid to be exposed to the atmosphere. When not in use, the device is completely closed. The design should ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.
- (c) Closed device which penetrates the tank, but which is part of a closed system and keeps tank contents from being released. Examples are the float-type systems, electronic probe, magnetic probe and protected sight glass.
- (d) Indirect device which does not penetrate the tank shell and is independent of the tank. An indirect measurement for determining the amount of cargo is used such as weighing of cargo, pipe flow meter, etc.

### 3.10 Gauging for individual substances

Types of gauging for individual substances are shown in column g of the Summary of Minimum Requirements, Chapter VI.

#### D. Vapour Detection

##### 3.11 General

3.11.1 Ships carrying toxic and/or flammable cargoes should be equipped with at least two instruments designed and calibrated for testing for the specific vapours in question. If such instruments are not capable of testing for both toxic concentrations and flammable concentrations, then two separate sets of instruments should be provided.

3.11.2 Vapour detection instruments may be portable or fixed. If a fixed system is installed, at least one portable instrument should be provided.

##### 3.12 Requirements for individual substances

Vapour detection requirements for individual substances are shown in column h of the Summary of Minimum Requirements, Chapter VI.

#### E. Fire Protection

##### 3.13 Fire-extinguishing arrangements

3.13.1 All ships irrespective of size carrying cargoes which are subject to this Code should be subject to Regulation 65 of Chapter II of the International Convention for the Safety of Life at Sea, 1960.

3.13.2 All sources of ignition should be excluded from spaces where flammable vapours may be present.

##### 3.14 Fire-extinguishing equipment

3.14.1 Suitable fire-extinguishing equipment for all products to be carried should be provided and kept in good operating order.



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3.14.2 For products evolving flammable vapours such equipment should include a fixed fire-extinguishing system approved by the Administration for the cargoes to be carried. CO<sub>2</sub> and steam-smothering systems should be avoided unless due consideration is given to the danger of static electricity.

3.15 Fire-extinguishing media

Fire-extinguishing media considered to be suitable for certain products are listed for information in column i of the Summary of Minimum Requirements, Chapter VI.

F. Personnel Protection

3.16 Requirements

3.16.1 For the protection of crew members who are engaged in loading and discharging operations, the ship should have on board suitable protective equipment consisting of large aprons, special gloves with long sleeves, suitable footwear, coveralls of chemical resistant material, and tight-fitting goggles and/or face shields. The protective clothing and equipment should cover all skin so that no part of the body is unprotected.

3.16.2 Work clothes and protective equipment should be kept in easily accessible places and in special lockers. Such equipment should not be kept within accommodation spaces unless cleaned.

3.16.3 Protective equipment should be used in any operation which may entail danger to personnel.

3.16.4 Ships carrying toxic cargoes should have on board sufficient but not less than 3 complete sets of safety equipment each permitting personnel to enter a gas-filled

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compartment and perform work there for at least 20 minutes. Such equipment should be in addition to that required by Regulation 65 of Chapter II of the International Convention for the Safety of Life at Sea, 1960.

3.16.5 One complete set of safety equipment should consist of:

- (a) one self-contained air-breathing apparatus (not using stored oxygen);
- (b) protective clothing, boots, gloves and tight-fitting goggles;
- (c) steel cored rescue line with belt; and explosion-proof lamp.

3.16.6 The ship should have on board an adequate supply of air supplied by either a special compressor or by sufficient spare bottles.

3.16.7 At least one set of safety equipment as required in 3.16.5 should be kept in a suitable clearly marked locker in a readily accessible place near the pump room. The other sets of safety equipment should also be kept in clearly marked easily accessible, suitable places.

3.16.8 The compressed air equipment should be inspected at least once a month by a reasonable officer. At least once a year the equipment should be inspected and tested by an expert.

3.16.9 A stretcher which is suitable for hoisting an injured person up from spaces such as pump room, should be placed in a readily accessible location.

3.16.10 If the characteristics of a cargo should so require, some form of respiratory protection suitable for such cargo should be available for every person on board.

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3.16.11 The ship should have on board medical first aid equipment including oxygen resuscitation equipment and antidotes for cargoes carried.

3.16.12 Suitably marked decontamination showers and an eye wash should be available on deck in convenient locations.

G. Tank Filling

3.17 General

Tanks carrying liquids at ambient temperatures should be so loaded as to avoid the tank becoming liquid full during the voyage having due regard to the highest temperature which the cargo may reach.

## CHAPTER IV - SPECIAL REQUIREMENTS

The provisions of this Chapter are applicable where specific reference is made in column j of the Summary of Minimum Requirements, Chapter VI.

### A. Special Requirements for Certain Cargoes

#### 4.1 Carbon bisulphide

4.1.1 Provisions should be made to maintain a water pad in the cargo tank during loading, unloading and during transit. In addition, an inert gas pad should be maintained in the ullage space during transit.

4.1.2 All openings should be in the top of the tank above the deck.

4.1.3 Loading lines should terminate near the bottom of the tank.

4.1.4 A standard ullage opening should be provided for emergency sounding.

4.1.5 Cargo piping and vent lines should be independent of piping and vent lines used for other cargo.

4.1.6 Pumps may be used for discharging cargo provided that they are of a type designed to avoid liquid pressure against the shaft gland or are of a submerged type and are suitable for use with cargo.

4.1.7 If a cargo discharge pump is used, it should be inserted through a cylindrical well extending from the tank top to a point near the tank bottom. A blanket of water should be formed in this well before attempting pump removal unless tank has been certified as gas free.

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4.1.8 Water or inert gas displacement may be used for discharging cargo provided the cargo system is designed for the expected pressure and temperature.

4.1.9 Safety relief valves should be of stainless steel construction.

4.1.10 Because of its low ignition temperature and close clearances required to arrest its flame propagation, carbon bisulphide requires safeguards beyond those provided by normal explosion-proof electrical equipment.

4.2 Ethyl ether

4.2.1 Unless inerted, natural ventilation should be provided for the voids around the cargo tanks while the vessel is under way. If a mechanical ventilation system is installed, all blowers should be of non-sparking construction. Mechanical ventilation equipment should not be located in the void spaces surrounding the cargo tanks.

4.2.2 Pressure relief valve settings should not be less than  $0.2 \text{ kp/cm}^2$  (3 psig) for gravity tanks.

4.2.3 Inert gas displacement may be used for discharging cargo from pressure vessel tanks provided the cargo system is designed for the expected pressure.

4.2.4 No electrical equipment except for approved lighting fixtures should be installed in enclosed spaces adjacent to cargo tanks. Lighting fixtures should be approved for use in ethyl ether vapours. The installation of electrical equipment on the weatherdeck should comply with the requirements of this Code.

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4.2.5 In view of the fire hazard provisions should be made to avoid any ignition source and/or heat generation in the cargo area.

4.2.6 Pumps may be used for discharging cargo provided that they are of a type designed to avoid liquid pressure against the shaft gland or are of a submerged type and are suitable for use with the cargo.

4.2.7 Provisions should be made to maintain the inert gas pad in the cargo tank during loading, unloading and during transit.

4.3 Liquid sulphur

4.3.1 Cargo tank ventilation

- (a) Cargo tank ventilation should be provided to maintain the concentration of  $H_2S$  below one-half of its lower explosive limit throughout the cargo tank vapour space for all conditions of carriage i.e., below 1.85 per cent by volume.
- (b) Where mechanical ventilation systems are used for maintaining low gas concentrations in cargo tanks, an alarm system should be provided to give warning if the system fails.
- (c) Ventilation systems should be designed and arranged to preclude depositing of sulphur within the system.

4.3.2 Void spaces

- (a) Openings to void spaces adjacent to cargo tanks should be designed and fitted to prevent the entry of water, sulphur or cargo vapour.

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(b) Connections should be provided to enable sampling and analyzing vapour in void spaces.

(c) Temperature controls should be provided.

4.4 Acetone cyanohydrin

Acetone cyanohydrin must be stabilized with an inorganic acid to a pH of not more than 2.5.

4.5 Elemental phosphorus

4.5.1 Phosphorus should, at all times, be loaded, carried and discharged under a water blanket of 760 mm (30 inches) minimum depth. During discharge operations it should be arranged that water occupy the volume of phosphorus discharged. Any water discharged from a phosphorus tank should be returned only to a shore installation.

4.5.2 Tanks should be designed and tested to a minimum equivalent water head of 2.4 m (8 feet) above the top of the tank, under designed loading conditions, taking into account the depth, specific gravity and method of loading and discharge of the phosphorus.

4.5.3 Tanks should be designed so as to minimize the interfacial area between the liquid phosphorus and its water blanket.

4.5.4 A minimum ullage space of one per cent should be maintained above the water blanket and should be filled with inert gas if phosphorus is carried in the liquid form.

4.5.5 All openings should be at the top of cargo tanks and fittings and joints attached thereto should be of materials resistant to phosphorus pentoxide.

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4.5.6 Phosphorus should be loaded at a temperature not exceeding 60°C (140°F).

4.5.7 Tank heating arrangements should be external to tanks and have a suitable method of temperature control to ensure that the temperature of the phosphorus does not exceed 60°C (140°F). A high temperature alarm should be fitted.

4.5.8 A water drench system acceptable to the Administration should be installed in all void spaces surrounding the tanks. The system should operate automatically in the event of an escape of phosphorus.

4.5.9 Void spaces referred to in 4.5.8 above should be provided with effective means of mechanical ventilation which should be capable of being sealed off quickly in any emergency.

4.5.10 Loading and discharge of phosphorus should be governed by a central system on the ship which, in addition to incorporating high level alarms, should ensure that no overflow of tanks is possible and that such operations can be stopped quickly in an emergency from either ship or shore.

4.5.11 During cargo transfer, a water hose on deck should be connected to a water supply and kept flowing throughout the operation so that any spillage of phosphorus may be washed down with water immediately.

4.5.12 Ship to shore loading and discharge connections should be approved by the Administration.



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4.6 Motor fuel anti-knock compounds containing TEL

4.6.1 Tanks used for these cargoes should not be used for the transportation of any other cargo except those commodities to be used in the manufacture of motor fuel anti-knock compounds containing lead alkyls.

4.6.2 If a pump room is located on deck level according to 4.13.3, the ventilation arrangements should be in compliance with 4.13.2.

4.6.3 Entry into cargo tanks used for the transportation of these cargoes is not permitted unless approved by the Administration.

4.6.4 Air analysis should be made for lead content to determine if the atmosphere is satisfactory prior to allowing personnel to enter the pump room or void spaces surrounding the cargo tank.

4.7 Propylene oxide

4.7.1 Propylene oxide transported under provisions of this section should be acetylene free.

4.7.2 No other product should be transported in tanks certified for propylene oxide except that the Administration may approve subsequent transportation of other products and return to propylene oxide service if tanks, piping and auxiliary equipment are satisfactorily cleaned.

4.7.3 All valves, flanges, fittings and accessory equipment should be of a type suitable for use with propylene oxides and should be constructed of steel or stainless steel, or other materials acceptable to the Administration.

Impurities of copper, magnesium and other acetylides-forming metals should be kept to a minimum. The chemical

composition of all material used should be submitted to the Administration for approval prior to fabrication. Discs or disc faces, seats and other wearing parts of valves should be made of stainless steel containing not less than 11 per cent chromium. Mercury, silver, aluminium, magnesium, copper and their alloys should not be used for any valves, gauges, thermometers, etc. All packing and gaskets should be constructed of materials which do not react spontaneously with or lower the auto-ignition temperature of the propylene oxides.

4.7.4 Pressure rating of valves, fittings and accessories should be not less than the maximum pressure for which the cargo tank is designed or the shut-off head of the cargo pump, whichever is greater. Threaded joints in the cargo liquid and vapour lines are prohibited.

4.7.5 Filling and discharge piping should extend to within 100 mm (4 inches) of the tank bottom or any sump pit.

4.7.6 Suitable means should be provided to return vapours to the shore during cargo transfer. For this purpose, a valved connection should be provided to a vapour return line to shore.

4.7.7 Tanks carrying propylene oxide should be vented independently of tanks carrying other products.

4.7.8 Manifolds for mounting multiple safety relief valves may be fitted with acceptable interlocking shut-off valves so arranged that at all times the required relief valve capacity will be available to relieve internal pressure. The valving arrangements should be such that no vapour will escape even if the "out-of-service" relief valve is removed.

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4.7.9 Enclosed spaces in which cargo tanks are located should be:

- (a) inerted by injection of a suitable inert gas or well ventilated and monitored, or
- (b) if an inerting system is not installed, be fitted with forced ventilation of such capacity to provide a complete change of air every three minutes and arranged in such a manner that any vapours lost into the space will be removed. The ventilation system should be in operation at all times during cargo transfer.

4.7.10 All ventilation machinery should be of non-sparking construction.

4.7.11 In no case should air be allowed to enter the cargo pump or piping system. During cargo transfer, vapour should not be discharged to the atmosphere.

4.7.12 Prior to disconnecting shore lines, the pressure in liquid and vapour lines should be relieved through suitable valves installed at the loading header. Liquid and vapour from these lines should not be discharged to the atmosphere.

4.7.13 Propylene oxide may be carried in gravity type tanks when carried at pressures less than  $0.7 \text{ kp/cm}^2$  (10 psig). Tanks should be designed for the maximum pressure expected to be encountered during loading, storing and discharging cargo.

4.7.14 Cargo tanks with a design pressure less than  $0.6 \text{ kp/cm}^2$  (9 psig) require a cooling system to maintain the propylene oxide below the boiling temperature at the pressure at which it is carried. The cooling system may

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not be required if it can be demonstrated that the propylene oxide can always be maintained below its boiling temperature at the pressure at which it is carried.

4.7.15 (a) Any cooling system should maintain the liquid temperature below  $40^{\circ}\text{C}$  ( $104^{\circ}\text{F}$ ) or below the boiling temperature, whichever is less. At least two complete cooling plants, automatically regulated by temperature variations within the tanks should be provided, each to be complete with the necessary auxiliaries for proper operation. The control system should also be capable of being manually operated. An alarm should be provided to indicate malfunctioning of the temperature controls. The capacity of each cooling system should be sufficient to maintain the temperature of the liquid cargo at or below the design temperature of the system.

(b) An alternate arrangement may consist of three cooling plants, any two of which should be sufficient to maintain the liquid temperature at or below the design temperature.

(c) Cooling systems requiring compression of propylene oxide are prohibited.

4.7.16 Pressure relief valve settings should not be less than  $0.21 \text{ kp/cm}^2$  (3 psig) for gravity tanks.

4.7.17 When propylene oxide is carried, piping systems in propylene oxide service should not be used for any other product and should be completely separate from all other systems. The piping system should be designed so that no cross connection may be made either through accident or design.

4.7.18 Filling density should not exceed 80 per cent for non-refrigerated pressure vessels.

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4.7.19 The cargo should be shipped under a suitable protective padding, such as nitrogen gas. Original charging of the gas pad at the loading facility is not adequate. Additional gas should be provided to maintain pad gas concentration. Any padding gas selected should be at least 98.0 per cent pure and free of reactive materials.

4.7.20 Prior to, during, and after loading, if necessary, the cargo tank vapour space should be tested to ensure that oxygen content is 2 per cent or less.

4.7.21 A water spray extinguishing system should be provided in the area where loading and unloading operations are conducted. The capacity and arrangement should be such as to blanket effectively the area in way of the loading manifold and exposed deck piping for propylene oxide. The rate of discharge and the arrangement of piping and nozzles should be such as to give a uniform distribution over the entire area protected. Additionally, means should be provided for local and remote manual operation. The arrangement should ensure that any spilled cargo is washed away. A water hose with pressure to the nozzle, when atmospheric temperatures permit, should be connected ready for immediate use during filling and discharge operations and any spillage of propylene oxide should immediately be washed away. The water spray extinguishing system should provide a uniform spray over the area of application of  $0.175 \text{ l/m}^2 \cdot \text{sec} \left( 0.5 \frac{\text{gallons}}{\text{ft}^2 \text{ sec}} \right)$

4.7.22 A remote operational, quick closing shut-off valve should be provided at each cargo hose connection used in cargo transfer. Such valves should be of the fail-closed

(closed on loss of power) type and be capable of local manual operation. The operating time for such valves should be such as to avoid excessive pressures in the piping on both ship and shore.

#### 4.8 Acids

4.8.1 The ship's shell plating should not form any boundaries of tanks containing mineral acids.

4.8.2 Materials of construction of the tanks should be in accordance with 2.17, 2.18 and 4.12. Proposals for lining mild steel tanks and related piping systems with corrosion-resistant materials may be considered by the Administration. The elasticity of the lining should not be less than that of the supporting boundary plating.

4.8.3 Unless constructed wholly of corrosion-resistant materials or fitted with an approved lining, the plating thickness should take into account the corrosivity of the cargo.

4.8.4 Flanges of the loading and discharge manifold connections should be provided with shields which may be portable to guard against the danger of the cargo being sprayed; and, in addition, drip trays should also be provided to guard against leakage on to the deck.

4.8.5 Because of the danger of evolution of hydrogen when these substances are being carried, no electrical equipment or other sources of ignition should be permitted in enclosed spaces adjacent to cargo tanks.

4.8.6 Substances subjected to the requirements of this section should be segregated from oil fuel bunkers in addition to the segregation requirements in 2.6 to 2.9.

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4.8.7 Provision should be made for suitable apparatus to detect leakage of cargo into adjacent spaces.

4.8.8 Bilge pumping arrangements from the pump room and spaces immediately adjacent to tanks containing acids and drainage arrangements in pump rooms should be generally of corrosive resistant materials.

4.9 Toxic products

4.9.1 Exhaust openings of tank vent systems should be located:

- (a) at a height of  $B/3$  or 6 m (20 feet) whichever is greater above the cargo tank;
- (b) not less than 6 m (20 feet) above the fore and aft gangway, if fitted within 6 m (20 feet) of the gangway; and
- (c) 15 m (49 feet) from any opening or air intake to any accommodation and service spaces.

4.9.2 Tank venting systems should be provided with a connection for a vapour return line to the shore installation.

4.9.3 Products should:

- (a) not be stowed adjacent to bunker tanks;
- (b) have separate piping systems; and
- (c) have separate tank vent systems.

4.10 Cargoes inhibited against self-reaction

4.10.1 Certain cargoes as listed in column j of the Summary of Minimum Requirements, Chapter VI, by the nature of their chemical make-up tend to polymerize under certain conditions of temperature, exposure to air or contact with

a catalyst. Mitigation of this tendency is carried out by introducing small amounts of chemical inhibitors into the liquid cargo or controlling the cargo tank environment.

4.10.2 Ships carrying these cargoes should be designed to eliminate from the cargo tanks and cargo handling system any material of construction or contaminants which could act as a catalyst or destroy the inhibitor.

4.10.3 Care should be taken to ensure that these cargoes are sufficiently inhibited to prevent polymerization at all times during the voyage. Ships carrying such cargoes should be provided with:

- (a) Cargo sampling equipment and test facilities to check at periodic intervals, the inhibitor concentration should it be of a type that deteriorates with age.
- (b) A supply of inhibitor and means of introducing and circulating the inhibitor into the cargo while en route, should it be required.

4.10.4 Ships using the exclusion of air as the method of preventing self-reaction of the cargo should comply with 2.19.3.

4.10.5 Venting systems should be of a design that eliminates blockage from polymer buildup. Venting equipment should be of a type that can be checked periodically for adequacy of operation.

4.11 Cargoes which have a vapour pressure greater than 1.033 kp/cm<sup>2</sup> at 37.8°C (14.7 psia at 100°F)

4.11.1 Unless the tank is specially designed to withstand the vapour pressure of the cargo provision should be made to maintain the temperature of the cargo below its boiling point at atmospheric pressure.



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4.11.2 Connections for returning the expelled gases ashore during loading should be provided.

4.11.3 Each tank should be provided with a pressure gauge indicating the pressure in the vapour space above the cargo.

4.11.4 Where the cargo is being cooled each tank should be provided with thermometers at the top and bottom of the tank.

B. Special Requirements for Construction and Equipment

4.12 Materials of construction

4.12.1 Copper, copper alloys, zinc, aluminium and mercury should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.2 Copper, copper alloys, zinc or galvanized steel should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.3 Aluminium, magnesium, zinc and lithium should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.4 Copper and copper bearing alloys should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.5 Aluminium or copper or alloys of either should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo vapour or liquid.

4.12.6 Aluminium, stainless steel or steel covered with a suitable protective lining or coating should be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.7 Alkaline or acidic materials, such as caustic soda or sulphuric acid, should not be allowed to contaminate this cargo.

4.12.8 The following materials of construction should be used:

(a) For concentrations of 98 per cent or greater, aluminium or stainless steel.

(b) For concentrations of less than 98 per cent, special acid resistant stainless steel.

4.12.9 Copper, silver, mercury and magnesium or other acetylides-forming metals and their alloys should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

4.12.10 Copper and copper bearing alloys with greater than one per cent copper should not be used as materials of construction for tanks, pipelines, valves, fittings and other items of equipment that may come in contact with cargo liquid or vapour.

#### 4.13 Pump rooms

4.13.1 Pump rooms if fitted should be situated within or adjacent to the cargo tank area.

4.13.2 The ventilation system as described in 3.1.2 should have a minimum capacity of at least 45 changes of air per hour based upon the total volume of space. The ventilation

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system exhaust ducts should discharge at least 10 m (32.8 feet) away from openings into accommodation spaces, intakes to ventilation systems, work areas or other similar spaces and at least 4 m (13.1 feet) above the tank deck.

4.13.3 Pumps should be located in the cargo tank or the pump room should be located on the deck level. Special consideration by the Administration should be required for below deck pump room.

4.14 Overflow control

The provisions of this section are applicable in addition to the required gauging devices where specific reference is made in column j of the Summary of Minimum Requirements, Chapter VI.

4.14.1 High level alarm Cargo tanks should be fitted with an alarm which will indicate when there is imminent danger of the tank being overfilled. Means should be provided to enable the alarm to be tested prior to loading.

4.14.2 Tank overflow control A system acceptable to the Administration should be provided to ensure that cargo tanks while being loaded cannot overflow onto the deck or overboard.

CHAPTER V - OPERATIONAL REQUIREMENTS

5.1 Maximum allowable quantity of cargo per tank

5.1.1 The quantity of a cargo, required to be carried in a Type I ship, should not exceed 1,250 m<sup>3</sup> (44143.3 cu.ft.) in any one tank.

5.1.2 The quantity of a cargo, required to be carried in a Type II ship, should not exceed 3,000 m<sup>3</sup> (105944 cu.ft.) in any one tank.

5.2 Cargo information

5.2.1 Information should be on board and available to all concerned, giving the necessary data for the safe carriage of the cargo. Such information should include for each dangerous chemical carried:

- (i) A full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;
- (ii) action to be taken in the event of spills or leaks;
- (iii) counter measures against accidental personal contact;
- (iv) fire-fighting procedures and fire-fighting media; and
- (v) procedures for cargo transfer, tank cleaning, gas freeing and ballasting.

5.2.2 If sufficient information necessary for the safe transportation of the cargo is not available, the cargo should be refused.

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5.2.3 Cargoes which evolve highly toxic imperceptible vapours should not be transported unless perceptible additives are introduced into the cargo.

5.3 Personnel training

5.3.1 All personnel should be adequately trained in the use of protective equipment and have basic training in the procedures, appropriate to their duties, necessary under emergency conditions.

5.3.2 Personnel involved in cargo operations should be adequately trained in handling procedures.

5.3.3 Officers should be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them should be instructed and trained in essential first aid for cargoes carried.

5.4 Tank entry

5.4.1 Personnel should not enter cargo tanks void spaces around such tanks, cargo handling spaces, or other enclosed spaces unless:

- (i) the compartment is free of toxic vapours and not deficient in oxygen; or
- (ii) personnel wear breathing apparatus and other necessary protective equipment and the entire operation is under the close supervision of a responsible officer.

5.4.2 Personnel should not enter such spaces when the only hazard is of a purely flammable nature except under the close supervision of a responsible officer.

5.5 Opening in cargo tanks

5.5.1 During handling and carriage of cargoes producing flammable and/or toxic vapours, or when ballasting after the discharge of such cargo, or when loading cargo, cargo tank lids should always be kept closed. With any hazardous cargo, cargo tank lids, ullage and sighting ports, tank washing access covers should be open only when necessary.

5.6 Additional operational requirements

Additional operational requirements are found in the following paragraphs of the Code:

1.7.3(a)	4.2.7	4.7.12
2.5	4.3.1	4.7.13
2.6.1	4.4	4.7.15
2.6.2(a) and (b)	4.5.1	4.7.17
2.6.4	4.5.4	4.7.18
2.14.2	4.5.6	4.7.19
2.15.2	4.5.11	4.7.20
2.21.1	4.6.1	4.7.21
2.21.2	4.6.3	4.7.22
3.11.1	4.6.4	4.8.4
3.11.2	4.7.1	4.8.5
3.16	4.7.2	4.8.6
3.17	4.7.6	4.9.3(a)
4.1.1	4.7.7	4.10.1
4.1.7	4.7.9	4.10.3
4.1.8	4.7.11	

CHAPTER VI

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SUMMARY OF MINIMUM REQUIREMENTS

a	b	c	d	e	f	g	h	i	j
Product Name	Ship Type	Tank Type	Tank Vents	Tank Environmental Control	Electrical Instruments	Gauging	Vapour Detection	Fire Protection (1)	Special Requirements (See Chapter IV)
Acetic Acid	3	2G	Cont	No	SP	R	I	A	4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8, 4.12.6
Acetic Anhydride	2	2G	Cont	No	SP	R	I-T	A	4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8, 4.12.6
Acetone Cyanohydrin	2	2G	Cont	No	St	C	T	A	4.4, 4.9, 4.12.6, 4.13.3, 4.14
Acetonitrile	2	2G	Cont	No	SP	R	I-T	A	4.9, 4.13.1
Acrylonitrile	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.10, 4.12.3, 4.13.1, 4.13.2, 4.14
Adiponitrile	3	2G	Cont	No	St	R	T	A	-
Allyl Alcohol	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.13.1, 4.13.2, 4.14
Allyl Chloride	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.13.1, 4.13.2, 4.14
Aminoethylethanolamine	3	2G	Open	No	St	O	No	A	4.12.1
Ammonia Aqua less than 28%	3	2G	Cont	No	SP	R	T	C	4.12.4, 4.12.10
Aniline	2	2G	Cont	No	St	C	T	A	4.9, 4.13.1, 4.13.2, 4.14
Benzene	3	2G	Cont	No	SP	R	I-T	B	4.9.1, 4.13.1, 4.13.2

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a Product Name	b Ship Type	c Tank Type	d Tank Vents	e Tank Environmental Control	f Electrical Instruments	g Gauging	h Vapour Detection	i (1) Fire Protection	j Special Requirements (See Chapter IV)
iso-Butyl Acrylate	2	2G	Cont	No	SP	R	I-F	A	4.10
n-Butyl Acrylate	2	2G	Cont	No	SP	R	I-T	A	4.10
iso-Butyraldehyde	3	2G	Cont	No	SP	O	I-T	A	4.12.7
n-Butyraldehyde	3	2G	Cont	No	SP	O	I-T	A	4.12.7
Camphor Oil	3	2G	Cont	No	SP	O	I	B	-
Carbolic Oil	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.14
Carbon Disulfide	2	1G	Cont	Inert	No Use	C	I-T	C	4.1, 4.9, 4.14
Carbon Tetrachloride	3	2G	Cont	No	St	R	T	-	4.9, 4.13.1, 4.13.2
Caustic Soda	3	2G	Open	No	St	O	No	-	4.12.1
Chlorobenzene	3	2G	Cont	No	SP	R	I-T	B	-
Chloroform	3	2G	Cont	No	St	R	T	-	4.9
Chlorohydrins, Crude	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.14
Chloro Sulfonic Acid	1	2G	Cont	No	-	C	T	-	4.8.2, 4.9.3, 4.8.4, 4.8.5, 4.8.6, 4.8.7, 4.8.8, 4.9, 4.14



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a Product Name	b Ship Type	c Tank Type	d Tank Vents	e Tank Environmental Control	f Electrical Instruments	g Gauging	h Vapour Detection	i (1) Fire Protection	j Special Requirements (See Chapter IV)
Cresols (Mixed isomers)	3	2G	Open	No	St	O	No	B	-
Crotonaldehyde	2	2G	Cont	No	SP	R	I-T	A	4.9, 4.12.7, 4.13.1, 4.13.2
1,2 Dichloropropane	2	2G	Cont	No	SP	R	I-T	B	4.9
1,3 Dichloropropane	2	2G	Cont	No	SP	R	I-T	B	4.9
Diethanolamine	3	2G	Open	No	St	O	No	A	4.12.2
Diethylenetriamine	3	2G	Open	No	St	O	No	A	4.12.2
Diisopropanolamine	3	2G	Open	No	St	O	No	A	4.12.2
Dimethylamine (40% Aq)	3	2G	Cont	No	SP	R	I-T	C,D	4.9, 4.12.2
Dimethylformamide	3	2G	Cont	No	SP	R	I-T	B	-
Epichlorohydrin	2	2G	Cont	No	SP	C	I-T	A	4.9, 4.14
Ethyl Acrylate	2	2G	Cont	No	SP	R	I-T	A	4.10
Ethyl Ether	2	1G	Cont	Inert	SP	C	I-T	A	4.2, 4.11, 4.12.9, 4.14
2 Ethyl 3 Propyl Acrolein	3	2G	Cont	No	SP	R	I-T	A	-

a Product Name	b Ship Type	c Tank Type	d Tank Vents	e Tank Environmental Control	f Electrical Instruments	g Gauging	h Vapour Detection	i (1) Fire Protection	j Special Requirements (See Chapter IV)
Ethylene Cyanohydrin	3	2G	Open	No	St	O	No	A	-
Ethylene Diamine	2	2G	Cont	No	SP	R	I-T	A	4.12.2
Ethylene Dibromide	2	2G	Cont	No	St	R	T	-	4.1, 4.9
Ethylene Dichloride	2	2G	Cont	No	SP	R	I-T	B	4.12.4, 4.14.2
Formaldehyde, 37% aqueous solution	3	2G	Cont	No	SP	R	I-T	A	4.12.7
Formic Acid	3	2G	Cont	No	SP	R	T	A	4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8, 4.10.8
Furfural	3	2G	Cont	No	SP	R	I-T	A	4.12.7
Hydrochloric Acid	3	1G	Cont	No	St	R	T	-	4.8
Isoprene	3	2G	Cont	No	SP	R	I	B	4.10, 4.11
Methyl Acrylate	2	2G	Cont	No	SP	R	I-T	B	4.10
Methyl Methacrylate	2	2G	Cont	No	SP	R	I-T	B	4.10

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a	b	c	d	e	f	g	h	i	j
Product Name	Ship Type	Tank Type	Tank Vents	Tank Environmental Control	Electrical Instruments	Gauging	Vapour Detection	Fire Protection (1)	Special Requirements (See Chapter IV)
Monoethanolamine	3	2G	Open	No	St	O	I-T	A	4.12.2
Monoisopropanolamine	3	2G	Open	No	St	O	I-T	A	4.12.2
Morpholine	3	2G	Cont	No	SP	O	I	A	4.12.2
M.P. Anti-Knock Compounds	2	1G	Cont	No	SP	C	I-T	CB	4.6, 4.9, 4.13.3, 4.14
Nitric Acid, 70% and over	2	2G	Cont	No	St	C	T	-	4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8, 4.14
Olefin	2	2G	Cont	No	St	C	T	-	4.8.2, 4.8.3, 4.8.4, 4.8.5, 4.8.6, 4.8.7, 4.8.8, 4.13.1, 4.13.2, 4.14
Phenol	2	2G	Cont	No	St	C	T	A	4.9, 4.14
Phosphoric Acid	3	2G	Open	No	St	O	No	-	4.8.1, 4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8
Phosphorus	1	1G	Cont	Yes	St	C	No	-	4.5, 4.14
Propionic Acid	3	2G	Cont	No	SP	O	I	A	4.8.2, 4.8.3, 4.8.4, 4.8.6, 4.8.7, 4.8.8, 4.12.6
Propylene Oxide	2	2G	Cont	Inert	SP	C	I-T	A	4.7
Pyridine	3	2G	Cont	No	SP	R	I	A	4.12.4
Styrene Monomer	3	2G	Cont	No	SP	O	I	B	4.10, 4.12.4

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a Product Name	b Ship Type	c Tank Type	d Tank Vents	e Tank Environmental Control	f Electrical Instruments	g Gauging	h Vapour Detection	i (1) Fire Protection	j Special Requirements (See Chapter IV)
Sulfur liquid	3	1G	Open	Yes	SP	O	I-T	-	4.3
Sulfuric Acid	3	2G	Open	No	St	O	No	-	4.8
Triethanolamine	3	2G	Open	No	St	O	No	A	4.12.1
Tricthylenetetramine	3	2G	Open	No	St	O	No	A	4.12.1
Vinyl Acetate	3	2G	Cont	No	SP	O	I	A	4.10
Vinylidene Chloride	2	2G	Cont	Yes	SP	R	I-T	B	4.10, 4.11, 4.12.5

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EXPLANATORY NOTES

- Ship Type:** 1, 2 or 3 indicates Ship Types I, II or III, respectively as discussed in II.1 - Physical Protection .
- Tank Type:** 1 - Independent tank G - Gravity tank  
2 - Integral tank P - Pressure tank
- Tank Vents:** Open - Open vent  
Cont - Controlled venting  
SR - Safety Relief Valve
- Electrical:** St - Standard electrical systems  
SP - Special requirements
- Gauging:** O - Open  
R - Restricted  
C - Closed
- Vapour Detection:** I - Inflammable vapours  
T - Toxic vapours
- Fire Protection:** A - Alc. foam deck system  
B - Reg. foam deck system  
C - Water spray  
D - Dry chemical
- Footnotes:** (1) Dry chemical may be used as an alternative to either alcohol or regular foam  
- Indicates nil requirement

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CHAPTER VII - LIST OF CHEMICALS TO WHICH THE CODE DOES NOT APPLY

In the following are listed certain products which are not considered to come within the scope of the Code. The list may be used as a guide in considering bulk carriage of products whose hazards have not yet been evaluated.

Acetone	Ethylene glycol
Amyl acetate - iso	2-Ethyl hexanol
" " - n	Glycerine
" " - sec	Heptane - n
Amyl alcohol - n	Hexane - n
" " - p, iso	Hexylene glycol
" " - sec, n	Methyl ethyl ketone
" " - sec, iso	Methyl isobutyl ketone
" " - tert	Nonyl Phenol
Butyl acetate - iso	Petroleum naphtha
" " - n	Perchloroethylene
" " - sec	Propionaldehyde
Butyl alcohol - iso, n, sec, tert	Propyl acetate - iso, n
Cyclohexane	Propyl alcohol - iso, n
Decyl alcohol - n	Propylene glycol
Diethylene glycol	Trichloroethane - alpha, beta, 1.1.1
Diethylene glycol - monoethyl ether	Triethylene glycol
Dipropylene glycol	Tripropylene glycol
Ethyl acetate	Turpentine
Ethyl alcohol	Xylenes

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CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS  
CARRYING DANGEROUS CHEMICALS IN BULK