TÜRK LOYDU

Chapter 8 – Chemical Tankers

July 2019

This latest edition incorporates all rule changes. This rule is totally revised. Changes after the publication of the rule are written in red colour.

For Chemical Tankers, which are subject to BCH Code 2008 as amended, the unified interpretations of TL (TL- I Chemical Code) shall be followed.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in TL- PR 29 is on or after 01st of July 2019. New rules or amendments entering into force after the date of contract for construction are to be applied if required by those rules. See Rule Change Notices on **TL** website for details.

"General Terms and Conditions" of the respective latest edition will be applicable (see Rules for Classification and Surveys).

If there is a difference between the rules in English and in Turkish, the rule in English is to be considered as valid. This publication is available in print and electronic pdf version. Once downloaded, this document will become UNCONTROLLED. Please check the website below for the valid version.

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Chemical Tankers

Section 14 – Personnel Protection

Section 15 – Special Requirements

Section 16 – Operational Requirements

Section 17 – Summary of Minimum Requirements

Section 18 – List of Products to Which this Chapter Does not Apply

Section 19 – Index of Products Carried in Bulk

Section 20 – Transport of Liquid Chemical Wastes

Section 21 – Criteria for Assigning Carriage Requirements for Products Subject to the IBC Code

AMENDMENTS

Revision	RCS No.	EIF Date*
Section 02	01/2024	01.07.2024
Section 03	02/2023	01.07.2023
Section 15	05/2022	01.01.2023
Section 02	03/2021	01.07.2021
Section 01	04/2020	01.01.2021
Section 15	04/2020	01.01.2021
Section 16	04/2020	01.01.2021

* Entry into Force (EIF) Date is provided for general guidance only, EIF dates given in Rule Change Summary (RCS) are considered valid. In addition to the above stated changes, editorial corrections may have been made.

SECTION 1

GENERAL

A. Scope

1. The purpose of this Chapter is to provide an international standard for the safe carriage, in bulk by sea, of dangerous chemicals and noxious liquid substances listed in Section 17 of the Chapter. This chapter prescribes the design and construction standards of ships, regardless of tonnage, involved in such carriage and the equipment they shall carry to minimize the risk to the ship, its crew and the environment, having regard to the nature of the products involved.

2. These Rules apply to ships having their machinery aft and built for the carriage in bulk of dangerous chemicals which are listed in Section 17. These ships are to comply with the requirements of the latest version of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code.)

3. *This Chapter primarily deals with ship design and equipment. In order to ensure the safe transport of the products, the total system must, however, be appraised. Further to this chapter the requirements of Rules for Classification and Surveys as well as the relevant provisions of Chapter 1 – Hull, Sections 1÷26 and 28, the Chapters 4 – Machinery, 4 –1 Automation, and Chapter 5 - Electrical Installation apply. The Rules of this Chapter incorporate the IMO-Resolutions MEPC.166(56) and MSC.219(82) - "International Code for the construction and Equipment of Ships carrying dangerous Chemicals in Bulk" (IBC-Code), 2007 edition, as amended. For ships carrying hazardous liquid wastes in bulk for the purpose of dumping at sea the provisions of the IMO-Resolution A.582 (14) apply.*

4. *The requirements of the IBC Code and the additional requirements of this Chapter are also applicable to new products, which may be considered to come within the scope of these Rules, but are not at present listed in either of the tables in Chapter 17 or Chapter 18 of the IBC Code.*

5. *For the carriage in bulk of products which are not listed in either of the tables in Section 17 or Section 18, presenting more severe hazards than those covered by the IBC Code, the **TL** reserves the right to establish requirements and/or conditions additional to those contained in these Rules.*

6. *Certain requirements of the IBC Code that are not within the scope of classification e.g. item 8 "Equivalents", item 16. Survey and Certification, Section 14 "Personal Protection", certain operational requirements in Section 15 "Special Requirements" and Section 16 "Operational Requirements" have been included in these rules. Except for item 8 "Equivalents" and the operational requirements as mentioned above they will, however, be applied in such instances where;*

.1 Türk Loydu is authorized by Administrations to issue on their behalf the "Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk" or where

.2 Türk Loydu is authorized to carry out investigations and surveys on behalf of Administrations on the basis of which the "Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk" will be issued by the Administrations or where

.3 Türk Loydu is requested to certify compliance with the Code.

7. Section 16 of this Chapter, dealing with operational requirements of chemical tankers, highlights the regulations in other sections that are operational in nature and mentions those other important safety features that are peculiar to chemical tanker operation.

Operating Requirements have been included for guidance only and will not be looked at by the Türk Loydu.

8. **Equivalents**

Where the Code requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof shall be fitted or carried in a ship,or that any particular provision shall be made, or any procedure or arrangement shall be complied with, the Administration may allow any other fitting, material, appliance, apparatus, item of equipment or typ thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that ship, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment, or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by the Code. However, the Administration may not allow operational methods or procedures to be made an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof, which are prescribed by the Code, unless such substitution is specifically allowed by the Code.When the Administration 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, it shall communicate to the Organization the particulars thereof, together with a report on the evidence submitted, so that the Organization may circulate the same to other Contracting Governments to **SOLAS** and Parties to **MARPOL** for the information of their officers.

9 Application of the IBC-Code

9.1 The IBC-Code applies to ships regardless of size, including those of less than 500 gross tonnage, engaged in the carriage of bulk cargoes of dangerous chemicals or noxious liquid substances (NLS), other than petroleum or similar flammable products as follows:

.1 Products having significant fire hazards in excess of those of petroleum products and similar flammable products;

.2 Products having significant hazards in addition to or other than flammability.

9.2 The Code is at present limited to the liquids shown in the summary of minimum requirements in Section 17. Products that have been reviewed and determined not to present safety and pollution hazards to such an extent as to warrant the application of the Code are found in Section 18.

9.3 Liquids covered by the Code are those having a vapour pressure not exceeding 0.28 MPa absolute at a temperature of 37.8 °C.

9.4 For the purpose of the **1974 SOLAS Convention**, the Code applies to ships which are engaged in the carriage of products included in Section 17 on the basis of their safety characteristics and identified as such by an entry of S or S/P in *column d*.

9.5 For the purpose of **MARPOL 73/78**, the Code applies only to NLS tankers, as defined in Regulation 1.16.2 of Annex II thereof, which are engaged in the carriage of Noxious Liquid Substances identified as such by an entry of X, Y or Z in *column c* of Section 17.

9.6 For a product proposed for carriage in bulk, but not listed in Section 17 or 18, the Administration and Port Administrations involved in such carriage shall prescribe the preliminary suitable conditions for the carriage, having regard to the criteria for hazard evaluation of bulk chemicals. For the evaluation of the pollution hazard of such a product and assignment of its pollution category, the procedure specified in regulation 6.3 of Annex II of **MARPOL 73/78** must be followed. The Organization shall be notified of the conditions for consideration for inclusion of the product in the Code.

9.7 Unless expressly provided otherwise, the Code applies to ships, the keels of which are laid or which are at the stage where:

.1 Construction identifiable with the ship begins; and

.2 Assembly has commenced comprising at least 50 tonnes or 1 % of the estimated mass of all structural material, whichever is less; on or after 1 July, 1986.

9.8 A ship, irrespective of the date of construction, which is converted to a chemical tanker on or after 1 July 1986 shall be treated as a chemical tanker constructed on the date on which such conversion commences.

This conversion provision does not apply to the modification of a ship referred to in regulation 1.14 of Annex II of **MARPOL 73/78**.

9.9 Where reference is made in the Code to a paragraph, all the provisions of the subparagraphs of that designation shall apply.

10. Hazards

Hazards of products covered by the Code include:

10.1 *Fire hazard*, defined by flashpoint, explosive/flammability limits/range and auto ignition temperature of the chemical.

10.2 *Health hazard*, defined by:

.1 Corrosive effects on the skin in the liquid state; or

.2 Acute toxic effect, taking into account values of LD 50 (oral):

a dose which is lethal to 50% of the test subjects when administered orally;
LD 50 (dermal):

a dose which is lethal to 50% of the test subjects when administered to the skin;
LC 50 (inhalation):

the concentration which is lethal by inhalation to 50 % of the test subjects; or

.3 Other health effects such as carcinogenicity and sensitization.

10.3 *Reactivity hazard*, defined by reactivity:

.1 With water;

.2 With air;

.3 With other products; or

.4 Of the product itself (e.g. polymerization)

10.4 *Marine pollution hazard*, as defined by:

.1 Bioaccumulation;

.2 Lack of ready biodegradability;

.3 Acute toxicity to aquatic organisms;

.4 Chronic toxicity to aquatic organisms;

.5 Long-term human health effects; and

.6 Physical properties resulting in the product floating or sinking and so adversely affecting marine life.

11. Documents to be submitted

11.1 *Apart from the drawings and documents listed in Chapter 1 – Hull, Section 1, G, the following documents are to be submitted in triplicate:*

.1 General arrangement plan,

.2 Data on the location and capacity of cargo tanks and products intended to be carried,

.3 Drawings of the cargo tanks and information on the materials to be used,

.4 Data of the foundations and the fastening of the cargo tanks where the cargo tanks are independent from the hull,

*.5 Damage stability calculations if **TL** is acting in accordance with A.6.1 to A.6.3,*

.6 Drawings showing the arrangement of access and inspection openings for compliance with the requirements in Section 3.4. (in particular double bottom and double hull).

11.2 *Apart from the documents listed in Chapter 4 – Machinery, Section 20, A.3. the following documents are to be submitted in triplicate:*

.1 Drawings of cargo piping system with pumps including their driving machinery,

.2 Drawings of remote-controlled valves including their actuating equipment,

.3 Drawings of the tank venting system including pressure/vacuum devices, flame arresters and vapour returns,

.4 Plans and calculation of safety relief valves

.5 Gas freeing system in cargo tanks including inert gas system

.6 Drawings of bilge and ballast water lines within the cargo area,

.7 Drawings of the cargo heating system,

.8 Drawings of the tank washing system,

.9 Details of the tank gauging and cargo temperature measuring systems,

.10 Gas dangerous zones plan

.11 Hazardous areas and electrical equipment installed in hazardous areas

.12 Gas detection system

.13 Details of the overflow control,

.14 Details of the materials coming into contact with the cargo and their vapour,

.15 Drawings of the fire-extinguishing systems within the cargo area.

.16 Drawings of the under water outlet for the discharge of cargo residues.

.17 Procedure and arrangement manual

12. The layout of this chapter is in line with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), adopted by the Maritime Safety Committee at its forty-eighth session. Gas carriers may also carry in bulk liquid chemicals covered by this Code, as prescribed in the IGC Code.

13. The 1998 edition of the Code was based on the original text as adopted by MSC resolution MSC.4(48). In response to resolution 15 of the International Conference on Marine Pollution, 1973, the MEPC, at its twenty-second session, adopted, by resolution MEPC.19(22), the IBC Code extended to cover marine pollution prevention aspects for the implementation of Annex II to MARPOL 73/78.

This edition of this chapter includes latest amendments adopted by the IMO

14. As from the date of entry into force of the 1983 amendments to SOLAS 74 (i.e. 1 July 1986) and the date of implementation of Annex II of MARPOL 73/78 (i.e. 6 April 1987), this Code became subject to mandatory requirements under these Conventions. Amendments to this chapter, whether from the point of view of safety or of marine pollution, must therefore be adopted and brought into force in accordance with the procedures laid down in article VIII of SOLAS 74 and article 16 of MARPOL 73/78 respectively.

15 Additional requirements

15.1 Emergency towing arrangement

*Emergency towing arrangements are to be fitted on chemical tankers of 20 000 tdw and above in accordance with the **SOLAS**, Chapter II-1, Reg. 3-4, see also Chapter 1 – Hull Structures, Section 28, E.2.*

15.2 Steering gear

Additional requirements for steering gear of chemical tankers of 10000 gross tonnage and above are given in Chapter 4 Machinery, Section 9.

15.3 Safe Access to Tanker Bows

*Every chemical tanker shall be equipped with means for safe access to the bow in accordance with **SOLAS**, Chapter II-1, Reg. 3-3, and ICLL, REG. 25 (4), 26 (2), 27(7) (see also TL- I LL50).*

16. Surveys and Certification

The relevant requirements are given in IBC Code Chapter 1.5.

B. Definitions

Accommodation spaces are those spaces used for public spaces, corridors, lavatories, cabins,offices, hospitals, cinemas, games and hobbies rooms,barber shops, pantries containing no cooking appliancesand similar spaces.

Public spaces are those portions of the accommodation spaces which are used for halls, dining rooms, lounges and similar permanently enclosed spaces.

Adjacent, means all cases of facial contact, linear contact and point contact unless otherwise specified.

Administration means the Government of the State whose flag the ship is entitled to fly. For **Administration (Port)** see **Port Administration.**

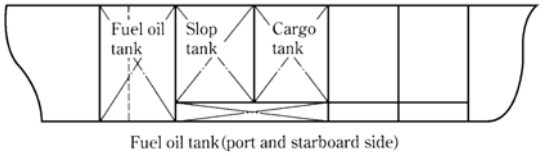
Anniversary date means the day and the month of each year which will correspond to the date of expiry of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

Boiling point is the temperature at which a product exhibits a vapour pressure equal to the atmospheric pressure.

Breadth B in [m] means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. For determination of scantlings the Breadth **B** as per Chapter 1 – Hull Structures,Section 1, H.2.6 is to be taken.

Cargo area is that part of the ship that contains cargo tanks, slop tanks, cargo pump-rooms including pump-rooms, cofferdams, ballast or void spaces adjacent to cargo tanks or slop tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces.Where independent tanks are installed in hold spaces, cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forward-most hold space are excluded from the cargo area.

The term cargo area excludes the fuel oil tanks adjacent to the cargo tanks or slop tanks of the arrangement as given in Figure 1.1.



Fuel oil tank (port and starboard side)

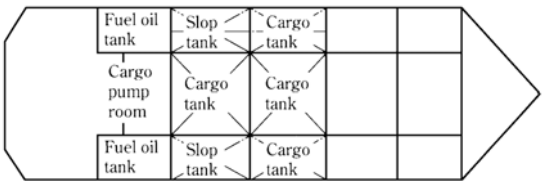


Figure 1.1

Cargo pump-room is a space containing pumps and their accessories for the handling of products covered by these Rules.

Cargo service spaces are spaces within the cargo area used for workshops, lockers and storerooms of more than 2 m² in area used for cargo handling equipment.

Cargo tank is the envelope designed to contain the cargo.

Chemical Tanker is a cargo ship constructed or adapted and used for the carriage in bulk of any liquid product listed in Section 17.

Cofferdam is the isolating space between two adjacent steel bulkheads or decks. This space may be a void space or a ballast space.

Control stations are those spaces in which ship's radio or main navigating equipment or the emergency source of power is located or where the fire-recording or fire-control equipment is centralized.

This does not include special fire-control equipment which can be most practically located in the cargo area.

Dangerous chemicals means any liquid chemicals designated as presenting a safety hazard, based on the safety criteria for assigning products to Section 17.

Density is the ratio of the mass to the volume of a product, expressed in terms of kilograms per cubic metre. This applies to liquids, gases and vapours.

Explosive/flammability limits/range are the conditions defining the state of fuel-oxidant mixture at which application of an adequately strong external ignition source is only just capable of producing flammability in a given test apparatus.

Flashpoint is the temperature in degrees Celsius at which a product will give off enough flammable vapour to be ignited. Values given in the Code are those for a "closed-cup test" determined by an approved flashpoint apparatus.

Hold space is the space enclosed by the ship's structure in which an independent cargo tank is situated.

Independent means that a piping or venting system, for example, is in no way connected to another system and that there are no provisions available for the potential connection to other systems.

Length Lc in [m] means 96 % of the total length on a waterline at 85 % of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel, the waterline on which this length is measured shall be parallel to the designed waterline. *For determination of scantlings the length **L** as per Chapter 1 – Hull Structures, Section 1, H.2.1 is to be taken.*

Machinery spaces of Category A are those spaces and trunks to such spaces which contain:

.1 Internal-combustion machinery used for main propulsion; or

.2 Internal-combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or

.3 Any oil-fired boiler or oil fuel unit or any oilfired equipment other than boilers, such as inert gas generators, incinerators, etc.

Machinery spaces are all machinery spaces of Category A and all other spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating,stabilizing, ventilation and air-conditioning machinery, and similar spaces; and trunks to such spaces.

MARPOL means the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as amended.

Noxious Liquid Substance means any substance indicated in the Pollution Category column of chapters 17 or 18 of the International Bulk Chemical Code, or the current MEPC.2/Circular or provisionally assessed under the provisions of regulation 6.3 of MARPOL Annex II as falling into categories X,Y or Z.

Oil fuel unit is the equipment used for the preparation of oil fuel for delivery to an oil-fired boiler, or equipment used for the preparation for delivery of heated oil to an internal-combustion engine and includes any oil pressure pumps, filters and heaters dealing with oil at a gauge pressure of more than 0.18 Mpa.

Organization is the International Maritime Organization (IMO).

Permeability of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

Port Administration means the appropriate authority of the country in the port of which the ship is loading or unloading.

Products is the collective term used to cover both Noxious Liquid Substances and Dangerous Chemicals.

Pump-room is a space, located in the cargo area, containing pumps and their accessories for the handling of ballast and oil fuel.

Recognized organization is an organization authorized by an Administration in accordance with MARPOL Annex II regulation 8.2.2 and SOLAS regulation XI-1/1.

Recognized Standards are applicable international or national standards acceptable to the Administration or standards laid down and maintained by an organisation which complies with the standards adopted by the Organization and which is recognized by the Administration (This definition includes the TL-Rules).

Reference temperature is the temperature at which the vapour pressure of the cargo corresponds to the set pressure or the pressure-relief valve.

Separate means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system.

(a) Piping system completely independent from each other.

(b) The piping system that come through with the tank carrying other cargo, but can be separated by the means as exemplified in (Acceptable) in Figure 1.2 when cargoes likely to cause dangerous reaction with each other are carried may be regarded as those completely independent from each other. In case where separation can be achieved by this method, operational precautions are to be noted in the Operation Manual.

Service spaces are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store-rooms, workshops other than those forming part of the machinery spaces and similar spaces and trunks to such spaces.

SOLAS means the International Convention for the Safety of Life at Sea, 1974, as amended.

Vapour pressure is the equilibrium pressure of the saturated vapour above a liquid expressed in pascals (Pa) at a specified temperature.

Void space is an enclosed space in the cargo area external to a cargo tank, other than a hold space, ballast space, oil fuel tank, cargo pump-room, pump-room, or any space in normal use by personnel.

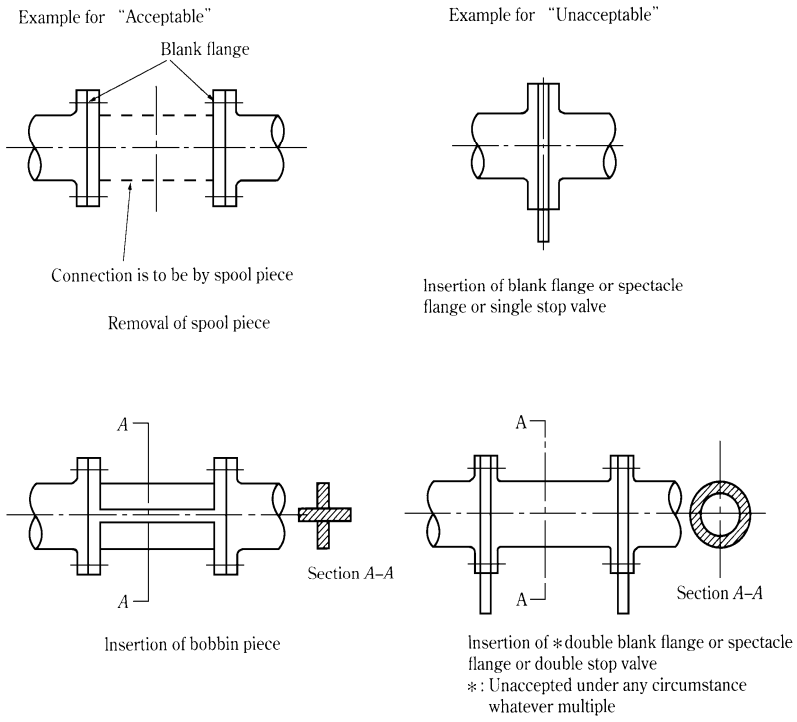


Figure 1.2

Purging means the introduction of inert gas into a tank which is already in an inert condition with the object of further reducing the oxygen content; and/or reducing the existing hydrocarbon or other flammable vapours content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

Gas-freeing means the process where a portable or fixed ventilation system is used to introduce fresh air into a tank in order to reduce the concentration of hazardous gases or vapours to a level safe for tank entry.

SECTION 2

SHIP SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

2.1 General

2.1.1 Ships, subject to this chapter, shall survive the normal effects of flooding following assumed hull damage caused by some external force. In addition, to safeguard the ship and the environment, the cargo tanks of certain types of ships shall be protected from penetration in the case of minor damage to the ship resulting, for example, from contact with a jetty or tug, and given a measure of protection from damage in the case of collision or stranding, by locating them at specified minimum distances inboard from the ship's shell plating. Both the assumed damage and the proximity of the cargo tanks to the ship's shell shall be dependent upon the degree of hazard presented by the products to be carried.

2.1.2 Ships subject to this chapter shall be designed to one of the following standards:

.1 A type 1 ship is a chemical tanker intended to transport section 17 products with very severe environmental and safety hazards which require maximum preventive measures to preclude an escape of such cargo.

.2 A type 2 ship is a chemical tanker intended to transport section 17 products with appreciably severe environmental and safety hazards which require significant preventive measures to preclude an escape of such cargo.

.3 A type 3 ship is a chemical tanker intended to transport section 17 products with sufficiently severe environmental and safety hazards which require a moderate degree of containment to increase survival capability in a damaged condition.

Thus, a type 1 ship is a chemical tanker intended for the transportation of products considered to present the greatest overall hazard and type 2 and type 3 for products of progressively lesser hazards. Accordingly, a type 1 ship shall survive the most severe standard of damage and its cargo tanks shall be located at the maximum prescribed distance inboard from the shell plating.

2.1.3 The ship type required for individual products is indicated in *column e* in the table of section 17.

2.1.4 If a ship is intended to carry more than one product listed in section 17, the standard of damage shall correspond to that product having the most stringent ship type requirement. The requirements for the location of individual cargo tanks, however, are those for ship types related to the respective products intended to be carried.

2.2 Freeboard and stability

2.2.1 Ships subject to the IBC code may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force. However, the draught associated with the assignment shall not be greater than the maximum draught otherwise permitted by the IBC Code.

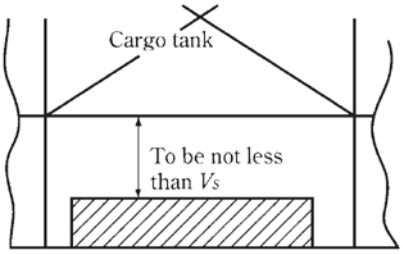
2.2.2 The stability of the ship in all seagoing conditions shall be to a standard which is acceptable to the Administration.

2.2.3 When calculating the effect of free surfaces of consumable liquids for loading conditions it shall be assumed that, for each type of liquid, at least one transverse pair or a single centre tank has a free surface and the tank or combination of tanks to be taken into account shall be those where the effect of free surfaces is the greatest. The free surface effect in undamaged compartments shall be calculated by a method acceptable to the Administration.

2.2.4 Solid ballast shall not normally be used in double-bottom spaces in the cargo area. Where, however, because of stability considerations, the fitting of solid ballast in such spaces becomes unavoidable, then its disposition shall be

governed by the need to ensure that the impact loads resulting from bottom damage are not directly transmitted to the cargo tank structure.

Where the requirements for the initial stability are not satisfied, use of solid ballast may be approved. When solid ballast is provided directly below the tank, the distance between the top of solid ballast and cargo tank bottom is to be not less than the vertical extent of damage Vs as given Figure 2.1.



Notes:Shaded Section: Solid ballast
Vs : Vertical extent of damage given item 2.5.1

Figure 2.1

2.2.5 The master of the ship shall be supplied with a loading and stability information booklet. This booklet shall contain details of typical service and ballast conditions, provisions for evaluating other conditions of loading and a summary of the ship's survival capabilities. In addition, the booklet shall contain sufficient information to enable the master to load and operate the ship in a safe and seaworthy manner.

2.2.6 All ships, subject to the Code, shall be fitted with a stability instrument, capable of verifying compliance with intact and damage stability requirements, approved by the Administration having regard to the performance standards recommended by **TL (1)**:

2.2.6.1 Ships constructed before 1 January 2016 shall comply with this requirement at the first scheduled renewal survey of the ship after 1 January 2016 but not later than 1 January 2021;

2.2.6.2 Notwithstanding the requirements of 2.2.6.1, a stability instrument fitted on a ship constructed before 1 January 2016 need not be replaced provided it is capable of verifying compliance with intact and damage stability, to the satisfaction of the Administration; and

2.2.6.3 For the purposes of control under regulation 16 of MARPOL Annex II, the Administration shall issue a document of approval for the stability instrument.

2.2.7 The Administration may waive the requirements of 2.2.6 for the following ships provided the procedures employed for intact and damage stability verification maintain the same degree of safety, as being loaded in accordance with the approved conditions **(2)**. Any such waiver shall be duly noted on the International Certificate of Fitness referred to in paragraph 1.5.4:

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(1) *Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the Guidelines for the Approval of Stability Instruments (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461) (See also IACS Rec. 110).*

(2) *Refer to operational guidance provided in part 2 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461).*

2.2.7.1 Ships which are on a dedicated service, with a limited number of permutations of loading such that all anticipated conditions have been approved in the stability information provided to the master in accordance with the requirements of 2.2.5;

2.2.7.2 Ships where stability verification is made remotely by a means approved by the Administration;

2.2.7.3 Ships which are loaded within an approved range of loading conditions; or

2.2.7.4 Ships constructed before 1 January 2016 provided with approved limiting KG/GM curves covering all applicable intact and damage stability requirements.

2.3 Shipside discharges below the freeboard deck

2.3.1 The provision and control of valves fitted to discharges led through the shell from spaces below the freeboard deck or from within the super-structures and deck-houses on the freeboard deck fitted with weathertight doors shall comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves shall be limited to:

.1 One automatic non-return valve with a positive means of closing from above the freeboard deck; or

.2 Where the vertical distance from the summer load waterline to the inboard end of the discharge pipe exceeds 0.01L, two automatic non-return valves without positive means of closing, provided that the inboard valve is always accessible for examination under service conditions.

2.3.2 For the purpose of this section, "summer load line" and "freeboard deck" have the meanings as defined in the International Convention on Load Lines in force.

2.3.3 The automatic non-return valves referred to in 2.3.1.1 and 2.3.1.2 shall be fully effective in preventing admission of water into the ship, taking into account the sinkage, trim and heel in survival requirements in 2.9, and shall comply with recognized standards.

2.4 Conditions of loading

Damage survival capability shall be investigated on the basis of loading information submitted to the Administration for all anticipated conditions of loading and variations in draught and trim. Ballast conditions where the chemical tanker is not carrying products covered by this code, or is carrying only residues of such products, need not be considered.

2.5 Damage assumptions

2.5.1 The assumed maximum extent of damage shall be:

.1	Side damage:		
.1.1	Longitudinal extent:	$1/3L^{2/3}$ or 14.5 m, whichever is less	
.1.2	Transverse extent	B/5 or 11.5 m, whichever is less (measured inboard from the ship's side at right angles to the centreline at the level of the summer load line)	
.1.3	Vertical extent:	upwards without limit (measured from the moulded line of the bottom shell plating at centreline)	
.2	Bottom damage:	For 0.3L from the forward perpendicular of the ship	Any other part of the ship
.2.1	Longitudinal extent:	$1/3L^{2/3}$ or 14.5 m, whichever is less	$1/3L^{2/3}$ or 5 m, whichever is less
.2.2	Transverse extent:	B/6 or 10 m, whichever is less	B/6 or 5 m, whichever is less
.2.3	Vertical extent:	B/15 or 6 m, whichever is less [measured from the moulded line of the bottom shell plating at centreline (see 2.6.2))	B/15 or 6 m, whichever is less [measured from the moulded line of the bottom shell plating at centreline (see 2.6.2))

2.5.2 If any damage of a lesser extent than the maximum damage specified in 2.5.1 would result in a more severe condition, such damage shall be considered.

2.6 Location of cargo tanks

2.6.1 Cargo tanks shall be located at the following distances inboard:

.1 Type 1 ships: from the side shell plating, not less than the transverse extent of damage specified in 2.5.1.1.2, and from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 2.5.1.2.3, and nowhere less than 760 mm from the shell plating. This requirement does not apply to the tanks for diluted slops arising from tank washing.

.2 Type 2 ships: from the moulded line of the bottom shell plating at centreline, not less than the vertical extent of damage specified in 2.5.1.2.3, and nowhere less than 760 mm from the shell plating. This requirement does not apply to the tanks for diluted slops arising from tank washing.

.3 Type 3 ships: no requirement.

2.6.2 Except for type 1 ships, suction wells installed in cargo tanks may protrude into the vertical extent of bottom damage specified in 2.5.1.2.3 provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less. Where there is no double bottom, the protrusion of the suction well of independent tanks below the upper limit of bottom damage shall not exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

Note:

In general, the area of suction wells is not to be greater than that required to accommodate cargo pumps, suction pipes, valves, heating coils etc., and to ensure efficient flow and the necessary access for cleaning and maintenance.

2.7 Flooding assumptions

2.7.1 The requirements of 2.9 shall be confirmed by calculations which take into consideration the design characteristics of the ship; the arrangements, configuration and contents of the damaged compartments; the distribution, relative densities and the free surface effects of liquids; and the draught and trim for all conditions of loading.

2.7.2 The permeabilities of spaces assumed to be damaged shall be as follows:

Spaces	Permeabilities
Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Voids	0.95
Intended for consumable liquids	0 to 0.95*****
Intended for other liquids	0 to 0.95*****
***** *The permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment.*	

2.7.3 Wherever damage penetrates a tank containing liquids it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

2.7.4 Every watertight division within the maximum extent of damage defined in 2.5.1 and considered to have sustained damage in positions given in 2.8.1 shall be assumed to be penetrated. Where damage less than the maximum is being considered in accordance with 2.5.2, only watertight divisions or combinations of watertight divisions within the envelope of such lesser damage shall be assumed to be penetrated.

2.7.5 The ship shall be so designed as to keep unsymmetrical flooding to the minimum consistent with efficient arrangements.

2.7.6 Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, shall not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of 2.9 and sufficient residual stability shall be maintained during all stages where equalization is used. Spaces which are linked by ducts of large cross-sectional area may be considered to be common. *(Use of this equalization arrangement is to be accepted only for obtaining the GZ area of 0.0175m-rad for the righting lever of 0.1m and the range between the state of equilibrium and 20^o . Without the use of this equalization arrangement, the requirements for heel angle and positive stability range are to be satisfied. (See Figure 2.2. as an example))*

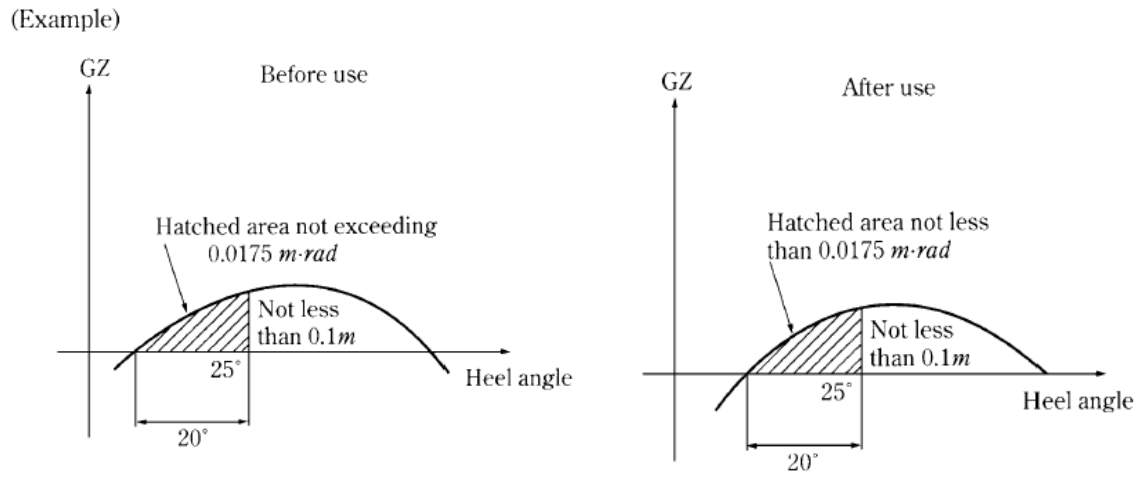


Figure 2.2

2.7.7 If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 2.5, arrangements shall be such that progressive flooding cannot thereby extend to compartments other than those assumed to be flooded for each case of damage.

Tunnels, ducts, pipes, doors, bulkheads and decks which might form watertight boundaries of intact spaces in the case of assumed conventional damage are to have minimum strength adequate to withstand the pressure height corresponding to the deepest equilibrium waterline in damaged conditions.

2.7.8 The buoyancy of any superstructure directly above the side damage shall be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that:

.1 They are separated from the damaged space by watertight divisions and the requirements of 2.9.3 in respect of these intact spaces are complied with; and

.2 Openings in such divisions are capable of being closed by remotely operated sliding watertight doors and unprotected openings are not immersed within the minimum range of residual stability required in 2.9; however, the immersion of any other openings capable of being closed weathertight may be permitted.

2.8 Standard of damage

2.8.1 Ships shall be capable of surviving the damage indicated in 2.5 with the flooding assumptions in 2.7 to the extent determined by the ship's type according to the following standards:

.1 A type 1 ship shall be assumed to sustain damage anywhere in its length.

.2 A type 2 ship of more than 150 m in length shall be assumed to sustain damage anywhere in its length.

.3 A type 2 ship of 150 m in length or less shall be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft.

.4 A type 3 ship of more than 225 m in length shall be assumed to sustain damage anywhere in its length.

.5 A type 3 ship of 125 m in length or more but not exceeding 225 m in length shall be assumed to sustain damage anywhere in its length except involving either of the bulkheads bounding a machinery space located aft.

.6 A type 3 ship below 125 m in length shall be assumed to sustain damage anywhere in its length except involving damage to the machinery space when located aft. However, the ability to survive the flooding of the machinery space shall be considered by the Administration.

Note:

The treatment of the stairway cases located forward or aft end bulkheads of the machinery space is to be in accordance with following Figure (Figure 2.3)

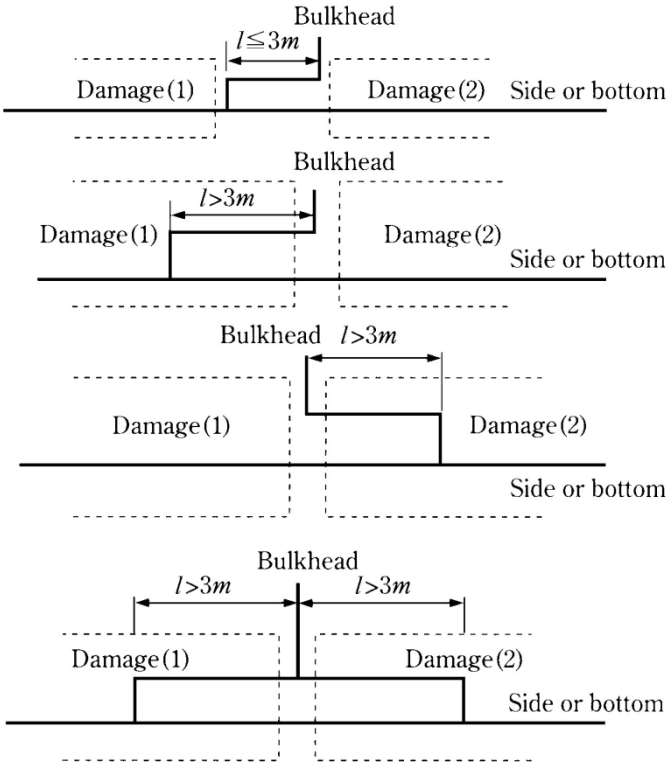


Figure 2.3

The longitudinal extent of damage to the superstructure in the case of side damage to a machinery space aft, with the standards of damage as 2.8.1, is generally to be the same as the longitudinal extent of the side damage to the machinery space.Figure 2.4.

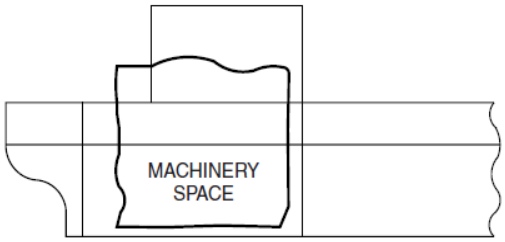


Figure 2.4

2.8.2 In the case of small type 2 and type 3 ships which do not comply in all respects with the appropriate requirements of 2.8.1.3 and 2.8.1.6, special dispensation may only be considered by the Administration provided that alternative measures can be taken which maintain the same degree of safety. The nature of the alternative measures shall be approved and clearly stated and be available to the port Administration. Any such dispensation shall be duly noted on the International Certificate of Fitness referred to in 1.5.4.

2.9 Survival requirements

2.9.1 Ships subject to this code shall be capable of surviving the assumed damage specified in 2.5 to the standard provided in 2.8 in a condition of stable equilibrium and shall satisfy the following criteria.

2.9.2 In any stage of flooding:

.1 The waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings shall include air pipes and openings which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and watertight flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, hinged watertight access doors with open/closed indication locally and at the navigation bridge, of the quick-acting or single-action type that are normally closed at sea, hinged watertight doors that are permanently closed at sea, and sidescuttles of the non-opening type;

.2 The maximum angle of heel due to unsymmetrical flooding shall not exceed 25°, except that this angle may be increased to 30° if no deck immersion occurs;

.3 The residual stability during intermediate stages of flooding shall be to the satisfaction of the Administration. However, it shall never be significantly less than that required by 2.9.3.

2.9.3 At final equilibrium after flooding:

.1 The righting-lever curve shall have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range shall not be less than 0.0175 m radians. Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.9.2.1 and other openings capable of being closed weathertight may be permitted *(The survival requirements at the final stage of equilibrium are to be accordance with Figure 2.5)*; and

.2 The emergency source of power shall be capable of operating.

Note :
The 20° range may be measured from any angle commencing between the position of equilibrium and the angle of 25° (or 30° if no deck immersion occurs).Other openings capable of being closed weathertight do not include ventilators (complying with ILLC 19(4)) that for operational reasons have to remain open to supply air to the engine room or emergency generator room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship.

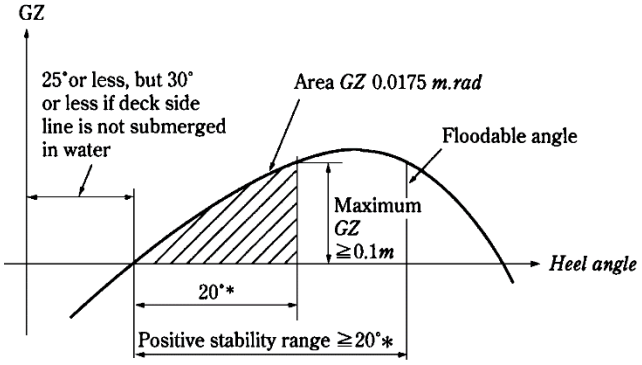


Figure 2.5

SECTION 3

SHIP ARRANGEMENTS

3.1 Cargo segregation

3.1.1 Unless expressly provided otherwise, tanks containing cargo or residues of cargo subject to this Chapter shall be segregated from accommodation, service and machinery spaces and from drinking water and stores for human consumption by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, oil fuel tank or other similar space.

3.1.2 Cargo piping shall not pass through any accommodation, service or machinery space other than cargo pump-rooms or pump-rooms.

3.1.3 Cargoes, residues of cargoes or mixtures containing cargoes, which react in a hazardous manner with other cargoes, residues or mixtures, shall: *(see also 3.7)*

.1 Be segregated from such other cargoes by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible cargo;

.2 Have separate pumping and piping systems which shall not pass through other cargo tanks containing such cargoes, unless encased in a tunnel; and

.3 Have separate tank venting systems.

A cruciform joint (see Figure 3.1) can be considered a "double barrier" for the purpose of segregation as follows:

.1. Between mutually hazardous reactive cargoes;

.2. Between water reactive cargoes and water.

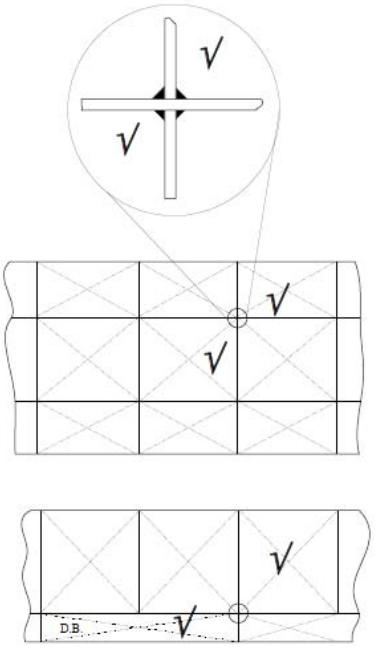


Figure 3.1 Segregation of mutually hazardous reactive cargoes

Where cargoes which react with other cargoes in a hazardous manner are loaded simultaneously, the ship arrangement as given in Figure 3.2 is not to be accepted.

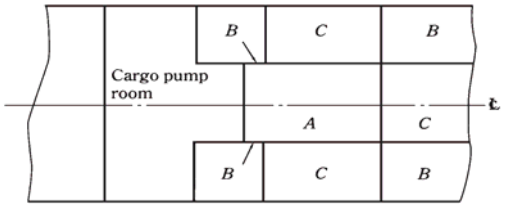


Figure 3.2

A and B react with each other in a hazardous manner. (Arrowhead indicates linear contacts.)

A, B and C do not react with each other in a hazardous manner.

Only in the requirements for segregation of cargoes which react with each other, the linear contacts and point contacts as given in Figure 3.3 may be accepted.

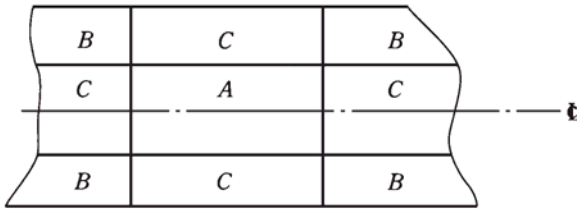


Figure 3.3

A and B react with each other in a hazardous manner.

A and C, and B and C do not react with each other in a hazardous manner.

Where the cargo pipes are of common pipes, they are not to pass through cargo tanks carrying cargoes which react with each other in a hazardous manner except for the cases where pipe arrangement is provided a tunnel or made as given in Figure 3.4

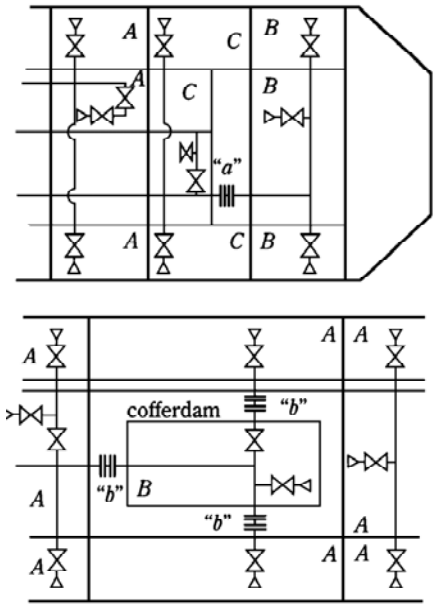


Figure 3.4

a and b are to be segregated within cofferdams or void spaces. No segregation in tanks is to be accepted.

A and B are cargoes which react with other in a hazardous manner.

A and C, and B and C are safe cargoes which do not react with each other in a hazardous manner. In this case, however, cargo operation of cargo B by connecting the spool pieces of a and b after discharging cargo A is unacceptable, and therefore provisions of independent cargo pumps may be required for cargo operation on tanks segregated under the method given above.

3.1.4 If cargo piping systems or cargo ventilation systems are to be separated. This separation may be achieved by the use of design or operational methods. Operational methods shall not be used within a cargo tank and shall consist of one of the following types:

.1 Removing spool-pieces or valves and blanking the pipe ends;

.2 Arrangement of two spectacle flanges in series, with provisions for detecting leakage into the pipe between the two spectacle flanges.

3.1.5 Cargoes subject to this Chapter shall not be carried in either the fore or aft peak tank.

3.2 Accommodation, service and machinery spaces and control stations

3.2.1 No accommodation or service spaces or control stations shall be located within the cargo area except over a cargo pump-room recess or pump-room recess that complies with SOLAS regulations II-2/4.5.1 to 4.5.2.4 and no cargo or slop tank shall be aft of the forward end of any accommodation.

Chain locker is to be arranged outside the cargo area. Paint lockers are not to be located within the cargo area.

When segregated by a gastight deck and well ventilated, such a space is not electrically hazardous space, and in this case, arrangement of accommodation spaces, service spaces or control stations above fuel oil tanks adjacent to cargo tanks in the poop as given in Figure 3.5 may be accepted.

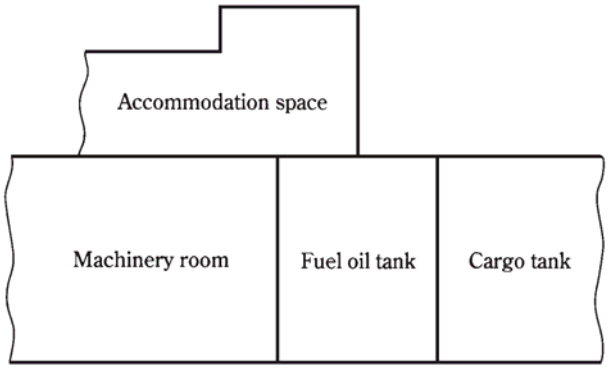


Figure 3.5

3.2.2 In order to guard against the danger of hazardous vapours, due consideration shall be given to the location of air intakes and openings into accommodation, service and machinery spaces and control stations in relation to cargo piping and cargo vent systems. (*See also 3.2.3, 3.7, 8.2.2, 12.1.5 and 15.12, where applicable*)

3.2.3 Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations shall not face the cargo area. They shall be located on the end bulkhead not facing the cargo area and/or on the outboard side of the superstructure or deck-house at a distance of at least 4% of the length (L) of the ship but not less than 3 m from the end of the superstructure or deck-house facing the cargo area. This distance, however, need not exceed 5 m. No doors shall be permitted within the limits mentioned above, except that doors to those spaces not having

access to accommodation and service spaces and control stations, such as cargo control stations and store-rooms, may be fitted. Where such doors are fitted, the boundaries of the space shall be insulated to "A-60" standard. Bolted plates for removal of machinery may be fitted within the limits specified above. Wheelhouse doors and wheelhouse windows may be located within the limits specified above so long as they are so designed that a rapid and efficient gas- and vapour-tightening of the wheelhouse can be ensured. Windows and sidescuttles facing the cargo area and on the sides of the superstructures and deck-houses within the limits specified above shall be of the fixed (non-opening) type. Such sidescuttles in the first tier on the main deck shall be fitted with inside covers of steel or equivalent material.

Air outlets are subject to the same requirements as air inlets and air intakes.

Access facing the cargo area or in prohibited zones should be restricted to stores for cargo-related and safety equipment, cargo control stations and emergency showers.

Access to forecastle spaces containing sources of ignition may be permitted through doors facing cargo area provided the doors are located outside hazardous areas as defined in IEC Publication 60092-502.

On all chemical tankers, regardless of the type of products to be carried, where a deckhouse is substituted for a superstructure and liquid products could flow along the sides of the house, the house front is to be continued to the sides of the ship in the form of a sill, or a permanent spillage barrier is to be arranged as described in Regulation II-2/56.6 of SOLAS 74(83).

3.3 Cargo pump-rooms

3.3.1 Cargo pump-rooms shall be so arranged as to ensure:

.1 Unrestricted passage at all times from any ladder platform and from the floor; and

.2 Unrestricted access to all valves necessary for cargo handling for a person wearing the required personnel protective equipment.

In general, a cargo pump room is to be provided with one set of access/escape ladders. Where it is envisaged that personnel are normally employed in a pump room or the pump room is unusually large, an additional means of escape may be required. Cargo pump rooms and pump rooms may not give direct access to other ship spaces and are to be separated from adjacent spaces by means of gas-tight bulkheads and/or decks.

3.3.2 Permanent arrangements shall be made for hoisting an injured person with a rescue line while avoiding any projecting obstacles.

3.3.3 Guard railings shall be installed on all ladders and platforms.

3.3.4 Normal access ladders shall not be fitted vertical and shall incorporate platforms at suitable intervals.

3.3.5 Means shall be provided to deal with drainage and any possible leakage from cargo pumps and valves in cargo pump-rooms. The bilge system serving the cargo pump-room shall be operable from outside the cargo pump-room. One or more slop tanks for storage of contaminated bilge water or tank washings shall be provided. A shore connection with a standard coupling or other facilities shall be provided for transferring contaminated liquids to onshore reception facilities.

Any cargo tank may be used for holding contaminated cargo pump-room bilge water and cargo tank washings irrespective of the cargo tank location requirements of paragraph 2.6 of the Chapter.

3.3.6 Pump discharge pressure gauges shall be provided outside the cargo pump-room.

3.3.7 Where machinery is driven by shafting passing through a bulkhead or deck, gastight seals with efficient lubrication or other means of ensuring the permanence of the gas seal shall be fitted in way of the bulkhead or deck.

Where gastight seals are maintained with efficient lubrication, shaft seals of a type for periodical feeding of grease are not to be accepted, but continuous gastight sealing is to be ensured. These shaft seals are to be provided outside the cargo pump room. (Given in Figure 3.6 in an example.)

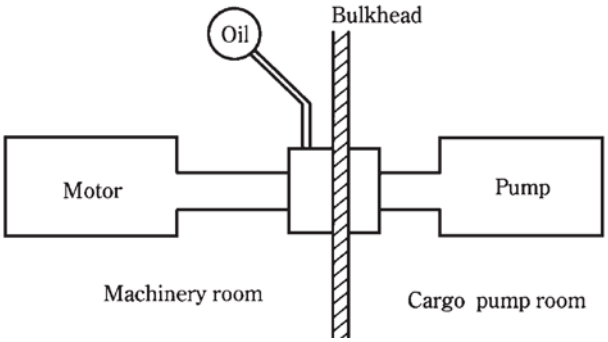


Figure 3.6

3.4 Access to spaces in the cargo area

3.4.1 Access to cofferdams, ballast tanks, cargo tanks and other spaces in the cargo area shall be direct from the open deck and such as to ensure their complete inspection. Access to double-bottom spaces may be through a cargo pump-room, pump-room, deep cofferdam, pipe tunnel or similar compartments, subject to consideration of ventilation aspects.

To take care of restrictions in the movement of personnel and to limit the time needed for a possible emergency escape, two separate means of access should be provided in double bottom tanks and similar spaces where obstructions impede movement. The two accesses should be as widely separated as practicable.

The provision of only one access may be approved in special circumstances if the ability to readily traverse the space or to remove an injured person can be proved to the satisfaction of the Administration.

3.4.2 For access through horizontal openings, hatches or manholes, the dimensions shall be sufficient to allow a person wearing a self-contained air-breathing apparatus and protective equipment to ascend or descend any ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening shall be not less than 600 mm by 600 mm.(Figure 3.7)

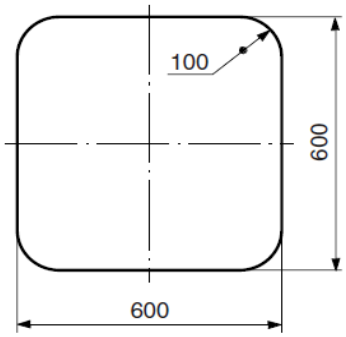


Figure 3.7

3.4.3 For access through vertical openings, or manholes providing passage through the length and breadth of the space, the minimum clear opening shall be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom shell plating unless gratings or other footholds are provided.(Figure 3.8)

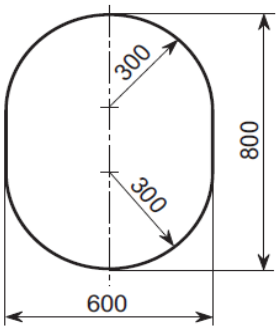


Figure 3.8

3.4.4 Smaller dimensions may be approved by the Administration in special circumstances, if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Administration.

Although fuel oil tanks are not included in the definition of "cargo area" where such tanks are adjacent to cargo tanks the requirements of item 3.4 are applicable.

3.5 Bilge and ballast arrangements

3.5.1 Pumps, ballast lines, vent lines and other similar equipment serving permanent ballast tanks shall be independent of similar equipment serving cargo tanks and of cargo tanks themselves. Discharge arrangements for permanent ballast tanks sited immediately adjacent to cargo tanks shall be outside machinery spaces and accommodation spaces. Filling arrangements may be in the machinery spaces provided that such arrangements ensure filling from tank deck level and non-return valves are fitted.

An eductor situated in the cargo area using water power from pumps in the machinery spaces may be accepted as a means to discharge permanent ballast from tanks and/or double bottoms adjacent to cargo tanks, provided the supply line is above deck level and a non-return valve and removable spool piece are fitted in the supply line outside the machinery space (Figure 3.9).

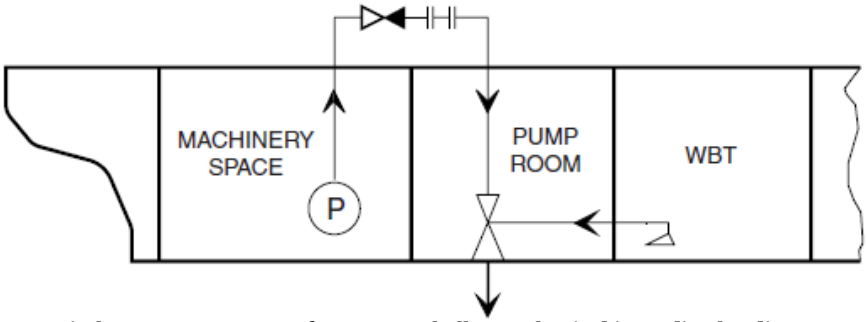


Figure 3.9 Discharge arrangement of permanent ballast tanks sited immediately adjacent to cargo tanks

3.5.2 Filling of ballast in cargo tanks may be arranged from deck level by pumps serving permanent ballast tanks, provided that the filling line has no permanent connection to cargo tanks or piping and that non-return valves are fitted.

The filling arrangement may consist of a portable spool piece or flexible hose plus an isolating valve on the inlet to the cargo tank. This isolating valve is in addition to the required non-return valve. Consideration should be given to the arrangement of in-tank piping and the creation of static electricity.

3.5.3 Bilge pumping arrangements for cargo pump-rooms, pump-rooms, void spaces, slop tanks, double-bottom tanks and similar spaces shall be situated entirely within the cargo area except for void spaces, double-bottom tanks and ballast tanks where such spaces are separated from tanks containing cargo or residues of cargo by a double bulkhead.

The relaxation relevant to the bilge system for spaces which are separated from cargo tanks by a double bulkhead is to be understood as limited to spaces not enclosing piping which may contain cargo.

Use of cargo pumps as bilge pumps:

a) Cargo pumps may also be used as bilge pumps provided they are connected to the bilge piping through a shut-off valve and a non-return valve arranged in series.

b) In the case of carriage of corrosive liquids, one of the cargo pumps may be used for bilge service provided it is connected to the bilge piping through two shut-off valves plus a non-return valve arranged in series.

c) In cargo pump rooms of ships carrying toxic or corrosive products, suitable means for conveying spills from cargo pumps and valves to collecting trays are to be fitted. Trays may also consist of part of the pump room bottom, suitably bounded and protected against the corrosive action of products. Spills may be disposed of by means of suitable pumps or eductors. In the case of carriage of mutually incompatible products, the abovementioned means for collecting and disposing of spills are to be different and separated from each other.

3.6 Pump and pipeline identification

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

3.7 Bow or stern loading and unloading arrangements

3.7.1 Cargo piping may be fitted to permit bow or stern loading and unloading. Portable arrangements shall not be permitted.

3.7.2 Bow or stern loading and unloading lines shall not be used for the transfer of products required to be carried in type 1 ships. Bow and stern loading and unloading lines shall not be used for the transfer of cargoes emitting toxic vapours required to comply with 15.12.1, unless specifically approved by the Administration.

3.7.3 In addition to 5.1, the following provisions apply:

.1 The piping outside the cargo area shall be fitted at least 760 mm inboard on the open deck. Such piping shall be clearly identified and fitted with a shutoff valve at its connection to the cargo piping system within the cargo area. At this location, it shall also be capable of being separated by means of a removable spool-piece and blank flanges when not in use.

.2 The shore connection shall be fitted with a shutoff valve and a blank flange.

.3 The piping shall be full-penetration butt-welded, and fully radiographed. Flange connections in the piping shall only be permitted within the cargo area and at the shore connection.

.4 Spray shields shall be provided at the connections specified in 3.7.3.1 as well as collecting trays of sufficient capacity, with means for the disposal of drainage.

.5 The piping shall be self-draining to the cargo area and preferably into a cargo tank. Alternative arrangements for draining the piping may be accepted by the Administration.

.6 Arrangements shall be made to allow such piping to be purged after use and maintained gas-safe when not in use. The vent pipes connected with the purge shall be located in the cargo area. The relevant connections to the piping shall be provided with a shutoff valve and blank flange.

3.7.4 Entrances, air inlets and openings to accommodation, service and machinery spaces and control stations shall not face the cargo shore-connection location of bow or stern loading and unloading arrangements. They shall be located on the outboard side of the superstructure or deck-house at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the house facing the cargo shore-connection location of the bow or stern loading and unloading arrangements. This distance, however, need not exceed 5 m. Sidescuttles facing the shore-connection location and on the sides of the superstructure or deck-house within the distance mentioned above shall be of the fixed (non-opening) type. In addition, during the use of the bow or stern loading and unloading arrangements, all doors, ports and other openings on the corresponding superstructure or deck-house side shall be kept closed. Where, in the case of small ships, compliance with 3.2.3 and this paragraph is not possible, the Administration may approve relaxations from the above requirements.

3.7.5 Air pipes and other openings to enclosed spaces not listed in 3.7.4 shall be shielded from any spray which may come from a burst hose or connection.

3.7.6 Escape routes shall not terminate within the coamings required by 3.7.7 or within a distance of 3 m beyond the coamings.

3.7.7 Continuous coamings of suitable height shall be fitted to keep any spills on deck and away from the accommodation and service areas.

Note:
In general, the height of the coaming is to be not less than 150 mm. In any case, it is to be not less than 50 mm above the upper edge of the sheerstrake.

3.7.8 Electrical equipment within the coamings required by 3.7.7 or within a distance of 3 m beyond the coamings shall be in accordance with the requirements of section 10.

3.7.9 Fire-fighting arrangements for the bow or stern loading and unloading areas shall be in accordance with 11.3.16.

3.7.10 Means of communication between the cargo control station and the cargo shore-connection location shall be provided and certified safe, if necessary. Provision shall be made for the remote shutdown of cargo pumps from the cargo shore-connection location.

SECTION 4

CARGO CONTAINMENT

4.1 Definitions

4.1.1 Independent tank means a cargo-containment envelope, which is not contiguous with, or 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 structural completeness of the ship's hull.

4.1.2 Integral tank means a cargo-containment envelope which forms part of the ship's hull and which may be stressed in the same manner and by the same loads which stress the contiguous hull structure and which is normally essential to the structural completeness of the ship's hull.

4.1.3 Gravity tank means a tank having a design pressure not greater than 0.07 MPa gauge at the top of the tank. A gravity tank may be independent or integral. A gravity tank shall be constructed and tested according to recognized standards, taking account of the temperature of carriage and relative density of the cargo.

4.1.4 Pressure tank means a tank having a design pressure greater than 0.07 MPa gauge. A pressure tank shall be an independent tank and shall be of a configuration permitting the application of pressure-vessel design criteria according to recognized standards.

4.2 Tank type requirements for individual products

Requirements for both installation and design of tank types for individual products are shown in *column f* in the table of section 17.

4.2.1 Scantlings and testing

4.2.1.1 Ships with inserted and permanently fitted tanks with plane walls, not forming part of the ship's main structure

4.2.1.1.1 General

For ships with inserted and permanently fitted tanks with plane walls not forming part of the ship's main structure, the requirements of Chapter 1 – Hull Structures, Section 1 –21, are applicable unless otherwise mentioned in the following.

For fastening of the tanks the requirements of Chapter 10 – Liquefied Gas Carriers are to be observed. Where the tanks are extending from board to board a longitudinal bulkhead is to be provided.

4.2.1.1.2 Scantlings of the cargo tanks

The scantlings of tank structural elements shall be determined by the formulae shown in Chapter 1 – Hull Structures, Section 12, B.

4.2.1.2 Ships with tanks independent of the shell plating forming part of the ship's main structure

For ships with tanks independent of the shell plating, which form, however, part of the ship's main structure, the requirements of Chapter 1 – Hull Structures, Section 28, are applicable.

4.2.1.3 Thickness of solid stainless steel and clad steel plating and of lined plating

4.2.1.3.1 *Where solid stainless steel plating or clad stainless steel plating is used the applicable corrosion addition is t_k = 0.5 mm. If gross scantlings result from the formulae in Chapter 1 – Hull Structures, Section12 and Section 28 the corrosion addition*

according to Chapter 1, Section 3, is to be deducted. Afterwards t_k = 0.5 mm is to be added. Where plating lined with rubber or synthetic material is used, the thickness of plating and stiffeners determined in accordance with Chapter 1 – Hull Structures, Section 12 or Section 28 may be reduced by the values in [mm] shown in table 4.1.

4.2.1.3.2 *The thickness of the cladding shall not be less than 1.5 mm for vertical walls and not less than 2.0 mm for tank bottoms.*

Table 4.1

Arrangement of cargo or water ballast	***Plating both sides lined***	***Plating one side lined***
Cargo at both sides	*0.5*	*—*
Cargo at one side, other side dry	*1.0*	*1.0*
Cargo at one side, other side water ballast	*1.0*	*0.5*

4.2.1.3.3 *The suitability of stainless steel and rubber or synthetic material lining is to be proved unless already verified in service. See also Section 6.1 - 0.1.*

4.2.1.4 Testing

4.2.1.4.1 *Gravity tanks shall be tested according to Chapter 1 - Hull Structures, Section 22. All cargo tank bulkheads shall be water tested from at least one side.*

4.2.1.4.2 *For details of dimensioning and testing of pressure tanks Chapter 4 – Machinery Installations, Section 14, shall be observed.*

SECTION 5

CARGO TRANSFER

5.1 Piping scantlings

5.1.1 Subject to the conditions stated in 5.1.4 the wall thickness (t) of pipes shall not be less than:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} (mm)$$

where:

t_0 = Theoretical thickness

t_0 = PD/(2Ke+P) (mm)

with

P = Design pressure (MPa) referred to in 5.1.2

D = Outside diameter (mm)

K = Allowable stress (N/mm^2) referred to in 5.1.5

e = Efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, which are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with recognized standards. In other cases, an efficiency factor of less than 1.0, in accordance with recognized standards, may be required depending on the manufacturing process.

b = Allowance for bending (mm). The value of b shall be chosen so that the calculated stress in the bend, due to internal pressure only, does not exceed the allowable stress. Where such justification is not given, b shall be not less than:

$$b = \frac{Dt_0}{2.5r} (mm)$$

with

r = Mean radius of the bend (mm).

c = Corrosion allowance (mm). If corrosion or erosion is expected, the wall thickness of piping shall be increased over that required by the other design requirements.

*The coefficient C (added corrosion thickness) is normally to be equal to at least 3 mm. **TL** may accept a lesser value for pipes made of austenitic or austenitic-ferritic stainless steel, pipes with internal lining or, if applicable, pipes with acceptable external protective lining or painting.*

a = Negative manufacturing tolerance for thickness (%)

Note:

For piping subjected to green seas, the design pressure P, in MPa, in the formula in 5.1.1 of the IBC Code is to be replaced by an equivalent pressure P' given by the following formula:

$$p' = \frac{1}{2}\left(p + \sqrt{p^2 + 0{,}006 R' K \frac{D_c}{D}} \right)$$

D_C = *External diameter of the pipe taking into account the insulation (in mm), whose thickness is to be taken at least equal to:*

40 mm if $D \leq 50$ *mm*
80 mm if $D \leq 150$ *mm*

Intermediate values are to be determined by interpolation R' : Drag corresponding to the effect of green seas, in daN/mm^2, such as given in Table 5.1 as a function of the location of the pipes and of their height H (in m) above the deepest loadline; intermediate values are to be determined by interpolation.

Table 5.1

External diameter of pipe ***(1)***	*Aft of the quarter of the ship's length*			*Forward of the quarter of the ship's length*		
	$H \leq 8$	$H = 13$	$H \geq 18$	$H \leq 8$	$H = 13$	$H \geq 18$
≤25	1500	250	150	2200	350	150
50	1400	250	150	2000	350	150
75	1100	250	150	1600	350	150
100	700	250	150	700	350	150
≥ 150	500	250	150	700	350	150

(1) D_C *if the pipe is insulated, D otherwise.*

5.1.2 The design pressure P in the formula for to in 5.1.1 is the maximum gauge pressure to which the system may be subjected in service, taking into account the highest set pressure on any relief valve on the system.

5.1.3 Piping and piping-system components which are not protected by a relief valve, or which may be isolated from their relief valve, shall be designed for at least the greatest of:

.1 For piping systems or components, which may contain some liquid, the saturated vapour pressure at 45°C;

.2 The pressure setting of the associated pump discharge relief valve;

.3 The maximum possible total pressure head at the outlet of the associated pumps when a pump discharge relief valve is not installed.

5.1.4 The design pressure shall not be less than 1 MPa gauge except for open-ended lines, where it shall be not less than 0.5 MPa gauge.

5.1.5 For pipes, the allowable stress K to be considered in the formula for to in 5.1.1 is the lower of the following values:

$$\frac{R_m}{A} \text{ or } \frac{R_e}{B}$$

where:

R_m = Specified minimum tensile strength at ambient temperature (N/mm^2)

R_e = Specified minimum yield stress at ambient temperature (N/mm^2). If the stress-strain curve does not show a defined yield stress, the 0.2% proof stress applies.

A and B shall have values of at least A = 2.7 and B = 1.8.

5.1.6.1 The minimum wall thickness shall be in accordance with Chapter 4, Machinery, Section 16, C.

5.1.6.2 Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to weight of pipes and content and to superimposed loads from supports, ship deflection or other causes, the wall thickness shall be increased over that required by 5.1.1 or, if this is impracticable or would cause excessive local stresses, these loads shall be reduced, protected against or eliminated by other design methods.

5.1.6.3 Flanges, valves and other fittings shall be in accordance with recognized standards, taking into account the design pressure defined under 5.1.2.

5.1.6.4 For flanges not complying with a standard, the dimensions for flanges and associated bolts shall be to the satisfaction of the **TL**.

5.2 Piping fabrication and joining details

5.2.1 The requirements of this sub-section apply to piping inside and outside the cargo tanks. However, relaxations from these requirements may be accepted in accordance with recognized standards for open-ended piping and for piping inside cargo tanks except for cargo piping serving other cargo tanks.

5.2.2 Cargo piping shall be joined by welding except:

.1 For approved connections to shutoff valves and expansion joints; and

.2 For other exceptional cases specifically approved by the **TL**.

Cargo piping should be welded except for necessary flanged connections to valves, expansion joints (as permitted in paragraph 5.2.2.1), spool pieces and similar fittings or where required for coating, lining, fabrication, inspection or maintenance.

5.2.3 The following direct connections of pipe lengths without flanges may be considered:

.1 Butt-welded joints with complete penetration at the root may be used in all applications.

.2 Slip-on welded joints with sleeves and related welding having dimensions in accordance with recognized standards shall only be used for pipes with an external diameter of 50 mm or less. This type of joint shall not be used when crevice corrosion is expected to occur.

.3 Screwed connections, in accordance with recognized standards, shall only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

5.2.4 Expansion of piping shall normally be allowed for by the provision of expansion loops or bends in the piping system.

.1 Bellows, in accordance with recognized standards, may be specially considered.

.2 Slip joints shall not be used.

The use of bellows is not permitted for corrosive and polymerising products, except if provision is made to prevent stagnation of liquids.

5.2.5 Welding, post-weld heat treatment and non-destructive testing shall be performed in accordance with Chapter 3, Welding.

a) Butt welded pipes and accessories are to be X-rayed at random and entirely checked by means of a dye-penetrant test or an equivalent method.

b) X-rays are to cover at least 10% of the connections and may be extended, at the request of the Surveyor depending on the results of the inspection.

c) Relaxation of the above requirements may be considered by the TL on a case-by-case basis for pipes welded at workshops. However, this only applies to ships exclusively intended to carry cargoes with minor fire risk.

5.3 Flange connections

5.3.1 Flanges shall be of the welded-neck, slip-on or socket-welded type. However, socket-welded-type flanges shall not be used in nominal size above 50 mm.

5.3.2 Flanges shall comply with recognized standards as to their type, manufacture and test.

5.4 Test requirements for piping

5.4.1 The test requirements of this sub-section apply to piping inside and outside cargo tanks. However, relaxations from these requirements may be accepted in accordance with recognized standards for piping inside tanks and open-ended piping.

5.4.2 After assembly, each cargo piping system shall be subject to a hydrostatic test to at least 1.5 times the design pressure. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the hydrostatic test may be conducted prior to installation aboard the ship. Joints welded on board shall be hydrostatically tested to at least 1.5 times the design pressure.

5.4.3 After assembly on board, each cargo piping system shall be tested for leaks to a pressure depending on the method applied.

5.5 Piping arrangements

5.5.1 Cargo piping shall not be installed under deck between the out-board side of the cargo-containment spaces and the skin of the ship unless clearances required for damage protection (see 2.6) 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.

5.5.2 Cargo piping located below the main deck may run from the tank it serves and penetrate tank bulkheads or boundaries common to longitudinally or transversally adjacent cargo tanks, ballast tanks, empty tanks, pump-rooms or cargo pump-rooms provided that inside the tank it serves it is fitted with a stop-valve operable from the weather deck and provided cargo compatibility is assured in the event of piping failure. As an exception, where a cargo tank is adjacent to a cargo pump-room, the stop valve operable from the weather deck may be situated on the tank bulkhead on the cargo pump-room side, provided an additional valve is fitted between the bulkhead valve and the cargo pump. A totally enclosed hydraulically operated valve located outside the cargo tank may, however, be accepted, provided that the valve is:

.1 Designed to preclude the risk of leakage *(The intent is to guard against the hazard of cargo leaking past a valve gland into the space where the valve is located)*;

.2 Fitted on the bulkhead of the cargo tank which it serves;

.3 Suitably protected against mechanical damage;

.4 Fitted at a distance from the shell as required for damage protection; and

.5 Operable from the weather deck.

5.5.3 In any cargo pump-room where a pump serves more than one tank, a stop valve shall be fitted in the line to each tank.

5.5.4 Cargo piping installed in pipe tunnels shall also comply with the requirements of 5.5.1 and 5.5.2. Pipe tunnels shall satisfy all tank requirements for construction, location and ventilation and electrical hazard requirements. Cargo compatibility shall be assured in the event of a piping failure. The tunnel shall not have any other openings except to the weather deck and cargo pump-room or pump-room.

5.5.5 Cargo piping passing through bulkheads shall be so arranged as to preclude excessive stresses at the bulkhead and shall not utilize flanges bolted through the bulkhead.

5.6 Cargo-transfer control systems

5.6.1 For the purpose of adequately controlling the cargo, cargo-transfer systems shall be provided with:

.1 One stop-valve capable of being manually operated on each tank filling and discharge line, located near the tank penetration; if an individual deep well pump is used to discharge the contents of a cargo tank, a stop-valve is not required on the discharge line of that tank; *(The provisions of this paragraph are not intended to be additional to those of paragraphs 5.5.2 and 5.5.3 for cargo piping below deck)*

.2 One stop valve at each cargo-hose connection *(One blank flange provided in addition to the stop valve at each cargo hose connection)*;

.3 Remote shutdown devices for all cargo pumps and similar equipment.

5.6.2 The controls necessary during transfer or transport of cargoes covered by this code other than in cargo pump-rooms which have been dealt with elsewhere in this code shall not be located below the weather deck.

5.6.3 For certain products, additional cargo-transfer control requirements are shown in *column o* in the table of section 17.

5.7 Ship's cargo hoses

5.7.1 Liquid and vapour hoses used for cargo transfer shall be compatible with the cargo and suitable for the cargo temperature.

Paragraph 5.7.1 applies to cargo hoses carried on board the vessel and "compatibility with the cargo" means that:

.1. The cargo hose does not lose its mechanical strength or deteriorate unduly when in contact with the cargo, and

.2. The cargo hose material does not affect the cargo in a hazardous way.

Consideration must be given to internal and external surfaces with respect to the above where hoses may be used as an integral part of, or connected to emergency cargo pumps and submerged in the cargo tank.

5.7.2 Hoses subject to tank pressure or the discharge pressure of pumps shall be designed for a bursting pressure not less than 5 times the maximum pressure the hose will be subjected to during cargo transfer.

5.7.3 For cargo hoses installed on board ships on or after 1 July 2002, each new type of cargo hose, complete with end-fittings, shall be prototype-tested at a normal ambient temperature with 200 pressure cycles from zero to at least twice the specified maximum working pressure. After this cycle pressure test has been carried out, the prototype test shall demonstrate a bursting pressure of at least 5 times its specified maximum working pressure at the extreme service temperature. Hoses used for prototype testing shall not be used for cargo service. Thereafter, before being placed in service, each new length of cargo hose produced shall be hydrostatically tested at ambient temperature to a pressure not less than 1.5 times its specified maximum working pressure but not more than two-fifths of its bursting pressure. The hose shall be stencilled or otherwise marked with the date of testing, its specified maximum working pressure and, if used in services other than the ambient temperature services, its maximum and minimum service temperature, as applicable. The specified maximum working pressure shall not be less than 1 MPa gauge.

SECTION 6

MATERIALS OF CONSTRUCTION, PROTECTIVE LININGS AND COATINGS

6.1 Structural materials used for tank construction, together with associated piping, pumps, valves, vents and their jointing materials, shall be suitable at the temperature and pressure for the cargo to be carried and shall comply with the Chapter II – Materials. Steel is assumed to be the normal material of construction.

Non-metallic materials used in cargo tanks and connected equipment are to be suitable for the liquids and vapours to which they are exposed.

Primers containing zinc may not be used for stainless steel. Where such type of primer is used for other items which are welded to stainless steel, provisions are to be made to avoid the contamination of the stainless steel by zinc.

6.2 The shipyard is responsible for providing compatibility information to the ship operator and/or master. This must be done in a timely manner before delivery of the ship or on completion of a relevant modification of the material of construction.

6.3 Where applicable, the following should be taken into account in selecting the material of construction:

.1 Notch ductility at the operating temperature;

.2 Corrosive effect of the cargo; and

.3 Possibility of hazardous reactions between the cargo and the material of construction.

Selection of materials, coating systems and linings coming into contact with cargo liquid or vapour is to be based on the list of cargoes to be carried and shall take into account the suitability and resistance data supplied and guarantied by the material or coating manufacturers.

Where chlorides are included in the list of cargoes the molybdenum content of stainless steel is not to be less than 2.5 %.

Where seawater is intended to be carried in stainless steel tanks for an extended period the pitting resistance equivalent

W = % Cr + 3.3 % Mo is not to be less than 30.

6.4 The shipper of the cargo is responsible for providing compatibility information to the ship operator and/or master. This must be done in a timely manner before transportation of the product. The cargo shall be compatible with all materials of construction such that:

.1 No damage to the integrity of the materials of construction is incurred; and/or

.2 No hazardous, or potentially hazardous reaction is created.

6.5 When a product is submitted to IMO for evaluation, and where compatibility of the product with materials referred to in paragraph 6.1 renders special requirements, the BLG Product Data Reporting form shall provide information on the required materials of construction. These requirements shall be reflected in Section 15 and consequentially be referred to in *column o* of Section 17. The reporting form shall also indicate if no special requirements are necessary. The producer of the product is responsible for providing the correct information.

SECTION 7

CARGO TEMPERATURE CONTROL

7.1 General

7.1.1 When provided, any cargo heating or cooling systems shall be constructed, fitted and tested in accordance with the rules of **TL**. Materials used in the construction of temperature-control systems shall be suitable for use with the product intended to be carried.

7.1.1.1 Cargo Temperature Control Systems

Wherever a particular temperature (higher or lower than the ambient temperature) is required to be maintained for the preservation of the cargo, one of the following systems is to be adopted:

a) Thermal insulated tanks capable of maintaining the temperature of the cargo within acceptable limits for the time of the voyage.

b) A heating or cooling plant or refrigerating plant.

c) A combination of a) and b) above.

7.1.1.2 Heating and Cooling plants

a) Manifolds for the delivery and backflow of heating media are to be fitted on the weather deck; connections to cargo tanks for inlet and outlet are to be in way of the cargo tank top.

b) Where the heat exchanger room is located in the accommodation area and considered as gas-safe, it is to be treated as a machinery space (not a category A machinery space) and provided with independent mechanical extraction ventilation as well as with scuppers discharging directly into the machinery space.

7.1.1.3 Reference Temperature

Wherever the cargo temperature is maintained by a heating or refrigerating plant, unless otherwise indicated in the con- tract specification, the system is to be designed taking into account the reference temperatures indicated in Table 7.1.

Table 7.1

Reference temperature (°C)		
	Heating system	*Cooling system*
Sea	*0*	*32*
Air	*5*	*45*

7.1.1.4 Redundancy

Wherever the heating or cooling system is essential for the preservation of the cargo, the following components are to be duplicated:

a) Coils and ducts in cargo tanks

b) Heating or cooling sources

c) Circulating pumps for cargo and heating cooling media; if suitable for the use, cargo pumps may be employed for the circulation of the heating or cooling media

d) Refrigeration plant.

7.1.1.5 Maximum Surface Temperature

Depending on the class temperature of the cargoes being carried, the maximum surface temperature of the heating system, within enclosed spaces inside the cargo area should not exceed the values of Table 7.2.

Table 7.2

Class temperature	***Maximum surface temperature of the heating system***
T1	*450°C*
T2	*300°C*
T3	*200°C*
T4	*135°C*
T5	*100°C*
T6	*85°C*

7.1.2 Heating or cooling media shall be of a type approved for use with the specific cargo. Consideration shall be given to the surface temperature of heating coils or ducts to avoid dangerous reactions from localized overheating or overcooling of cargo. (See also 15.13.6.)

7.1.3 Heating or cooling systems shall be provided with valves to isolate the system for each tank and to allow manual regulation of flow.

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

7.1.5 Means shall be provided for measuring the cargo temperature.

.1 The means for measuring the cargo temperature shall be of restricted or closed type, respectively, when a restricted or closed gauging device is required for individual substances, as shown in column j in the table of Section 17.

.2 A restricted temperature-measuring device is subject to the definition for a restricted gauging device in 13.1.1.2 (e.g. a portable thermometer lowered inside a gauge tube of the restricted type).

.3 A closed temperature-measuring device is subject to the definition for a closed gauging device in 13.1.1.3 (e.g. a remote-reading thermometer of which the sensor is installed in the tank).

.4 When overheating or overcooling could result in a dangerous condition, an alarm system which monitors the cargo temperature shall be provided. (See also operational requirements in 16.6.)

7.1.6 When products for which 15.12, 15.12.1 or 15.12.3 are listed in *column o* in the table of Section 17 are being heated or cooled, the heating or cooling medium shall operate in a circuit:

.1 Which is independent of other ship's services, except for another cargo heating or cooling system, and which does not enter the machinery space; or

.2 Which is external to the tank carrying toxic products; or

.3 Where the medium is sampled to check for the presence of cargo before it is recirculated to other services of the ship or into the machinery space. The sampling equipment shall be located within the cargo area and be capable of detecting the presence of any toxic cargo being heated or cooled. Where this method is used, the coil return shall be tested not only at the commencement of heating or cooling of a toxic product, but also on the first occasion the coil is used subsequent to having carried an unheated or uncooled toxic cargo.

7.2 Additional requirements

For certain products, additional requirements contained in section 15 are shown in *column o* in the table of Section 17.

SECTION 8

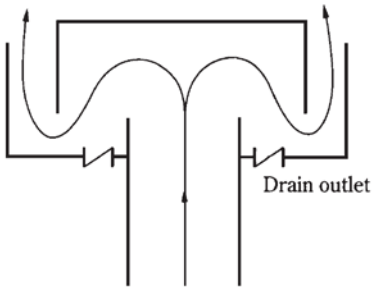
CARGO TANK VENTING AND GAS-FREEING ARRANGEMENTS

8.1 General

The requirements of this Section apply in lieu of SOLAS Regulation II-2/4.5.3, 4.5.6 and 16.3.2.

8.2 Cargo tank venting

8.2.1 All cargo tanks shall be provided with a venting system appropriate to the cargo being carried and these systems shall be independent of the air pipes and venting systems of all other compartments of the ship. Tank venting systems shall be designed so as to minimize the possibility of cargo vapour accumulating about the decks, entering accommodation, service and machinery spaces and control stations and, in the case of flammable vapours, entering or collecting in spaces or areas containing sources of ignition. Tank venting systems shall be arranged to prevent entrance of water See Figure 8.1) into the cargo tanks and, at the same time, vent outlets shall direct the vapour discharge upwards in the form of unimpeded jets.



Drain outlet is to be sized so small that no bulk of vapour leaks out

Figure.8.1

8.2.2 The venting systems shall be connected to the top of each cargo tank and as far as practicable the cargo vent lines shall be self-draining back to the cargo tanks under all normal operational conditions of list and trim. Where it is necessary to drain venting systems above the level of any pressure/vacuum valve, capped or plugged drain cocks shall be provided.

When large amounts of drainage from vent lines is envisaged provision for a hose connection to a drain line draining to a suitable slop tank should be provided.

8.2.3 Provision shall be made to ensure that the liquid head in any tank does not exceed the design head of the tank. Suitable high-level alarms, overflow control systems or spill valves, together with gauging and tank filling procedures, may be accepted for this purpose. Where the means of limiting cargo tank overpressure includes an automatic closing valve, the valve shall comply with the appropriate provisions of 15.19.

8.2.4 Tank venting systems shall be designed and operated so as to ensure that neither pressure nor vacuum created in the cargo tanks during loading or unloading exceeds tank design parameters. The main factors to be considered in the sizing of a tank venting system are as follows:

.1 Design loading and unloading rate;

.2 Gas evolution during loading: this shall be taken account of by multiplying the maximum loading rate by a factor of at least 1.25;

.3 Density of the cargo vapour mixture;

.4 Pressure loss in vent piping and across valves and fittings; and

.5 Pressure/vacuum settings of relief devices.

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

8.2.6 The master shall be provided with the maximum permissible loading and unloading rates for each tank or group of tanks consistent with the design of the venting systems.

8.3 Types of tank venting systems

8.3.1 An open tank venting system is a system which offers no restriction except for friction losses to the free flow of cargo vapours to and from the cargo tanks during normal operations. 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 to cargo segregation. In no case shall shutoff valves be fitted either to the individual vents or to the header.

The design that restricts the ingress of the cargo of a cargo tank into other cargo tanks through vent lines even at times of heavy weather. In consideration of possible degrading of product quality due to coming to contact with different other dangerous chemicals or their vapours, however, it is desirable that even the open type vent system be of independent design as far as practicable. Figure 8.2

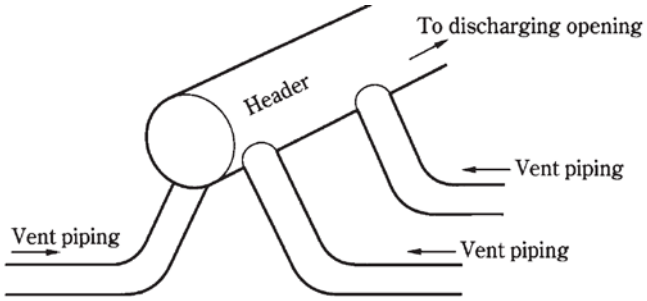


Figure.8.2

8.3.2 A controlled tank venting system is a system in which pressure- and vacuum-relief valves or pressure/vacuum valves are fitted to each tank to limit the pressure or vacuum in the tank. 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 to cargo segregation. In no case shall shut-off valves be fitted either above or below pressure- or vacuum-relief valves or pressure/vacuum valves. Provision may be made for bypassing a pressure- or vacuum-relief valve or pressure/vacuum valve under certain operating conditions provided that the requirement of 8.3.6 is maintained and that there is suitable indication to show whether or not the valve is bypassed.

By-passing of P/V valves is allowed during cargo operations for cargoes which do not require a vapor return system, provided that the vent-line outlet is fitted with flame arresters and is located at the required height above the deck level. However, by-passing of high-velocity valves is not permitted.

8.3.2.1 *In case where the controlled vent systems of the cargo tanks carrying the cargoes different from each other or the same cargoes are led to a common pipe header, the pressure relief valves and vacuum regulating valves are to be separate from each other, and any other arrangement than that given in Figure 8.3 is unacceptable. This requirement does not apply to tanks where cargoes which react in a dangerous manner are carried.*

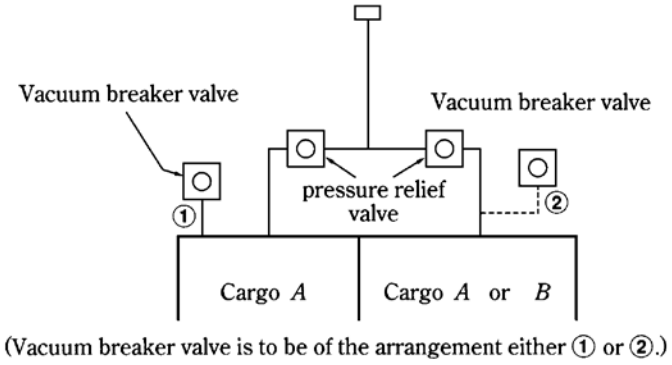


Figure 8.3

8.3.2.2 *When P/V valves whose pressure side and vacuum side are led to the common pipe for the vent system of the cargo tank intended to carry cargoes different from each other or the same cargos are used, any arrangement other than the vent system independent for each tank is unacceptable. Accordingly, both the arrangements given in Figure 8.4a and Figure 8.4b are unacceptable.*

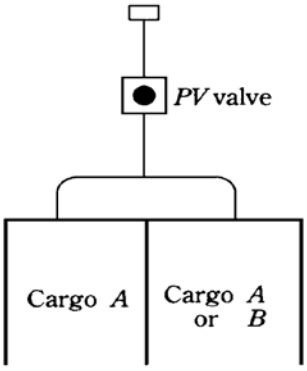


Figure 8.4a

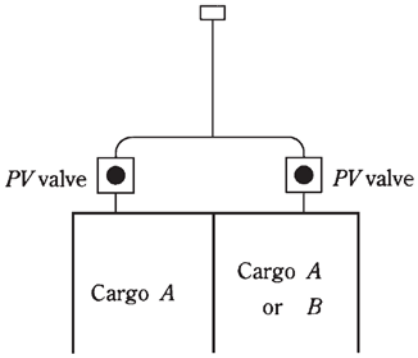


Figure 8.4b

8.3.3 Controlled tank venting systems shall consist of a primary and a secondary means of allowing full flow relief of vapour to prevent over-pressure or under-pressure in the event of failure of one means. Alternatively, the secondary means may consist of pressure sensors fitted in each tank with a monitoring system in the ship's cargo control room or position from which cargo operations are normally carried out. Such monitoring equipment shall also provide an alarm facility which is activated by detection of over-pressure or under-pressure conditions within a tank.

Vent outlets of cargo tanks intended for the carriage of flammable or toxic products are to be arranged at a distance of not less than 3 m from exhaust ducts and as far as possible from inlet ducts to pump rooms and cargo pump rooms.

8.3.4 The position of vent outlets of a controlled tank venting system shall be arranged:

.1 At a height of not less than 6 m above the weather deck (Figure 8.5) or above a raised walkway if fitted within 4 m of the raised walkway; and

.2 At a distance of at least 10 m measured horizontally from the nearest air intake or opening to accommodation, service and machinery spaces and ignition sources.

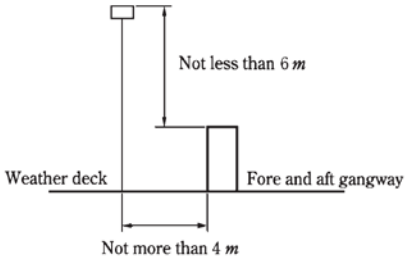


Figure 8.5

8.3.5 The vent outlet height referred to in 8.3.4.1 may be reduced to 3 m above the deck or a raised walkway, as applicable, provided that high-velocity venting valves of an approved type, directing the vapour/air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted.

8.3.6 Controlled tank venting systems fitted to tanks to be used for cargoes having a flashpoint not exceeding 60°C (closed-cup test) shall be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of the devices shall comply with the requirements of the **TL**, which shall contain at least the standards adopted by the Organization (See MSC/Circ. 677 as amended by MSC/Circ.1009 and MSC.1/Circ.1324).

8.3.7 In designing venting systems and in the selection of devices to prevent the passage of flame for incorporation into the tank venting system, due attention shall be paid to the possibility of the blockage of these systems and fittings by, for example, the freezing of cargo vapour, polymer build-up, atmospheric dust or icing up in adverse weather conditions. In this context it shall be noted that flame arresters and flame screens are more susceptible to blockage. Provisions shall be made such that the system and fittings may be inspected, operationally checked, cleaned or renewed as applicable.

8.3.8 Reference in 8.3.1 and 8.3.2 to the use of shutoff valves in the venting lines shall be interpreted to extend to all other means of stoppage, including spectacle blanks and blank flanges.

8.4 Venting requirements for individual products

Venting requirements for individual products are shown in *column g*, and additional requirements in *column o* in the table of Section 17.

8.5 Cargo tank purging

When the application of inert gas is required by Section 11, 11.1.1, before gas-freeing, the cargo tanks shall be purged with inert gas through outlet pipes with cross-sectional area such that an exit velocity of at least 20 m/s can be maintained when any three tanks are being simultaneously supplied with inert gas. The outlets shall extend not less than 2 m above the deck level. Purging shall continue until the concentration of hydrocarbon or other flammable vapours in the cargo tanks has been reduced to less than 2% by volume.

8.6 Cargo tank gas-freeing

8.6.1 The arrangements for gas-freeing cargo tanks used for cargoes other than those for which open venting is permitted shall be such as to minimize the hazards due to the dispersal of flammable or toxic vapours in the atmosphere and to flammable or toxic vapour mixtures in a cargo tank. Accordingly, gas-freeing operations shall be carried out such that vapour is initially discharged:

.1 Through the vent outlets specified in 8.3.4 and 8.3.5; or

.2 Through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 30 m/s maintained during the gas-freeing operation; or

.3 Through outlets at least 2 m above the cargo tank deck level with a vertical exit velocity of at least 20 m/s which are protected by suitable devices to prevent the passage of flame.

When the flammable vapour concentration at the outlets has been reduced to 30% of the lower flammable limit and, in the case of a toxic product, the vapour concentration does not present a significant health hazard, gas-freeing may thereafter be continued at cargo tank deck level.

8.6.2 The outlets referred to in 8.6.1.2 and 8.6.1.3 may be fixed or portable pipes.

8.6.3 In designing a gas-freeing system in conformity with 8.6.1, particularly in order to achieve the required exit velocities of 8.6.1.2 and 8.6.1.3, due consideration shall be given to the following:

.1 Materials of construction of system;

.2 Time to gas-free;

.3 Flow characteristics of fans to be used;

.4 The pressure losses created by ducting, piping, cargo tank inlets and outlets;

.5 The pressure achievable in the fan driving medium (e.g. water or compressed air); and

.6 The densities of the cargo vapour/air mixtures for the range of cargoes to be carried.

SECTION 9

ENVIRONMENTAL CONTROL

9.1 General

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

9.1.2 There are four different types of control for cargo tanks, as follows:

.1 *Inerting:* by filling the cargo tank and associated piping systems and, where specified in Section 15, the spaces surrounding the cargo tanks, with a gas or vapour which will not support combustion and which will not react with the cargo, and maintaining that condition.

.2 *Padding:* by filling the cargo tank and associated piping systems with a liquid, gas or vapour which separates the cargo from the air, and maintaining that condition.

.3 *Drying:* by filling the cargo tank and associated piping systems with moisture- free gas or vapour with a dewpoint of -40°C or below at atmospheric pressure, and maintaining that condition.

.4 *Ventilation:* forced or natural.

9.1.3 Where inerting or padding of cargo tanks is required by IBC Code in column "h" of chapter 17:

.1 An adequate supply of inert gas for use in filling and discharging the cargo tanks shall be carried or shall be manufactured on board unless a shore supply is available. In addition, sufficient inert gas shall be available on the ship to compensate for normal losses during transportation.

.2 The inert gas system on board the ship shall be able to maintain a pressure of at least 0.007 MPa gauge within the containment system at all times. In addition, the inert gas system shall not raise the cargo tank pressure to more than the tank's relief-valve setting.

.3 Where padding is used, similar arrangements for supply of the padding medium shall be made as required for inert gas in 9.1.3.1 and 9.1.3.2.

.4 Means shall be provided for monitoring ullage spaces containing a gas blanket to ensure that the correct atmosphere is being maintained.

.5 Inerting or padding arrangements or both, where used with flammable cargoes, shall be such as to minimize the creation of static electricity during the admission of the inerting medium.

Note: *Chemical tankers of 8000 dwt and above, constructed on or after 1 January 2016 shall be fitted with a fixed inert gas system. Requirements given for inert gas plants in the FSS Code Ch. 15 as amended by IMO Res. MSC.367 (93) shall apply.*

Chemical tankers when transporting oil with flashpoint not exceeding 60°C shall comply with the inert gas requirements of SOLAS Reg. II-2/4.5.5.

9.1.4 Where drying is used and dry nitrogen is used as the medium, similar arrangements for supply of the drying agent shall be made to those required in 9.1.3. Where drying agents are used as the drying medium on all air inlets to the tank, sufficient medium shall be carried for the duration of the voyage, taking into consideration the diurnal temperature range and the expected humidity.

9.2 Environmental control requirements for individual products

The required types of environmental control for certain products are shown in *column h* in the table of Section 17.

SECTION 10

ELECTRICAL INSTALLATIONS

10.1 General

10.1.1 The provisions of this section are applicable to ships carrying cargoes which are inherently, or due to their reaction with other substances, flammable or corrosive to the electrical equipment, and shall be applied in conjunction with applicable electrical requirements of part D of chapter II-1 of SOLAS. Regarding Part D, Chapter II-1 of **SOLAS** see Chapter 5 – Electrical Installation.

10.1.2.1 Electrical installations shall be such as to minimize the risk of fire and explosion from flammable products*.

10.1.2.2 Where the specific cargo is liable to damage the materials normally used in electrical apparatus, due consideration shall be given to the particular characteristics of the materials chosen for conductors, insulation, metal parts, etc. As far as necessary, these components shall be protected to prevent contact with gases or vapours liable to be encountered.

10.1.3 Unless otherwise required in this Section the provisions of Chapter 5 – Electrical Installation are to be complied with.

10.1.4 Electrical equipment, cables and wiring shall not be installed in the hazardous locations unless it conforms with the standards not inferior to those acceptable to the Organization*. However, for locations not covered by such standards, electrical equipment, cables and wiring which do not conform to the standards may be installed in hazardous locations based on a risk assessment to the satisfaction of the Administration, to ensure that an equivalent level of safety is assured.

10.1.5 Where electrical equipment is installed in hazardous locations, as permitted in this section, it shall be to the satisfaction of the Administration and certified by the relevant authorities recognized by the Administration for operation in the flammable atmosphere concerned, as indicated in *column i* in the table of section 17.

10.1.6 For guidance, indication is given if the flashpoint of a substance is in excess of 60°C. In the case of a heated cargo, carriage conditions might need to be established and the requirements for cargoes having a flashpoint not exceeding 60°C applied.

10.2 Bonding

Independent cargo tanks shall be electrically bonded to the hull. All gasketed cargo-pipe joints and hose connections shall be electrically bonded.

10.3 Electrical requirements for individual products

Electrical requirements for individual products are shown in *column i* in the table of section 17.

10.4 Electrical ventilator motors

Requirements for electrical motors for ventilation systems are also given in Section 12.1.8.

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* *Reference is made to the recommendations published by the International Electrotechnical Commission, in particular to Publication IEC 60092-502.*

SECTION 11

FIRE PROTECTION AND FIRE EXTINCTION

11.1 Application

11.1.1 The requirements for tankers in SOLAS chapter II-2 shall apply to ships covered by this chapter, irrespective of tonnage, including ships of less than 500 tons gross tonnage, except that:

.1 Regulations 10.8 and 10.9 shall not apply;

.2 Regulation 4.5.1.2 (i.e. the requirements for location of the main cargo control station) need not apply;

.3 Regulations 10.2, 10.4, and 10.5 shall apply as they would apply to cargo ships of 2,000 tons gross tonnage and over;

SOLAS Regulations II-2/10.2 and 10.4 apply to cargo ships of 500 gross tonnage and over under SOLAS and to chemical carriers, regardless of size, under the IBC Code.

SOLAS II-2/10.5, except for sub-paragraph 10.5.6, applies to chemical tankers, regardless of size, constructed on/after 1 July 1986.

.4 Regulation 10.5.6 shall apply to ships of 2,000 gross tonnage and over

SOLAS II-2/10.5.6 applies only to chemical tankers constructed on/after 1 July 2002 and of 2,000 gross tonnage and above.

.5 The provisions of 11.3 shall apply in lieu of regulation 10.8;

.6 The provisions of 11.2 shall apply in lieu of regulation 10.9;

.7 Regulation 4.5.10 shall apply to ships of 500 gross tonnage and over, replacing “hydrocarbon gases” by “flammable vapours” in the regulation; and

.8 Regulations 13.3.4 and 13.4.3 shall apply to ships of 500 gross tonnage and over.

11.1.2 Notwithstanding the provisions of 11.1.1, ships engaged solely in the carriage of products which are non-flammable (entry NF in *column i* of the table of minimum requirements) need not comply with requirements for tankers specified in SOLAS chapter II-2, provided that they comply with the requirements for cargo ships of that section, except that regulation 10.7 need not apply to such ships and 11.2 and 11.3, hereunder, need not apply.

11.1.3 For ships engaged solely in the carriage of products with a flashpoint of 60°C and above (entry "Yes" in *column i* of the table of minimum requirements), the requirements of SOLAS chapter II-2 may apply as specified in regulation II-2/1.6.4 in lieu of the provisions of this section.

11.1.4 In lieu of the provisions of SOLAS regulation II-2/1.6.7, the requirements of regulations II-2/4.5.10.1.1 and II-2/4.5.10.1.4 shall apply and a system for continuous monitoring of the concentration of flammable vapours shall be fitted on ships of 500 gross tonnage and over which were constructed before 1 January 2009 by the date of the first scheduled dry-docking after 1 January 2009, but not later than 1 January 2012. Sampling points or detector heads should be located in suitable positions in order that potentially dangerous leakages are readily detected. When the flammable vapour concentration reaches a pre-set level which shall not be higher than 10% of the lower flammable limit, a continuous audible and visual alarm signal shall be automatically effected in the pump-room and cargo control room to alert personnel to the potential hazard. However, existing monitoring systems already fitted having a pre-set level not greater than 30% of the

lower flammable limit may be accepted. Notwithstanding the above provisions, the Administration may exempt ships not engaged on international voyages from those requirements.

11.2 Cargo pump-rooms

11.2.1 The cargo pump-room of any ship shall be provided with a fixed carbon dioxide fire-extinguishing system as specified in SOLAS regulation II-2/10.9.1.1. A notice shall be exhibited at the controls stating that the system is only to be used for fire-extinguishing and not for inerting purposes, due to the electrostatic ignition hazard. The alarms referred to in SOLAS regulation II-2/10.9.1.1.1 shall be safe for use in a flammable cargo vapour/air mixture. For the purpose of this requirement, an extinguishing system shall be provided which would be suitable for machinery spaces. However, the amount of gas carried shall be sufficient to provide a quantity of free gas equal to 45% of the gross volume of the cargo pump-room in all cases.

The requirements of Regulation II- 2/10.9.1.1 of the 1974 ***SOLAS*** *Convention are given in Chapter 4 – Machinery Section 18.*

11.2.2 Cargo pump-rooms of ships which are dedicated to the carriage of a restricted number of cargoes shall be protected by an appropriate fire-extinguishing system approved by the Administration.

11.2.3 If cargoes are to be carried which are not suited to extinguishment by carbon dioxide or equivalent media, the cargo pump-room shall be protected by a fire extinguishing system consisting of either a fixed pressure water spray or high expansion foam system. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall reflect this conditional requirement.

11.3 Cargo area

11.3.1 Every ship shall be provided with a fixed deck foam system in accordance with the requirements of 11.3.2 to 11.3.12.

11.3.2 Only one type of foam concentrate shall be supplied, and it shall be effective for the maximum possible number of cargoes intended to be carried. For other cargoes for which foam is not effective or is incompatible, additional arrangements to the satisfaction of the Administration shall be provided. Regular protein foam shall not be used.

11.3.3 The arrangements for providing foam shall be capable of delivering foam to the entire cargo tanks deck area as well as into any cargo tank, the deck of which is assumed to be ruptured.

11.3.4 The deck foam system shall be capable of simple and rapid operation. The main control station for the system shall be suitably located outside of the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fires in the areas protected.

11.3.5 The rate of supply of foam solution shall be not less than the greatest of the following:

.1 2 l/min per square metre of the cargo tanks deck area, where cargo tanks deck area means the maximum breadth of the ship times the total longitudinal extent of the cargo tank spaces;

.2 20 l/min per square metre of the horizontal sectional area of the single tank having the largest such area;

.3 10 l/min per square metre of the area protected by the largest monitor, such area being entirely forward of the monitor, but not less than 1,250 l/min. For ships less than 4,000 tonnes deadweight, the minimum capacity of the monitor shall be to the satisfaction of the Administration.

11.3.6 Sufficient foam concentrate shall be supplied to ensure at least 30 min of foam generation when using the highest of the solution rates stipulated in 11.3.5.1, 11.3.5.2 and 11.3.5.3.

11.3.7 Foam from the fixed foam system shall be supplied by means of monitors and foam applicators. At least 50% of the foam rate required in 11.3.5.1 or 11.3.5.2 shall be delivered from each monitor. The capacity of any monitor shall be at least 10 l/min of foam solution per square metre of deck area protected by that monitor, such area being entirely forward of the monitor. Such capacity shall be not less than 1,250 l/min. *For ships of less than 4000 tonnes deadweight, the minimum required capacity for a monitor is to be not less than 1000 litres/min and the application rate that each monitor is to be capable of supplying is to be at least 10 litres/min per each square metre of the surface to be protected.*

11.3.8 The distance from the monitor to the farthest extremity of the protected area forward of that monitor shall be not more than 75% of the monitor throw in still air conditions.

11.3.9 A monitor and hose connection for a foam applicator shall be situated both port and starboard at the poop front or accommodation spaces facing the cargo area.

11.3.10 Applicators shall be provided for flexibility of action during fire- fighting operations and to cover areas screened from the monitors. The capacity of any applicator shall be not less than 400 l/min and the applicator throw in still air conditions shall be not less than 15 m. The number of foam applicators provided shall be not less than four. The number and disposition of foam main outlets shall be such that foam from at least two applicators can be directed to any part of the cargo tanks deck area.

11.3.11 Valves shall be provided in the foam main, and in the fire main where this is an integral part of the deck foam system, immediately forward of any monitor position to isolate damaged sections of those mains.

11.3.12 Operation of a deck foam system at its required output shall permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire main.

The simultaneous use of the minimum required number of jets of water is to be possible, in general, on deck over the full length of the ship, in the accommodation and service spaces, in control spaces and in machinery spaces.

11.3.13 Ships which are dedicated to the carriage of a restricted number of cargoes shall be protected by alternative provisions to the satisfaction of the Administration when they are just as effective for the products concerned as the deck foam system required for the generality of flammable cargoes.

11.3.14 Suitable portable fire-extinguishing equipment for the products to be carried shall be provided and kept in good operating order.

The capacity of each item of portable fire-extinguishing equipment is to comply with the relevant provisions of the 1974 SOLAS Convention, as amended.

11.3.15 Where flammable cargoes are to be carried, all sources of ignition shall be excluded from hazardous locations unless such sources conform with 10.1.4.

11.3.16 Ships fitted with bow or stern loading and unloading arrangements shall be provided with one additional foam monitor meeting the requirements of 11.3.7 and one additional applicator meeting the requirements of 11.3.10. The additional monitor shall be located to protect the bow or stern loading and unloading arrangements. The area of the cargo line forward or aft of the cargo area shall be protected by the above-mentioned applicator.

11.4 Special requirements

All fire-extinguishing media determined to be effective for each product are listed in *column l* in the table of Section 17.

For dry powder systems see Chapter 4 – Machinery, Section 18

SECTION 12

MECHANICAL VENTILATION IN THE CARGO AREA

For ships to which the Code applies, the requirements of this section replace the requirements of SOLAS regulations II-2/4.5.2.6 and 4.5.4.

However, for products addressed under paragraphs 11.1.2 and 11.1.3, except acids and products for which paragraph 15.17 applies, SOLAS regulations II-2/4.5.2.6 and 4.5.4 may apply in lieu of the provisions of this section.

12.1 Spaces normally entered during cargo-handling operations

12.1.1 Cargo pump-rooms and other enclosed spaces which contain cargo-handling equipment and similar spaces in which work is performed on the cargo shall be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces.

All required ventilation systems are to be capable of being stopped from a position located outside the served spaces and above the weather deck.

12.1.2 Provision shall be made to ventilate such spaces prior to entering the compartment and operating the equipment and a warning notice requiring the use of such ventilation shall be placed outside the compartment.

12.1.3 Mechanical ventilation inlets and outlets shall be arranged to ensure sufficient air movement through the space to avoid the accumulation of toxic or flammable vapours or both (taking into account their vapour densities) and to ensure sufficient oxygen to provide a safe working environment, but in no case shall 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 cargo pump-rooms are prescribed in 15.17.

12.1.4 Ventilation systems shall be permanent and shall normally be of the extraction type. Extraction from above and below the floor plates shall be possible. In rooms housing motors driving cargo pumps, the ventilation shall be of the positive-pressure type.

12.1.5 Ventilation exhaust ducts from spaces within the cargo area shall discharge upwards in locations at least 10 m in the horizontal direction from ventilation intakes and openings to accommodation, service and machinery spaces and control stations and other spaces outside the cargo area.

The height of ventilation outlets is not to be less than 3 m above the weather deck or 2 m above the fore and aft gangway if fitted within 3 m of the gangway. For certain products increased heights are prescribed in 15.17.

12.1.6 Ventilation intakes shall be so arranged as to minimize the possibility of recycling hazardous vapours from any ventilation discharge opening.

The ventilation intakes are to be fitted in locations at least 3 m in the horizontal direction from ventilation intakes and openings to accommodation, service and machinery spaces and control stations and other spaces outside the cargo area. The height of ventilation intakes is not to be less than 3 m above the weatherdeck.

12.1.7 Ventilation ducts shall not be led through accommodation, service and machinery spaces or other similar spaces.

12.1.8 Electric motors driving fans shall be placed outside the ventilation ducts if the carriage of flammable products is intended. Ventilation fans and fan ducts, in way of fans only, for hazardous locations referred to in section10 shall be of non-sparking construction, defined as:

.1 Impellers or housing of non-metallic construction, due regard being paid to the elimination of static electricity;

.2 Impellers and housing of non-ferrous materials;

.3 Impellers and housing of austenitic stainless steel; and

.4 Ferrous impellers and housing with not less than 13 mm design tip clearance.

Any combination of an aluminium or a magnesium alloy fixed or rotating component and a ferrous fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and shall not be used in these places.

12.1.9 Sufficient spare parts shall be carried for each type of fan on board required by this chapter.

12.1.10 Protection screens of not more than 13 mm square mesh shall be fitted in outside openings of ventilation ducts.

12.2 Pump-rooms and other enclosed spaces normally entered

Pump-rooms and other enclosed spaces normally entered which are not covered by 12.1.1 shall be fitted with mechanical ventilation systems, capable of being controlled from outside such spaces and complying with the requirements of 12.1.3, except that the capacity shall not be less than 20 changes of air per hour, based upon the total volume of the space. Provision shall be made to ventilate such spaces prior to personnel entering.

A pump-room is subject to this paragraph whether or not control for pumps and valves is fitted external to the pump-room.

The provisions of 12.1.5, 12.1.6 apply except that the distance of the ventilation outlets specified in 12.1.5 may be reduced to not less than 3 m.

12.3 Spaces not normally entered

Double bottoms, cofferdams, duct keels, pipe tunnels, hold spaces and other spaces where cargo may accumulate shall be capable of being ventilated to ensure a safe environment when entry into the spaces is necessary. Where a permanent ventilation system is not provided for such spaces, approved means of portable mechanical ventilation shall be provided. Where necessary, owing to the arrangement of spaces, for instance hold spaces, essential ducting for ventilation shall be permanently installed. For permanent installations the capacity of eight air changes per hour shall be provided and for portable systems the capacity of 16 air changes per hour. Fans or blowers shall be clear of personnel access openings, and shall comply with 12.1.8.

SECTION 13

INSTRUMENTATION

13.1 Gauging

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

.1 Open device: which makes use of an opening in the tanks and may expose the gauger to the cargo or its vapour. An example of this is the ullage opening.

.2 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 shall ensure that no dangerous escape of tank contents (liquid or spray) can take place in opening the device.

.3 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. Alternatively, an indirect device which does not penetrate the tank shell and which is independent of the tank may be used. Examples are weighing of cargo, pipe flow meter.

13.1.2 Gauging devices shall be independent of the equipment required under 15.19.

13.1.3 Open gauging and restricted gauging shall be allowed only where:

.1 Open venting is allowed by this chapter; or

.2 Means are provided for relieving tank pressure before the gauge is operated.

13.1.4 Types of gauging for individual products are shown in *column j* in the table of section 17.

13.2 Vapour detection

13.2.1 Ships carrying toxic or flammable products or both shall 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 shall be provided.

*Vapour detection instruments, either fixed or portable, are to be of a type recognised suitable by the **TL** for the products to be carried. The spaces to be monitored are:*

- *Cargo pump rooms*
- *Spaces containing motors driving cargo pumps, except for the machinery space*
- *Enclosed spaces containing cargo piping, equipment connected with cargo handling, cofferdams, enclosed spaces and double bottoms adjacent to cargo tanks*
- *Pipe tunnels*
- *Other spaces, in the opinion of the **TL**, depending on the ship type.*

Where a fixed system is installed, it is to serve the spaces among those listed above which are normally entered by the crew.

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

13.2.3 When toxic-vapour-detection equipment is not available for some products which require such detection, as indicated in *column k* in the table of section 17, the Administration may exempt the ship from the requirement, provided an appropriate entry is made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk. When granting such an exemption, the Administration shall recognize the necessity for additional breathing-air supply and an entry shall be made on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk drawing attention to the provisions of 14.2.4 and 16.4.2.2.

13.2.4 Vapour-detection requirements for individual products are shown in *column k* in the table of section 17.

SECTION 14

PERSONNEL PROTECTION

14.1 Protective equipment

14.1.1 For the protection of crew members who are engaged in loading and discharging operations, the ship shall 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 or face shields or both. The protective clothing and equipment shall cover all skin so that no part of the body is unprotected.

14.1.2 Work clothes and protective equipment shall be kept in easily accessible places and in special lockers. Such equipment shall not be kept within accommodation spaces, with the exception of new, unused equipment and equipment which has not been used since undergoing a thorough cleaning process. The Administration may, however, approve storage rooms for such equipment within accommodation spaces if adequately segregated from living spaces such as cabins, passageways, dining rooms, bathrooms, etc.

Lockers for work clothes or protective equipment which are not new or have not undergone a thorough cleaning process are not to open directly into accommodation spaces.

When a locker for clothes which have not undergone a thorough cleaning process is arranged in the accommodation area, it is to be bounded by "A-0" bulkheads and decks and provided with independent exhaust mechanical ventilation. The access to accommodation spaces, if allowed, is to be arranged through two substantially gastight self-closing steel doors without any hold-back device.

14.1.3 Protective equipment shall be used in any operation, which may entail danger to personnel.

14.2 Safety equipment

14.2.1 Ships carrying cargoes for which 15.12, 15.12.1 or 15.12.3 is listed in *column o* in the table of section 17 shall have on board sufficient but not less than three complete sets of safety equipment, each permitting personnel to enter a gas-filled compartment and perform work there for at least 20 min. Such equipment shall be in addition to that required by SOLAS regulation II-2/10.10.

14.2.2 One complete set of safety equipment shall consist of:

.1 One self-contained air-breathing apparatus (not using stored oxygen);

.2 Protective clothing, boots, gloves and tight-fitting goggles;

.3 Fireproof lifeline with belt resistant to the cargoes carried; and

.4 Explosion-proof lamp.

14.2.3 For the safety equipment required in 14.2.1, all ships shall carry either:

.1 One set of fully charged spare air bottles for each breathing apparatus;

.2 A special air compressor suitable for the supply of high-pressure air of the required purity;

.3 A charging manifold capable of dealing with sufficient spare air bottles for the breathing apparatus; or

.4 Fully charged spare air bottles with a total free air capacity of at least 6,000 l for each breathing apparatus on board in excess of the requirements of SOLAS regulation II-2/10.10.

14.2.4 A cargo pump-room on ships carrying cargoes which are subject to the requirements of 15.18 or cargoes for which in *column k* in the table of section 17 toxic-vapour-detection equipment is required but is not available shall have either:

.1 A low-pressure line system with hose connections suitable for use with the breathing apparatus required by 14.2.1. This system shall provide sufficient high-pressure air capacity to supply, through pressure-reduction devices, enough low-pressure air to enable two men to work in a gas-dangerous space for at least 1 h without using the air bottles of the breathing apparatus. Means shall be provided for recharging the fixed air bottles and the breathing apparatus air bottles from a special air compressor suitable for the supply of high-pressure air of the required purity; or

.2 An equivalent quantity of spare bottled air in lieu of the low-pressure air line. *The equivalent quantity of spare bottled air in lieu of the low-pressure air line shall be at least 4,800 ℓ.*

14.2.5 At least one set of safety equipment as required by 14.2.2 shall be kept in a suitable clearly marked locker in a readily accessible place near the cargo pump-room. The other sets of safety equipment shall also be kept in suitable, clearly marked, easily accessible places.

14.2.6 The breathing apparatus shall be inspected at least once a month by a responsible officer, and the inspection recorded in the ship's log-book. The equipment shall be inspected and tested by an expert at least once a year.

14.3 Emergency equipment

14.3.1 Ships carrying cargoes, for which "Yes" is indicated in *column n* of section 17, shall be provided with suitable respiratory and eye protection sufficient for every person on board for emergency escape purposes, subject to the following:

.1 Filter-type respiratory protection is unacceptable;

.2 Self-contained breathing apparatus shall have at least a duration of service of 15 min;

.3 Emergency escape respiratory protection shall not be used for fire-fighting or cargo-handling purposes and shall be marked to that effect.

14.3.2 The ship shall have on board medical first-aid equipment, including oxygen resuscitation equipment and antidotes for cargoes to be carried, based on the guidelines developed by the Organization*.

First aid equipment, whose preservation in good condition is the Master's responsibility, is to be kept in a special, clearly indicated locker.

14.3.3 A stretcher which is suitable for hoisting an injured person up from spaces such as the cargo pump-room shall be placed in a readily accessible location.

14.3.4 Suitably marked decontamination showers and an eyewash shall be available on deck in convenient locations. The showers and eyewash shall be operable in all ambient conditions.

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* *Reference is made to the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty.*

SECTION 15

SPECIAL REQUIREMENTS

15.1 General

15.1.1 The provisions of this section are applicable where specific reference is made in *column o* in the table of Section 17. These requirements are additional to the general requirements of this section.

15.2 Ammonium nitrate solution (93% or less)

15.2.1 The ammonium nitrate solution shall contain at least 7% by weight of water. The acidity (pH) of the cargo when diluted with ten parts of water to one part of cargo by weight shall be between 5.0 and 7.0. The solution shall not contain more than 10 ppm chloride ions, 10 ppm ferric ions and shall be free of other contaminants.

15.2.2 Tanks and equipment for ammonium nitrate solution shall be independent of tanks and equipment containing other cargoes or combustible products. Equipment which may, in service or when defective, release combustible products into the cargo (e.g. lubricants), shall not be used. Tanks shall not be used for seawater ballast.

15.2.3 Except where expressly approved by the Administration, ammonium nitrate solutions shall not be transported in tanks which have previously contained other cargoes unless tanks and associated equipment have been cleaned to the satisfaction of the Administration.

15.2.4 The temperature of the heat-exchanging medium in the tank heating system shall not exceed 160°C. The heating system shall be provided with a control system to keep the cargo at a bulk mean temperature of 140°C. High-temperature alarms at 145°C and 150°C and a low-temperature alarm at 125°C shall be provided. Where the temperature of the heat- exchanging medium exceeds 160°C, an alarm shall also be given. Temperature alarms and controls shall be located on the navigating bridge.

15.2.5 If the bulk mean cargo temperature reaches 145°C, a cargo sample shall be diluted with ten parts of distilled or demineralized water to one part of cargo by weight and the pH shall be determined by means of a narrow-range indicator paper or stick. Acidity measurements shall then be taken every 24 hours. If the pH is found to be below 4.2, ammonia gas shall be injected into the cargo until the pH of 5.0 is reached.

15.2.6 A fixed installation shall be provided to inject ammonia gas into the cargo. Controls for this system shall be located on the navigation bridge. For this purpose, 300 kg of ammonia per 1,000 tonnes of ammonium nitrate solution shall be available on board.

For the purpose of injecting ammonia the cargo may be circulated by means of the cargo pump. Gaseous ammonia may be injected into the cargo while the latter is circulated by the cargo pump.

15.2.7 Cargo pumps shall be of the centrifugal deepwell type or of the centrifugal type with water-flushed seals.
The seal for the centrifugal pump is to be a stuffing box provided with a lantern ring. Fresh water under pressure is to be injected into the stuffing box at the location of the lantern ring (Figure 15.1).

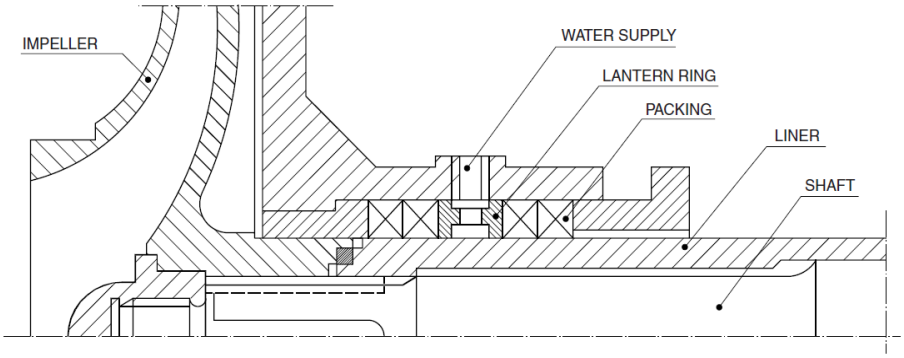

Figure 15.1

15.2.8 Vent piping shall be fitted with approved weatherhoods to prevent clogging. Such weatherhoods shall be accessible for inspection and cleaning.

15.2.9 Hot work on tanks, piping and equipment which have been in contact with ammonium nitrate solution shall only be done after all traces of ammonium nitrate have been removed, inside as well as outside.

15.3 Carbon disulphide

Carbon disulphide may be carried either under a water pad or under a suitable inert gas pad as specified in the following paragraphs.

Carriage under water pad

15.3.1 Provision shall be made to maintain a water pad in the cargo tank during loading, unloading and transit. In addition, an inert-gas pad shall be maintained in the ullage space during transit.

15.3.2 All openings shall be in the top of the tank, above the deck.

15.3.3 Loading lines shall terminate near the bottom of the tank.

15.3.4 A standard ullage opening shall be provided for emergency sounding.

15.3.5 Cargo piping and vent lines shall be independent of piping and vent lines used for other cargo.

15.3.6 Pumps may be used for discharging cargo, provided they are of the deepwell or hydraulically driven submersible types. The means of driving a deepwell pump shall not present a source of ignition for carbon disulphide and shall not employ equipment that may exceed a temperature of 80°C.

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

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

15.3.9 Safety relief valves shall be of stainless steel construction.

15.3.10 Because of its low ignition temperature and close clearances required to arrest its flame propagation, only intrinsically safe systems and circuits are permitted in the hazardous locations.

Carriage under suitable inert gas pad

15.3.11 Carbon disulphide shall be carried in independent tanks with a design pressure of not less than 0.06 MPa gauge.

15.3.12 All openings shall be located on the top of the tank, above the deck.

15.3.13 Gaskets used in the containment system shall be of a material which does not react with, or dissolve in, carbon disulphide.

15.3.14 Threaded joints shall not be permitted in the cargo containment system, including the vapour lines.

15.3.15 Prior to loading, the tank(s) shall be inerted with suitable inert gas until the oxygen level is 2% by volume or lower. Means shall be provided to automatically maintain a positive pressure in the tank using suitable inert gas during loading, transport and discharge. The system shall be able to maintain this positive pressure between 0.01 and 0.02 MPa, and shall be remotely monitored and fitted with over/underpressure alarms.

15.3.16 Hold spaces surrounding an independent tank carrying carbon disulphide shall be inerted by a suitable inert gas until the oxygen level is 2% or less. Means shall be provided to monitor and maintain this condition throughout the voyage. Means shall also be provided to sample these spaces for carbon disulphide vapour.

15.3.17 Carbon disulphide shall be loaded, transported and discharged in such a manner that venting to the atmosphere does not occur. If carbon disulphide vapour is returned to shore during loading or to the ship during discharge, the vapour return system shall be independent of all other containment systems.

15.3.18 Carbon disulphide shall be discharged only by submerged deepwell pumps or by a suitable inert gas displacement. The submerged deepwell pumps shall be operated in a way that prevents heat build-up in the pump. The pump shall also be equipped with a temperature sensor in the pump housing with remote readout and alarm in the cargo control room. The alarm shall be set at 80°C. The pump shall also be fitted with an automatic shut-down device to be activated if the tank pressure falls below atmospheric pressure during the discharge.

15.3.19 Air shall not be allowed to enter the cargo tank, cargo pump or lines while carbon disulphide is contained in the system.

15.3.20 No other cargo handling, tank cleaning or deballasting shall take place concurrent with loading or discharge of carbon disulphide.

15.3.21 A water spray system of sufficient capacity shall be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling and the tank domes. The arrangement of piping and nozzles shall be such as to give an uniform distribution rate of 10 l/m2/min. Remote manual operation shall be arranged such that remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. The water-spray system shall be capable of both local and remote manual operation, and the arrangement shall ensure that any spilled cargo is washed away. Additionally, a water hose with pressure to the nozzle when atmospheric temperature permits, shall be connected ready for immediate use during loading and unloading operations.

15.3.22 No cargo tanks shall be more than 98% liquid-full at the reference temperature (R).

15.3.23 The maximum volume (V_L) of cargo to be loaded in a tank shall be:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

where:

V = Volume of the tank

ρ_R = Density of cargo at the reference temperature (R)

ρ_L = Density of cargo at the loading temperature

R = Reference temperature

15.3.24 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied, and for the applicable maximum reference temperature, on a list approved by the Administration. A copy of the list shall be permanently kept on board by the master.

15.3.25 Zones on open deck, or semi-enclosed spaces on open deck within three metres of a tank outlet, gas or vapour outlet, cargo pipe flange or cargo valve of a tank certified to carry carbon disulphide, shall comply with the electrical equipment requirements specified for carbon disulphide in *column i*, section 17. Also, within the specified zone, no other heat sources, like steam piping with surface temperatures in excess of 80°C shall be allowed.

15.3.26 Means shall be provided to ullage and sample the cargo without opening the tank or disturbing the positive suitable inert gas blanket.

15.3.27 The product shall be transported only in accordance with a cargo handling plan that has been approved by the Administration. Cargo handling plans shall show the entire cargo piping system. A copy of the approved cargo handling plan shall be available on board. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be endorsed to include reference to the approved cargo handling plan.

15.4 Diethyl ether

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

15.4.2 Pressure-relief-valve settings shall not be less than 0.02 MPa gauge for gravity tanks.

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

15.4.4 In view of the fire hazard, provision shall be made to avoid any ignition source or heat generation or both in the cargo area.

15.4.5 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 hydraulically operated submerged type and are suitable for use with the cargo.

15.4.6 Provision shall be made to maintain the inert-gas pad in the cargo tank during loading, unloading and transit.

15.5 Hydrogen peroxide solutions

15.5.1 Hydrogen peroxide solutions over 60 % but not over 70 % by mass

15.5.1.1 Hydrogen peroxide solutions over 60% but not over 70% by mass shall be carried in dedicated ships only and no other cargoes shall be carried.

15.5.1.2 Cargo tanks and associated equipment shall be either pure aluminium (99.5%) or solid stainless steel (304L, 316, 316L or 316Ti), and passivated in accordance with approved procedures. Aluminium shall not be used for piping on

deck. All nonmetallic materials of construction for the containment system shall neither be attacked by hydrogen peroxide nor contribute to its decomposition.

15.5.1.3 Pump-rooms shall not be used for cargo-transfer operations.

15.5.1.4 Cargo tanks shall be separated by cofferdams from oil fuel tanks or any other space containing flammable or combustible materials.

15.5.1.5 Tanks intended for the carriage of hydrogen peroxide shall not be used for seawater ballast.

15.5.1.6 Temperature sensors shall be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring shall be located on the navigating bridge. If the temperature in the tanks rises above 35°C, visible and audible alarms shall be activated on the navigating bridge.

15.5.1.7 Fixed oxygen monitors (or gas-sampling lines) shall be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is satisfactory) and visible and audible alarms similar to those for the temperature sensors shall also be located on the navigating bridge. The visible and audible alarms shall be activated if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors shall also be available as back-up systems.

15.5.1.8 As a safeguard against uncontrolled decomposition, a cargo-jettisoning system shall be installed to discharge the cargo overboard. The cargo shall be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C per hour over a 5-hour period or when the temperature in the tank exceeds 40°C.

15.5.1.9 Cargo tank venting systems shall have pressure/vacuum-relief valves for normal controlled venting, and rupture discs or a similar device for emergency venting, should tank pressure rise rapidly as a result of uncontrolled decomposition. Rupture discs shall be sized on the basis of tank design pressure, tank size and anticipated decomposition rate.

15.5.1.10 A fixed water-spray system shall be provided for diluting and washing away any concentrated hydrogen peroxide solution spilled on deck. The areas covered by the water-spray shall include the manifold/hose connections and the tank tops of those tanks designated for carrying hydrogen peroxide solutions. The minimum application rate shall satisfy the following criteria:

.1 The product shall be diluted from the original concentration to 35% by mass within 5 minutes of the spill.

.2 The rate and estimated size of the spill shall be based upon maximum anticipated loading and discharge rates, the time required to stop flow of cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo control location or on the navigating bridge.

It is specified that, for the purpose of evaluating the estimated size of the cargo spill in the case of failure, cargo piping/hose failure is to be assumed to be total.

15.5.1.11 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1% per year at 25°C shall be carried. Certification from the shipper that the product meets this standard shall be presented to the master and kept on board. A technical representative of the manufacturer shall be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He shall certify to the master that the cargo has been loaded in a stable condition.

15.5.1.12 Protective clothing that is resistant to hydrogen peroxide solutions shall be provided for each crew member involved in cargo-transfer operations. Protective clothing shall include nonflammable coveralls, suitable gloves, boots and eye protection.

15.5.2 *Hydrogen peroxide solutions over 8 % but not over 60 % by mass*

15.5.2.1 The ship's shell plating shall not form any boundaries of tanks containing this product.

15.5.2.2 Hydrogen peroxide shall be carried in tanks thoroughly and effectively cleaned of all traces of previous cargoes and their vapours or ballast. Procedures for inspection, cleaning, passivation and loading of tanks shall be in accordance with MSC/Circ.394. A certificate shall be on board the vessel indicating that the procedures in the circular have been followed. The passivation requirement may be waived by an Administration for domestic shipments of short duration. Particular care in this respect is essential to ensure the safe carriage of hydrogen peroxide:

.1 When hydrogen peroxide is carried no other cargoes shall be carried simultaneously.

.2 Tanks which have contained hydrogen peroxide may be used for other cargoes after cleaning in accordance with the procedures outlined in MSC/Circ.394.

.3 Consideration in design shall provide minimum internal tank structure, free draining, no entrapment and ease of visual inspection.

15.5.2.3 Cargo tanks and associated equipment shall be either pure aluminium (99.5%) or solid stainless steel of types suitable for use with hydrogen peroxide (e.g. 304, 304L, 316, 316L, 316Ti). Aluminium shall not be used for piping on deck. All non-metallic materials of construction for the containment system shall neither be attacked by hydrogen peroxide nor contribute to its decomposition.

15.5.2.4 Cargo tanks shall be separated by a cofferdam from fuel oil tanks or any other space containing materials incompatible with hydrogen peroxide.

15.5.2.5 Temperature sensors shall be installed at the top and bottom of the tank. Remote temperature readouts and continuous monitoring shall be located on the navigating bridge. If the temperature in the tank rises above 35°C, visible and audible alarms shall activate on the navigating bridge.

15.5.2.6 Fixed oxygen monitors (or gas-sampling lines) shall be provided in void spaces adjacent to tanks to detect leakage of the cargo into these spaces. The enhancement of flammability by oxygen enrichment shall be recognized. Remote readouts, continuous monitoring (if gas-sampling lines are used, intermittent sampling is satisfactory) and visible and audible alarms similar to those for the temperature sensors shall also be located on the navigating bridge. The visible and audible alarms shall activate if the oxygen concentration in these void spaces exceeds 30% by volume. Two portable oxygen monitors shall also be available as back-up systems.

15.5.2.7 As a safeguard against uncontrolled decomposition, a cargo-jettisoning system shall be installed to discharge the cargo overboard. The cargo shall be jettisoned if the temperature rise of the cargo exceeds a rate of 2°C per hour over a 5-hour period or when the temperature in the tank exceeds 40°C.

15.5.2.8 Cargo tank venting systems with filtration shall have pressure/vacuum-relief valves for normal controlled venting, and a device for emergency venting, should tank pressure rise rapidly as a result of an uncontrolled decomposition rate, as stipulated in 15.5.2.7. These venting systems shall be designed in such a manner that there is

no introduction of seawater into the cargo tank even under heavy sea conditions. Emergency venting shall be sized on the basis of tank design pressure and tank size.

15.5.2.9 A fixed water-spray system shall be provided for diluting and washing away any concentrated solution spilled on deck. The areas covered by the water-spray shall include the manifold/hose connections and the tank tops of those tanks designated for the carriage of hydrogen peroxide solutions. The minimum application rate shall satisfy the following criteria:

.1 The product shall be diluted from the original concentration to 35% by mass within 5 minutes of the spill.

.2 The rate and estimated size of the spill shall be based upon maximum anticipated loading and discharge rates, the time required to stop flow of the cargo in the event of tank overfill or a piping/hose failure, and the time necessary to begin application of dilution water with actuation at the cargo control location or on the navigating bridge.

15.5.2.10 Only those hydrogen peroxide solutions which have a maximum decomposition rate of 1% per year at 25°C shall be carried. Certification from the shipper that the product meets this standard shall be presented to the master and kept on board. A technical representative of the manufacturer shall be on board to monitor the transfer operations and have the capability to test the stability of the hydrogen peroxide. He shall certify to the master that the cargo has been loaded in a stable condition.

15.5.2.11 Protective clothing that is resistant to hydrogen peroxide shall be provided for each crew member involved in cargo-transfer operations. Protective clothing shall include coveralls that are nonflammable, suitable gloves, boots and eye protection.

15.5.2.12 During transfer of hydrogen peroxide the related piping system shall be separated from all other systems. Cargo hoses used for transfer of hydrogen peroxide shall be marked "FOR HYDROGEN PEROXIDE TRANSFER ONLY".

15.5.3 Procedures for inspection, cleaning, passivation and loading of tanks for the carriage of hydrogen peroxide solutions 8-60 %, which have contained other cargoes, or for the carriage of other cargoes after the carriage of hydrogen peroxide

15.5.3.1 Tanks having contained cargoes other than hydrogen peroxide shall be inspected, cleaned and passivated before re-use for the transport of hydrogen peroxide solutions. The procedures for inspection and cleaning, as given in paragraphs 15.5.3.2 to 15.5.3.8 below, apply to both stainless steel and pure aluminium tanks (see paragraph 15.5.2.2). Procedures for passivation are given in paragraph 15.5.3.9 for stainless steel and 15.5.3.10 for aluminium. Unless otherwise specified, all steps apply to the tanks and to all associated equipment having been in contact with the other cargo.

15.5.3.2 After unloading the previous cargo the tank shall be rendered safe and inspected for any residues, scale and rust.

15.5.3.3 Tanks and associated equipment shall be washed with clean filtered water. The water to be used shall at least have the quality of potable water with a low chlorine content.

15.5.3.4 Trace residues and vapours of the previous cargo shall be removed by steaming of tank and equipment.

15.5.3.5 Tank and equipment are washed again with clean water (quality as above) and dried, using filtered, oil-free air.

15.5.3.6 The atmosphere in the tank shall be sampled and investigated for the presence of organic vapours and oxygen concentration.

15.5.3.7 The tank shall be checked again by visual inspection for residues of the previous cargo, scale and rust as well as for any smell of the previous cargo.

15.5.3.8 If inspection or measurements indicate the presence of residues of the previous cargo or its vapours, actions described in paragraphs 15.5.3.3 to 15.5.3.5 shall be repeated.

15.5.3.9 Tank and equipment made from stainless steel which have contained other cargoes than hydrogen peroxide or which have been under repair shall be cleaned and passivated, regardless of any previous passivation, according to the following procedure:

.1 New welds and other repaired parts shall be cleaned and finished using stainless steel wire brush, chisel, sandpaper or buff. Rough surfaces shall be given a smooth finish. A final polishing is necessary.

.2 Fatty and oily residues shall be removed by the use of appropriate organic solvents or detergent solutions in water. The use of chlorine-containing compounds shall be avoided as they can seriously interfere with passivation.

.3 The residues of the degreasing agent shall be removed, followed by a washing with water.

.4 In the next step, scale and rust shall be removed by the application of acid (e.g. a mixture of nitric and hydrofluoric acids), followed again by a washing with clean water.

.5 All the metal surfaces which can come into contact with hydrogen peroxide shall be passivated by the application of nitric acid of a concentration between 10 and 35% by mass. The nitric acid must be free from heavy metals, other oxidizing agents or hydrogen fluoride. The passivation process shall continue for 8 to 24 h, depending upon the concentration of acid, the ambient temperature and other factors. During this time a continuous contact between the surfaces to be passivated and the nitric acid shall be ensured. In the case of large surfaces this may be achieved by recirculating the acid. Hydrogen gas may be evolved in the passivation process, leading to the presence of an explosive atmosphere in the tanks. Therefore, appropriate measures must be taken to avoid the build-up or the ignition of such an atmosphere.

.6 After passivation the surfaces shall be thoroughly washed with clean filtered water. The washing process shall be repeated until the effluent water has the same pH value as the incoming water.

.7 Surfaces treated according to the above steps may cause some decomposition when coming into contact with hydrogen peroxide for the first time. This decomposition will cease after a short time (usually within two or three days). Therefore an additional flushing with hydrogen peroxide for a period of at least two days is recommended.

.8 Only degreasing agents and acid cleaning agents which have been recommended for this purpose by the manufacturer of the hydrogen peroxide shall be used in the process.

15.5.3.10 Tanks and equipment made from aluminium and which have contained cargoes other than hydrogen peroxide, or which have been under repair, shall be cleaned and passivated. The following is an example of a recommended procedure:

.1 The tank shall be washed with a solution of a sulphonated detergent in hot water, followed by a washing with water.

.2 The surface shall then be treated for 15 to 20 min with a solution of sodium hydroxide of a concentration of 7% by mass or treated for a longer period with a less concentrated solution (e.g. for 12 h with 0.4 to 0.5% sodium hydroxide). To prevent excessive corrosion at the bottom of the tank when treating with more concentrated solutions of sodium hydroxide, water shall be added continuously to dilute the sodium hydroxide solution which collects there.

.3 The tank shall be thoroughly washed with clean, filtered water. As soon as possible after washing, the surface shall be passivated by the application of nitric acid of a concentration between 30 and 35% by mass. The passivation process shall continue for 16 to 24 h. During this time a continuous contact between the surfaces to be passivated and the nitric acid shall be ensured.

.4 After passivation the surfaces shall be thoroughly washed with clean, filtered water. The washing process shall be repeated until the effluent water has the same pH value as the incoming water.

.5 A visual inspection shall be made to ensure that all surfaces have been treated. It is recommended that an additional flushing is carried out for a minimum of 24 h with dilute hydrogen peroxide solution of a concentration approximately 3% by mass.

15.5.3.11 The concentration and stability of the hydrogen peroxide solution to be loaded shall be determined.

15.5.3.12 The hydrogen peroxide is loaded under intermittent visual supervision of the interior of the tank from an appropriate opening.

15.5.3.13 If substantial bubbling is observed which does not disappear within 15 min after the completion of loading, the contents of the tank shall be unloaded and disposed of in an environmentally safe manner. The tank and equipment shall then be repassivated as described above.

15.5.3.14 The concentration and stability of the hydrogen peroxide solution shall be determined again. If the same values are obtained within the limits of error as in paragraph 15.5.3.10, the tank is considered to be properly passivated and the cargo ready for shipment.

15.5.3.15 Actions described in paragraphs 15.5.3.2 to 15.5.3.8 shall be carried out under the supervision of the master or shipper. Actions described in paragraphs 15.5.3.9 to 15.5.3.15 shall be carried out under the on-site supervision and responsibility of a representative of the hydrogen peroxide manufacturer or under supervision and responsibility of another person familiar with the safety-relevant properties of hydrogen peroxide.

15.5.3.16 The following procedure shall be applied when tanks having contained hydrogen peroxide solution are to be used for other products (unless otherwise specified, all steps apply to the tanks and to all associated equipment having been in contact with hydrogen peroxide):

.1 Hydrogen peroxide cargo residue shall be drained as completely as possible from tanks and equipment.

.2 Tanks and equipment shall be rinsed with clean water, and subsequently thoroughly washed with clean water.

.3 The interior of the tank shall be dried and inspected for any residues.

Steps .1 to .3, in 15.5.3.16, shall be carried out under the supervision of the master or the shipper. Step .3 in paragraph 15.5.3.16 shall be carried out by a person familiar with the safety-relevant properties of the chemical to be transported and of hydrogen peroxide.

SPECIAL CAUTIONS :

1 Hydrogen peroxide decomposition may enrich the atmosphere with oxygen and appropriate precautions shall be observed.

2 Hydrogen gas may be evolved in the passivation processes described in paragraphs 15.5.3.9.5, 15.5.3.10.2 and 15.5.3.10.4, leading to the presence of an explosive atmosphere in the tank. Therefore, appropriate measures must be taken to avoid the build-up or the ignition of such an atmosphere.

15.6 Motor fuel anti-knock compounds (containing lead alkyls)

15.6.1 Tanks used for these cargoes shall 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.

15.6.2 If a cargo pump-room is located on deck level according to 15.18, the ventilation arrangements shall be in compliance with 15.17.

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

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

15.7 Phosphorus, yellow or white

15.7.1 Phosphorus shall, at all times, be loaded, carried and discharged under a water pad of 760 mm minimum depth. During discharge operations, arrangements shall be made to ensure that water occupies the volume of phosphorus discharged. Any water discharged from a phosphorus tank shall be returned only to a shore installation.

15.7.2 Tanks shall be designed and tested to a minimum equivalent water head of 2.4 m above the top of the tank, under designed loading conditions, taking into account the depth, relative density and method of loading and discharge of the phosphorus.

15.7.3 Tanks shall be so designed as to minimize the interfacial area between the liquid phosphorus and its water pad.

15.7.4 A minimum ullage space of 1% shall be maintained above the water pad. The ullage space shall be filled with inert gas or naturally ventilated by two cowled standpipes terminating at different heights but at least 6 m above the deck and at least 2 m above the pump-house top.

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

15.7.6 Phosphorus shall be loaded at a temperature not exceeding 60°C.

15.7.7 Tank heating arrangements shall 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. A high-temperature alarm shall be fitted.

15.7.8 A water drench system acceptable to the **TL** shall be installed in all void spaces surrounding the tanks. The system shall operate automatically in the event of an escape of phosphorus.

15.7.9 Void spaces referred to in 15.7.8 shall be provided with effective means of mechanical ventilation which shall be capable of being sealed off quickly in an emergency.

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

15.7.11 During cargo transfer, a water hose on deck shall 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.

15.7.12 Ship-to-shore loading and discharge connections shall be of a type approved by the **TL**.

15.8 Propylene oxide or ethylene oxide/propylene oxide mixtures with an ethylene oxide content of not more than 30% by mass

15.8.1 Products transported under the provisions of this section shall be acetylene-free.

15.8.2 Unless cargo tanks are properly cleaned, these products shall not be carried in tanks which have contained as one of the three previous cargoes any products known to catalyse polymerization, such as:

.1 Mineral acids (e.g. sulphuric, hydrochloric, nitric);

.2 Carboxylic acids and anhydrides (e.g. formic, acetic);

.3 Halogenated carboxylic acids (e.g. chloracetic);

.4 Sulphonic acids (e.g. benzenesulphonic);

.5 Caustic alkalis (e.g. sodium hydroxide, potassium hydroxide);

.6 Ammonia and ammonia solutions;

.7 Amines and amine solutions; and

.8 Oxidizing substances.

15.8.3 Before loading, tanks shall be thoroughly and effectively cleaned, to remove all traces of previous cargoes

from tanks and associated pipework, except where the immediately prior cargo has been propylene oxide or ethylene oxide/propylene oxide mixtures. Particular care shall be taken in the case of ammonia in tanks made of steel other than stainless steel.

15.8.4 In all cases, the effectiveness of cleaning procedures for tanks and associated pipework shall be checked by suitable testing or inspection, to ascertain that no traces of acidic or alkaline materials remain that might create a hazardous situation in the presence of these products.

15.8.5 Tanks shall be entered and inspected prior to each initial loading of these products to ensure freedom from contamination, heavy rust deposits and visible structural defects. When cargo tanks are in continuous service for these products, such inspections shall be performed at intervals of not more than two years.

15.8.6 Tanks for the carriage of these products shall be of steel or stainless steel construction.

15.8.7 Tanks for the carriage of these products may be used for other cargoes after thorough cleaning of tanks and associated pipework systems by washing or purging.

15.8.8 All valves, flanges, fittings and accessory equipment shall be of a type suitable for use with the products and shall be constructed of steel or stainless steel in accordance with recognized standards. Discs or disc faces, seats and other wearing parts of valves shall be made of stainless steel containing not less than 11% chromium.

15.8.9 Gaskets shall be constructed of materials which do not react with, dissolve in, or lower the autoignition temperature of these products and which are fire-resistant and possess adequate mechanical behaviour. The surface presented to the cargo shall be polytetrafluoroethylene (PTFE), or materials giving a similar degree of safety by their inertness. Spirally wound stainless steel, with a filler of PTFE or similar fluorinated polymer, may be accepted.

15.8.10 Insulation and packing, if used, shall be of a material which does not react with, dissolve in, or lower the autoignition temperature of these products.

15.8.11 The following materials are generally found unsatisfactory for gaskets, packing and similar uses in containment systems for these products and would require testing before being approved by the Administration:

.1 Neoprene or natural rubber, if it comes into contact with the products.

.2 Asbestos, or binders used with asbestos.

.3 Materials containing oxides of magnesium, such as mineral wools.

15.8.12 Threaded joints shall not be permitted in the cargo liquid and vapour lines.

Threaded connections are only allowed for accessory and instrumental lines with an external diameter of 25 mm or less.

15.8.13 Filling and discharge piping shall extend to within 100 mm of the bottom of the tank or any sump pit.

15.8.14.1 The containment system for a tank containing these products shall have a valved vapour-return connection.

15.8.14.2 The products shall be loaded and discharged in such a manner that venting of the tanks to atmosphere does not occur. If vapour return to shore is used during tank loading, the vapour- return system connected to a containment

system for the product shall be independent of all other containment systems.

15.8.14.3 During discharge operations, the pressure in the cargo tank must be maintained above 0.007 MPa gauge.

15.8.15 The cargo may be discharged only by deepwell pumps, hydraulically operated submerged pumps, or inert-gas displacement. Each cargo pump shall be arranged to ensure that the product does not heat significantly if the discharge line from the pump is shut off or otherwise blocked.

15.8.16 Tanks carrying these products shall be vented independently of tanks carrying other products. Facilities shall be provided for sampling the tank contents without opening the tank to atmosphere.

15.8.17 Cargo hoses used for transfer of these products shall be marked "FOR ALKYLENE OXIDE TRANSFER ONLY".

15.8.18 Cargo tanks, void spaces and other enclosed spaces adjacent to an integral gravity cargo tank carrying propylene oxide shall either contain a compatible cargo (those cargoes specified in 15.8.2 are examples of substances considered incompatible) or be inerted by injection of a suitable inert gas. Any hold space in which an independent cargo tank is located shall be inerted. Such inerted spaces and tanks shall be monitored for these products and oxygen. The oxygen content of these spaces shall be maintained below 2%. Portable sampling equipment is satisfactory.

15.8.19 In no case shall air be allowed to enter the cargo pump or piping system while these products are contained within the system.

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

15.8.21 Propylene oxide may be carried in pressure tanks or in independent or integral gravity tanks. Ethylene oxide/propylene oxide mixtures shall be carried in independent gravity tanks or pressure tanks. Tanks shall be designed for the maximum pressure expected to be encountered during loading, conveying and discharging cargo.

15.8.22.1 Tanks for the carriage of propylene oxide with a design pressure less than 0.06 MPa gauge and tanks for the carriage of ethylene oxide/propylene oxide mixtures with a design pressure of less than 0.12 MPa gauge shall have a cooling system to maintain the cargo below the reference temperature.

15.8.22.2 The refrigeration requirement for tanks with a design pressure less than 0.06 MPa gauge may be waived by the Administration for ships operating in restricted areas or on voyages of restricted duration, and account may be taken in such cases of any insulation of the tanks. The area and times of year for which such carriage would be permitted shall be included in the conditions of carriage of the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.8.23.1 Any cooling system shall maintain the liquid temperature below the boiling temperature at the containment pressure. At least two complete cooling plants, automatically regulated by variations within the tanks, shall be provided. Each cooling plant shall be complete with the necessary auxiliaries for proper operation. The control system shall also be capable of being manually operated. An alarm shall be provided to indicate malfunctioning of the temperature controls. The capacity of each cooling system shall be sufficient to maintain the temperature of the liquid cargo below the reference temperature of the system.

15.8.23.2 An alternative arrangement may consist of three cooling plants, any two of which shall be sufficient to maintain the liquid temperature below the reference temperature.

15.8.23.3 Cooling media which are separated from the products by a single wall only shall be nonreactive with the products.

15.8.23.4 Cooling systems requiring compression of the products shall not be used.

15.8.24 Pressure-relief-valve settings shall not be less than 0.02 MPa gauge and for pressure tanks not greater than 0.7 MPa gauge for the carriage of propylene oxide and not greater than 0.53 MPa gauge for the carriage of propylene oxide/ethylene oxide mixtures.

15.8.25.1 The piping system for tanks to be loaded with these products shall be separated (as defined in 3.1.4) from piping systems for all other tanks, including empty tanks. If the piping system for the tanks to be loaded is not independent (as defined in 1.3.19), the required piping separation shall be accomplished by the removal of spool-pieces, valves, or other pipe section and the installation of blank flanges at these locations. The required separation applies to all liquid and vapour piping, liquid and vapour vent lines and any other possible connections, such as common inert-gas supply lines.

15.8.25.2 These products may be transported only in accordance with cargo-handling plans that have been approved by the **TL**. Each intended loading arrangement shall be shown on a separate cargo-handling plan. Cargo-handling plans shall show the entire cargo piping system and the locations for installation of blank flanges needed to meet the above piping separation requirements. A copy of each approved cargo-handling plan shall be maintained on board the ship. The International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk shall be endorsed to include reference to the approved cargo-handling plans.

15.8.25.3 Before each initial loading of these products and before every subsequent return to such service, certification verifying that the required piping separation has been achieved shall be obtained from a responsible person acceptable to the port Administration and carried on board the ship. Each connection between a blank flange and a pipeline flange shall be fitted with a wire and seal by the responsible person to ensure that in-advertent removal of the blank flange is impossible.

The "responsible person" may be e.g. the ship's master or the local Society's Surveyor.

15.8.26.1 No cargo tanks shall be more than 98% liquid-full at the reference temperature.

15.8.26.2 The maximum volume to which a cargo tank shall be loaded is:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

Where

V_L = maximum volume to which the tank may be loaded

V = volume of the tank

ρ_R = Density of cargo at the reference temperature

ρ_L = Density of cargo at the loading temperature and pressure

15.8.26.3 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied and for the applicable maximum reference temperature, on a list to be approved by the **TL**. A copy of the list shall be permanently kept on board by the master.

15.8.27 The cargo shall be carried under a suitable protective padding of nitrogen gas. An automatic nitrogen make-up system shall be installed to prevent the tank pressure falling below 0.007 MPa gauge in the event of product temperature fall due to ambient conditions or maloperation of refrigeration systems. Sufficient nitrogen shall be available on board to satisfy the demand of the automatic pressure control. Nitrogen of commercially pure quality (99.9% by volume) shall be used for padding. A battery of nitrogen bottles connected to the cargo tanks through a pressure-reduction valve satisfies the intention of the expression "automatic" in this context.

15.8.28 The cargo tank vapour space shall be tested prior to and after loading to ensure that the oxygen content is 2% by volume or less.

Analysing equipment to determine oxygen and propylene oxide contents is to be of a type recognised as suitable by TL. When portable analysers are used, there are to be at least two. When a fixed system is installed, a portable analyser is also to be provided.

15.8.29 A water-spray system of sufficient capacity shall be provided to blanket effectively the area surrounding the loading manifold, the exposed deck piping associated with product handling, and the tank domes. The arrangement of piping and nozzles shall be such as to give a uniform distribution rate of 10 l/m2/min. Remote manual operation shall be arranged such that remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system can be carried out from a suitable location outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the areas protected. The water-spray system shall be capable of both local and remote manual operation, and the arrangement shall ensure that any spilled cargo is washed away. Additionally, a water hose with pressure to the nozzle, when atmospheric temperatures permit, shall be connected ready for immediate use during loading and unloading operations.

15.8.30 A remotely operated, controlled closing-rate, shutoff valve shall be provided at each cargo-hose connection used during cargo transfer. *The closing time of shut-off valves provided at each cargo hose connection is to take account of the loading/unloading rate and is to be such as to avoid dangerous overpressure in cargo piping and hoses mentioned in the paragraphs*

15.9 Sodium chlorate solution (50% or less by mass)

15.9.1 Tanks and associated equipment, which have contained this product may be used for other cargoes after thorough cleaning by washing or purging.

15.9.2 In the event of spillage of this product, all spilled liquid shall be thoroughly washed away without delay. To minimize fire risk, spillage shall not be allowed to dry out.

15.10 Sulphur (molten)

15.10.1 Cargo tank ventilation shall be provided to maintain the concentration of hydrogen sulphide below one half of its lower explosive limit through-out the cargo tank vapour space for all conditions of carriage (i.e. below 1.85% by volume).

15.10.2 Where mechanical ventilation systems are used for maintaining low gas concentrations in cargo tanks, an alarm system shall be provided to give warning if the system fails.

15.10.3 Ventilation systems shall be so designed and arranged as to preclude depositing of sulphur within the system.

15.10.4 Openings to void spaces adjacent to cargo tanks shall be so designed and fitted as to prevent the entry of water, sulphur or cargo vapour.

15.10.5 Connections shall be provided to permit sampling and analysing of vapour in void spaces.

15.10.6 Cargo temperature controls shall be provided to ensure that the temperature of the sulphur does not exceed 155°C.

15.10.7 Sulphur (molten) has a flashpoint above 60°C ; however, electrical equipment shall be certified safe for gases evolved.

15.11 Acids

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

15.11.2 Proposals for lining steel tanks and related piping systems with corrosion-resistant materials may be considered by the **TL**. The elasticity of the lining shall not be less than that of the supporting boundary plating.
"Lining" is an acid-resistant material that is applied to the tank or piping system in a solid state i.e. not spray on.
The requirement for the elasticity of a lining to be not less than the supporting boundary plating is to prevent debonding at the interface between the lining and the lined surface.

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

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

15.11.5 Because of the danger of evolution of hydrogen when these substances are being carried, the electrical arrangements shall comply with section 10.1.4. The certified safe type equipment shall be suitable for use in hydrogen/air mixtures. Other sources of ignition shall not be permitted in such spaces.

In enclosed spaces adjacent to cargo tanks, electrical materials and equipment complying with the provisions of Section 10.1.2.1 are allowed.

15.11.6 Substances subjected to the requirements of this section shall be segregated from oil fuel tanks, in addition to the segregation requirements in Section 3.1.1.

15.11.7 Provision shall be made for suitable apparatus to detect leakage of cargo into adjacent spaces. *There are to be at least two leak detection apparatuses designed and calibrated to detect leakage of cargo into spaces adjacent to cargo tanks. The apparatuses may consist of a pH-meter, a gas detector suitable for the detection of hydrogen/air mixtures, of a type deemed suitable by TL, or of other suitable systems. These apparatuses may be fixed or portable; if a fixed system is installed, a portable apparatus is also to be provided.*

15.11.8 The cargo pump-room bilge pumping and drainage arrangements shall be of corrosion-resistant materials.

15.12 Toxic products

15.12.1 Exhaust openings of tank vent systems shall be located:

.1 At a height of B/3 or 6 m, whichever is greater, above the weather deck or, in the case of a deck tank, the access gangway;

.2 Not less than 6 m above the fore-and-aft gangway, if fitted within 6 m of the gangway;

.3 15 m from any opening or air intake to any accommodation and service spaces; and

.4 The vent height may be reduced to 3 m above the deck or fore-and-aft gangway, as applicable, provided high-velocity vent valves of an approved type, directing the vapour/air mixture upwards in an unimpeded jet with an exit velocity of at least 30 m/s, are fitted.

15.12.2 Tank venting systems shall be provided with a connection for a vapour-return line to the shore installation.

15.12.3 Products shall:

.1 Not be stowed adjacent to oil fuel tanks;

.2 Have separate piping systems; and

.3 Have tank vent systems separate from tanks containing non-toxic products.

15.12.4 Cargo tank relief-valve settings shall be a minimum of 0.02 MPa gauge.

15.13 Cargoes protected by additives

15.13.1 Certain cargoes with a reference in *column o* in the table of section 17, by the nature of their chemical make-up, tend, under certain conditions of temperature, exposure to air or contact with a catalyst, to undergo polymerization, decomposition, oxidation or other chemical changes. Mitigation of this tendency is carried out by introducing small amounts of chemical additives into the liquid cargo or controlling the cargo tank environment.

15.13.2 Ships carrying these cargoes shall be so designed as 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.

15.13.3 Care shall be taken to ensure that these cargoes are sufficiently protected to prevent deleterious chemical change at all times during the voyage. Ships carrying such cargoes shall be provided with a certificate of protection from the manufacturer, and kept during the voyage, specifying:

.1 The name and amount of additive present;

.2 Whether the additive is oxygen-dependent;

.3 Date additive was put in the product and duration of effectiveness;

.4 Any temperature limitations qualifying the additives' effective lifetime; and

.5 The action to be taken shall the length of voyage exceed the effective lifetime of the additives.

15.13.4 Ships using the exclusion of air as the method of preventing oxidation of the cargo shall comply with 9.1.3.

15.13.5 When a product containing an oxygen-dependent inhibitor is to be carried:

15.13.5.1 In a ship for which inerting is required under SOLAS regulation II-2/4.5.5, as amended, the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading **(1)**;

15.13.5.2 In a ship to which SOLAS regulation II-2/4.5.5, as amended, does not apply, the product may be carried without inertion (in tanks of a size not greater than 3,000 m^3). If inertion is to be applied on such a ship, then the application of inert gas shall not take place before loading or during the voyage, but shall be applied before commencement of unloading **(1)**.

15.13.6 Venting systems shall be of a design that eliminates blockage from polymer build-up. Venting equipment shall be of a type that can be checked periodically for adequacy of operation.

In addition to being designed so as to avoid internal obstructions due to polymer formation, the above-mentioned systems are to be fitted with pressure/vacuum valves and devices to prevent the passage of flame which are accessible for inspection and maintenance.

15.13.7 Crystallization or solidification of cargoes normally carried in the molten state can lead to depletion of inhibitor in parts of the tank's contents. Subsequent remelting can thus yield pockets of uninhibited liquid, with the accompanying risk of dangerous polymerization. To prevent this, care shall be taken to ensure that at no time are such cargoes allowed to crystallize or solidify, either wholly or partially, in any part of the tank. Any required heating arrangements shall be such as to ensure that in no part of the tank does cargo become overheated to such an extent that any dangerous polymerization can be initiated. If the temperature from steam coils would induce overheating, an indirect low-temperature heating system shall be used.

15.14 Cargoes with a vapour pressure greater than 0.1013 MPa absolute at 37.8°C

15.14.1 For a cargo referenced in *column o* in the table of section 17 to this subsection, a mechanical refrigeration system shall be provided unless the cargo system is designed to withstand the vapour pressure of the cargo at 45°C. Where the cargo system is designed to withstand the vapour pressure of the cargo at 45°C, and no refrigeration system is provided, a notation shall be made in the conditions of carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk to indicate the required relief-valve setting for the tanks.

System for maintaining cargo temperature below melting point:

*a) Any system installed for the purpose of keeping the cargo temperature below its boiling point is to be constructed to the satisfaction of **TL**.*

b) Whenever cargo tanks are designed specifically for the carriage of products dealt with in 15.7 of the IBC Code, they are to be capable of withstanding the vapour pressure of such products corresponding to 45°C.

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(1) *Refer to the MSC-MEPC circular on Products requiring oxygen dependent inhibitors.*

15.14.2 A mechanical refrigeration system shall maintain the liquid temperature below the boiling temperature at the cargo tank design pressure.

15.14.3 When ships operate in restricted areas and at restricted times of the year, or on voyages of limited duration, the Administration involved may agree to waive requirements for a refrigeration system. A notation of any such agreement, listing geographic area restrictions and times of the year, or voyage duration limitations, shall be included in the conditions of carriage on the International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk.

15.14.4 Connections shall be provided for returning expelled gases to shore during loading.

15.14.5 Each tank shall be provided with a pressure gauge which indicates the pressure in the vapour space above the cargo.

15.14.6 Where the cargo needs to be cooled, thermometers shall be provided at the top and bottom of each tank.

15.14.7.1 No cargo tanks shall be more than 98% liquid-full at the reference temperature (R).

15.14.7.2 The maximum volume (V_L) of cargo to be loaded in a tank shall be:

$$V_L = 0.98V\frac{\rho_R}{\rho_L}$$

Where

V = Volume of the tank

ρ_R = Density of cargo at the reference temperature (R)

ρ_L = Density of cargo at the loading temperature

15.14.7.3 The maximum allowable tank filling limits for each cargo tank shall be indicated for each loading temperature which may be applied, and for the applicable maximum reference temperature, on a list approved by the **TL**. A copy of the list shall be permanently kept on board by the master.

15.15 Hydrogen sulphide (H2S) detection equipment for bulk liquids

Hydrogen sulphide (H_2S) detection equipment shall be provided on board ships carrying bulk liquids prone to H_2S formation. It should be noted that scavengers and biocides, when used, may not be 100% effective in controlling the formation of H_2S. Toxic vapour detection instruments complying with the requirement in 13.2.1 of the Code for testing for H_2S may be used to satisfy this requirement.

15.16 Cargo contamination

15.16.1 Deleted.

15.16.2 Where *column o* in the table of section 17 refers to this subsection, water shall not be allowed to contaminate this cargo. In addition, the following provisions apply:

.1 Air inlets to pressure/vacuum-relief valves of tanks containing the cargo shall be situated at least 2 m above the weather deck.

.2 Water or steam shall not be used as the heat-transfer media in a cargo temperature control system required by section 7.

.3 The cargo shall not be carried in cargo tanks adjacent to permanent ballast or water tanks unless the tanks are empty and dry.

.4 The cargo shall not be carried in tanks adjacent to slop tanks or cargo tanks containing ballast or slops or other cargoes containing water which may react in a dangerous manner. Pumps, pipes or vent lines serving such tanks shall be separate from similar equipment serving tanks containing the cargo. Pipelines from slop tanks or ballast lines shall not pass through tanks containing the cargo unless encased in a tunnel.

15.17 Increased ventilation requirements

For certain products, the ventilation system as described in 12.1.3 shall have a minimum capacity of at least 45 changes of air per hour, based upon the total volume of space. The ventilation system exhaust ducts shall discharge at least 10 m away from openings into accommodation spaces, work areas or other similar spaces, and intakes to ventilation systems, and at least 4 m above the tank deck.

The height of the ventilation outlets shall not be less than 4 m above the tank deck or 2 m above the fore-and-aft gangway if fitted within 4 m of the gangway.

15.18 Special cargo pump-room requirements

For certain products, the cargo pump-room shall be located on the deck level or cargo pumps shall be located in the cargo tank. The Administration may give special consideration to cargo pump-rooms below deck.

As far as concerns the possibility of allowing the arrangement of cargo pump rooms below deck in specific cases, it is specified that, in practice, no circumstance can be foreseen where such an arrangement may be permitted.

15.19 Overflow control

Independency of systems

In almost all cases a cargo which requires a high level alarm and overflow-control also requires a closed gauging device.
A cargo tank containing such a product therefore requires three sensors:

.1 *Level gauging*

.2 *High-level alarm*

.3 *Overflow-control*

The sensing elements for .1, .2 and .3 shall be separated although sensors for .2 and .3 (reed switches, float chambers, electronic devices, etc.) may be contained in the same tube. Electronic, pneumatic, hydraulic circuits required for sensors .1, .2 and .3 shall be independent of each other such that a fault on any one will not render either of the others inoperative. Where processing units are used to give digital or visual indication such as in a bridge space, the independency of circuitry is to be maintained at least beyond this point. The power shall be supplied from distribution boards. Where a control room or a bridge space containing a modular unit is envisaged, separate level indication and visual alarms shall be provided for each of the functions .1, .2 or .3. An audible alarm shall also be provided but

since this is not directional it need not be separate. An audible alarm shall also be arranged in the cargo area. Where there is no control room an audible and visual alarm is to be arranged at the cargo control station. Testing of sensors shall be arranged from outside the tanks although entry into product clean tanks is not precluded. Simulation testing of electronic circuits or circuits which are self-monitoring is acceptable.

15.19.1 The provisions of this subsection are applicable where specific reference is made in *column o* in the table of section 17, and are in addition to the requirements for gauging devices.

15.19.2 In the event of a power failure on any system essential for safe loading, an alarm shall be given to the operators concerned.

15.19.3 Loading operations shall be terminated at once in the event of any system essential for safe loading becoming inoperative.

15.19.4 Level alarms shall be capable of being tested prior to loading.

15.19.5 The high-level alarm system required under 15.19.6 shall be independent of the overflow-control system required by 15.19.7 and shall be independent of the equipment required by Section 13.1.

15.19.6 Cargo tanks shall be fitted with a visual and audible high-level alarm which complies with 15.19.1 to 15.19.5 and which indicates when the liquid level in the cargo tank approaches the normal full condition.

15.19.7 A tank overflow-control system required by this subsection shall:

.1 Come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition;

.2 Give a visual and audible tank-overflow alarm to the ship's operator; and

.3 Provide an agreed signal for sequential shutdown of onshore pumps or valves or both and of the ship's valves. The signal, as well as the pump and valve shutdown, may be dependent on operator's intervention. The use of shipboard automatic closing valves shall be permitted only when specific approval has been obtained from the Administration and the port State authority concerned.

15.19.8 The loading rate (LR) of the tank shall not exceed:

$$LR = \frac{3600U}{t}\left(m^3/h\right)$$

where

U = Ullage volume (m3) at operating signal level;

t = Time(s) needed from the initiating signal to fully stopping the cargo flow into the tank, being the sum of times needed for each step in sequential operations such as operator's responses to signals, stopping pumps and closing valves;

and shall also take into account the pipeline system design pressure.

15.20 Alkyl (C7-C9) nitrates, all isomers

15.20.1 The carriage temperature of the cargo shall be maintained below 100°C to prevent the occurrence of a self-sustaining, exothermic decomposition reaction.

15.20.2 The cargo may not be carried in independent pressure vessels permanently affixed to the vessel's deck unless:

.1 The tanks are sufficiently insulated from fire; and

.2 The vessel has a water deluge system for the tanks such that the cargo temperature is maintained below 100°C and the temperature rise in the tanks does not exceed 1.5°C per hour for a fire of 650°C.

15.21 Temperature sensors

Temperature sensors shall be used to monitor the cargo pump temperature to detect overheating due to pump failures.

SECTION 16

OPERATIONAL REQUIREMENTS

16.1 Maximum allowable quantity of cargo per tank

16.1.1 The quantity of a cargo required to be carried in a type 1 ship shall not exceed 1,250 m^3 in any one tank.

16.1.2 The quantity of cargo required to be carried in a type 2 ship shall not exceed 3,000 m^3 in any one tank.

16.1.3 Tanks carrying liquids at ambient temperatures shall 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.

16.2 Cargo information

16.2.1 A copy of IBC Code, or national regulations incorporating the provisions of the Code, shall be on board every ship covered by IBC Code.

16.2.2 Any cargo offered for bulk shipment shall be indicated in the shipping documents by the product name, under which it is listed in section 17 or 18 of this chapter or the latest edition of MEPC.2/Circ. or under which it has been provisionally assessed. Where the cargo is a mixture, an analysis indicating the dangerous components contributing significantly to the total hazard of the product shall be provided, or a complete analysis if this is available. Such an analysis shall be certified by the manufacturer or by an independent expert acceptable to the Administration.

16.2.3 Information shall be on board, and available to all concerned, giving the necessary data for the safe carriage of the cargo in bulk. Such information shall include a cargo stowage plan, to be kept in an accessible place, indicating all cargo on board, including each dangerous chemical carried:

.1 A full description of the physical and chemical properties, including reactivity, necessary for the safe containment of the cargo;

.2 Action to be taken in the event of spills or leaks;

.3 Countermeasures against accidental personal contact;

.4 Fire-fighting procedures and fire-fighting media;

.5 Procedures for cargo transfer, tank cleaning, gas-freeing and ballasting; and

.6 For those cargoes required to be stabilized or inhibited, the cargo shall be refused if the certificate required by these paragraphs is not supplied.

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

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

16.2.6 Where *column o* in the table of section 17 refers to this paragraph, the cargo's viscosity at 20°C shall be specified on a shipping document, and if the cargo's viscosity exceeds 50 mPa.s at 20°C, the temperature at which the cargo has a viscosity of 50 mPa.s shall be specified in the shipping document.

16.2.7 Where *column o* in the table of chapter 17 refers to this paragraph, the cargo is subject to the prewash requirements in regulation 13.7.1.4 of Annex II of MARPOL.

16.2.8 Deleted.

16.2.9 Where *column o* in the table of section 17 refers to this paragraph, the cargo's melting point shall be indicated in the shipping document.

16.3 Personnel training

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

16.3.2 Personnel involved in cargo operations shall be adequately trained in handling procedures.

16.3.3 Officers shall be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them shall be instructed and trained in essential first aid for cargoes carried, based on the guidelines developed by the Organization*.

16.4 Opening of and entry into cargo tanks

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

16.4.2 Personnel shall not enter cargo tanks, void spaces around such tanks, cargo-handling spaces or other enclosed spaces unless:

.1 The compartment is free of toxic vapours and not deficient in oxygen; or

.2 Personnel wear breathing apparatus and other necessary protective equipment, and the entire operation is under the close supervision of a responsible officer.

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

16.5 Stowage of cargo samples

16.5.1 Samples which have to be kept on board shall be stowed in a designated space situated in the cargo area or, exceptionally, elsewhere, subject to the approval of the Administration.

16.5.2 The stowage space shall be:

.1 Cell-divided in order to avoid shifting of the bottles at sea;

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* *Refer to the Medical First Aid Guide for Use in Accidents Involving Dangerous Goods (MFAG), which provides advice on the treatment of casualties in accordance with the symptoms exhibited as well as equipment and antidotes that may be appropriate for treating the casualty and to the relevant provisions of the STCW Code, parts A and B.*

.2 Made of material fully resistant to the different liquids intended to be stowed; and

.3 Equipped with adequate ventilation arrangements.

16.5.3 Samples which react with each other dangerously shall not be stowed close to each other.

16.5.4 Samples shall not be retained on board longer than necessary.

16.6 Cargoes not to be exposed to excessive heat

16.6.1 Where the possibility exists of a dangerous reaction of a cargo, such as polymerization, decomposition, thermal instability or evolution of gas, resulting from local overheating of the cargo in either the tank or associated pipelines, such cargo shall be loaded and carried adequately segregated from other products whose temperature is sufficiently high to initiate a reaction of such cargo (see Section 7.1.5.4).

16.6.2 Heating coils in tanks carrying this product shall be blanked off or secured by equivalent means.

16.6.3 Heat-sensitive products shall not be carried in deck tanks, which are not insulated.

16.6.4 In order to avoid elevated temperatures, this cargo shall not be carried in deck tanks.

SECTION 17

SUMMARY OF MINIMUM REQUIREMENTS

Please refer to Chapter 17 of IBC Code as amended.

SECTION 18

LIST OF PRODUCTS TO WHICH THIS CHAPTER DOES NOT APPLY

Please refer to Chapter 18 of IBC Code as amended.

SECTION 19

INDEX OF PRODUCTS CARRIED IN BULK

Please refer to Chapter 19 of IBC Code as amended.

SECTION 20

TRANSPORT OF LIQUID CHEMICAL WASTES

20.1 Preamble

20.1.1 Maritime transport of liquid chemical wastes could present a threat to human health and to the environment.

20.1.2 Liquid chemical wastes shall, therefore, be transported in accordance with relevant international conventions and recommendations and, in particular, where it concerns maritime transport in bulk, with the requirements of this Chapter.

20.2 Definitions

For the purpose of this section:

20.2.1 **Liquid chemical wastes** are substances, solutions or mixtures, offered for shipment, containing or contaminated with one or more constituents which are subject to the requirements of this Chapter and for which no direct use is envisaged but which are carried for dumping, incineration or other methods of disposal other than at sea.

20.2.2 **Transboundary movement** means maritime transport of wastes from an area under the national jurisdiction of one country to or through an area under the national jurisdiction of another country, or to or through an area not under the national jurisdiction of any country, provided at least two countries are concerned by the movement.

20.3 Applicability

20.3.1 The requirements of this section are applicable to the transboundary movement of liquid chemical wastes in bulk by seagoing ships and shall be considered in conjunction with all other requirements of this Chapter.

20.3.2 The requirements of this section do not apply to:

.1 Wastes derived from shipboard operations which are covered by the requirements of MARPOL 73/78; and

.2 Substances, solutions or mixtures containing or contaminated with radioactive materials which are subject to the applicable requirements for radioactive materials.

20.4 Permitted shipments

20.4.1 Transboundary movement of wastes is permitted to commence only when:

.1 Notification has been sent by the competent authority of the country of origin, or by the generator or exporter through the channel of the competent authority of the country of origin, to the country of final destination; and

.2 The competent authority of the country of origin, having received the written consent of the country of final destination stating that the wastes will be safely incinerated or treated by other methods of disposal, has given authorization to the movement.

20.5 Documentation

20.5.1 In addition to the documentation specified in 16.2 of this Chapter, ships engaged in transboundary movement of liquid chemical wastes shall carry on board a waste movement document issued by the competent authority of the country of origin.

20.6 Classification of liquid chemical wastes

20.6.1 For the purpose of the protection of the marine environment, all liquid chemical wastes transported in bulk shall be treated as Category X noxious liquid substances, irrespective of the actual evaluated category.

20.7 Carriage and handling of liquid chemical wastes

20.7.1 Liquid chemical wastes shall be carried in ships and cargo tanks in accordance with the minimum requirements for liquid chemical wastes specified in Section 17, unless there are clear grounds indicating that the hazards of the wastes would warrant:

.1 Carriage in accordance with the ship type 1 requirements; or

.2 Any additional requirements of this Section applicable to the substance or, in case the of a mixture, its constituent presenting the predominant hazard.

SECTION 21

CRITERIA FOR ASSIGNING CARRIAGE REQUIREMENTS
FOR PRODUCTS SUBJECT TO THE IBC CODE

Please refer to Chapter 21 of IBC Code as amended.