

**BUREAU
VERITAS**

Classification of Compressed Natural Gas Carriers

April 2007

**Rule Note
NR 517 DR R00 E**

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MARINE DIVISION

GENERAL CONDITIONS

ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine Division (the "Society") is the classification ("Classification") of any ship or vessel or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- issues Certificates, Attestations and Reports following its interventions ("Certificates");
- publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as "Certification".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as "Services". The party and/or its representative requesting the services is hereinafter referred to as the "Client". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Shipbuilder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

ARTICLE 2

2.1. - Classification is the appraisal given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisal is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisal or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the performance of the requested Services.

ARTICLE 3

3.1. - The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are not a code of construction neither a guide for maintenance or a safety handbook.

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - **The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.**

3.3. - The Services of the Society are carried out by professional Surveyors according to the Code of Ethics of the Members of the International Association of Classification Societies (IACS).

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- conducts surveys at the place of their construction;
- classes Units and enters their class in its Register;
- surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.

ARTICLE 5

5.1. - The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.

5.2. - The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for.

In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.

5.3. - **The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder, respectively.**

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - **If the Services of the Society cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee.**

The Society bears no liability for indirect or consequential loss such as e.g. loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred.

ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. hereabove subject to compliance with 2.3. hereabove and Article 8 hereunder.

ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - **Overdue amounts are increased as of right by interest in accordance with the applicable legislation.**

8.3. - **The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.**

ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the classification file consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit;
- copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society Member of the International Association of Classification Societies (IACS) in case of the Unit's transfer of class;
- the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units are passed on to IACS according to the association working rules;
- the certificates, documents and information relative to the Units classed with the Society may be reviewed during IACS audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France.

12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

ARTICLE 13

13.1. - These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement.

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.



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Foreword

This document has been prepared to propose a set of requirements for ships carrying compressed natural gas (CNG).

It is based on the latest editions of Bureau Veritas Rules for the Classification of Steel Ships and on the IMO IGC code (including 1994, 1996 and 2000 amendments and draft amendments BLG9/17 2005) respectively.

As soon as the technical features of any CNG projects are sufficiently developed, it will be required to conduct a risk analysis focusing on the innovative components of each design, such as the containment system, and also on the process during cargo operations, in order to validate the main design options with respect to the present safety standard achieved through the application of the IMO IGC code.

In a first instance, it is observed that there is no dedicated existing set of rules and regulations covering the carriage in bulk of compressed natural gas. (For memory, SOLAS regulation II-2/19 deals with the carriage of dangerous goods in portable tanks or containers.)

However, the IMO “international code for the construction and equipment of ships carrying liquefied gases in bulk” (IGC code) mentions in §1.1.6:

“Where it is proposed to carry products which may be considered to come within the scope of the Code but are not at present designated in chapter 19, the Administrations and the port Administrations involved in such a carriage should establish preliminary suitable conditions of carriage based on the principles of the Code and notify the Organisations of such conditions.”

Therefore, the IMO IGC code is considered relevant to a project of ships carrying CNG, despite the fact that gas will not be transported in a liquid state.

The main reasons of this statement are:

- Methane is a substance mentioned in chapter 19 of the IGC code;*
- The present note deals with CNG carried in bulk in fixed containers;*
- Most of the hazards related to the carriage and to the handling of CNG are of a similar nature as those involved in the carriage of LNG;*
- The IGC code is a consistent set of regulations, generally recognised by the flag administrations.*

It is assumed in this Rule Note that any containers proposed are able to meet the criteria of independent type B or C cargo tanks as defined by the IMO IGC code.

In order to facilitate the use of this Rule Note and to have a self-standing document the applicable text of IGC Code has been incorporated and printed in Roman characters. Modifications and additional requirements are printed in italics.

The word “Administration” has been replaced by “Society”.

In this Rule Note, Ship Rules means the Bureau Veritas Rules for the Classification of Steel Ships.

1. General

1.1 Scope

1.1.1 Applicability

1.1.1.1 IGC Code requirements and the Society's Rules

a) Ships which are intended for the carriage of compressed natural gases are to comply with the requirements of the latest version of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, as amended. In this Rule Note reference to this Code and its amendments is made by the wording "IGC Code".

b) In general, this Rule Note applies to cargo containment and handling systems and to the interfaces between these systems and the remainder of the ship, which is to comply with the applicable requirements for hull and machinery given in Parts B,C and D of Ships Rules.

1.1.1.2 IGC Code requirements not within the scope of classification

The following requirements of the IGC Code are not within the scope of classification:

- Chapter 1, Section 1.4 - Equivalents
- Chapter 1, Section 1.5 - Surveys and certification
- Chapter 11, Section 11.6 – Fireman's outfits
- Chapter 14 – Personnel Protection
- Chapter 18 - Operating requirements.

Spare parts requirements are given for information within the scope of classification

1.1.1.3 Particularly hazardous products

For the carriage in bulk of products presenting more severe hazards than those covered by this Rule Note, the Society reserves the right to establish requirements and/or conditions additional to those contained in this Rule Note.

1.2 Safety Goal and Formal Safety Assessment

A quantified Formal Safety Assessment complying with IMO Guidelines MSC/Circ. 1023 is to be submitted in order to document that the safety level is equivalent or better than comparable ships covered by IGC Code.

It is the responsibility of the designer and/or the owner to define the applicable Risk Acceptance Criteria

1.3 Additional requirements

1.3.1 Emergency towing arrangement

Emergency towing arrangements are to be fitted on compressed gas tankers of 20.000 dwt and above in accordance with Ship Rules, Pt B, Ch 10, Sec 4, [4].

1.3.2 Steering gear

Additional requirements for steering gear of compressed gas carriers of 10.000 dwt and above are given in Ship Rules, Pt D, Ch 7, Sec 4, [7].

1.4 Documentation to be submitted

Tab 2 lists the plans, information, analysis, etc. which are to be submitted in addition to the information required in Ship Rules for the parts of the ship not affected by the cargo, as applicable.

Table 2: Documents to be submitted

No	A/I	Documents
1	I	Characteristics of natural gas to be carried, including maximum pressure, minimum temperature, corrosivity and other important design conditions
2	I	General arrangement plan, showing location of cargo tanks and fuel oil, ballast and other tanks
3	A	Gas-dangerous zones plan
4	A	Location of void spaces and accesses to dangerous zones

No	A/I	Documents
5	A	<i>Air locks between safe and dangerous zones</i>
6	A	<i>Ventilation duct arrangement in gas-dangerous spaces and adjacent zones</i>
7	A	<i>Details of hull structure in way of cargo tanks, including support arrangement for tanks, saddles, anti-floating and anti-lifting devices, deck sealing arrangements, etc. and means of protection of hull structure in case of jet leak.</i>
8	A	<i>Calculation of the hull temperature in all the design cargo conditions</i>
9	A	<i>Distribution of quality and steel grades in relation to the contemplated actual temperature obtained by the calculation in item 8</i>
10	A	<i>Hull stress analysis</i>
11	A	<i>Hull ship motion analysis, where a direct analysis is preferred to the methods indicated in Ship Rules, Ch 9, Sec 4</i>
12	A	<i>Intact and damage stability calculations</i>
13	A	<i>Scantlings, material and arrangement of the cargo containment system</i>
14	A	<i>Stress analysis of the cargo tanks, including fatigue analysis and crack propagation analysis for type "B" tanks. This analysis may be integrated with that indicated in item 10</i>
15	I	<i>Calculation of the thermal insulation suitability and refrigeration plant capability, if any, cooling down and temperature gradients during loading and unloading operations</i>
16	A	<i>Details of insulation</i>
17	A	<i>Details of ladders, fittings in tanks and relative stress analysis, if any</i>
18	A	<i>Details of tank deck sealings</i>
19	A	<i>Plans and calculations of safety relief valves</i>
20	A	<i>Details of cargo handling and vapour system, including arrangements and details of piping and fitting</i>

No	A/I	Documents
21	A	Details of cargo condensate pumps, if any and cargo compressors
22	A	Details of process pressure vessels and relative valving arrangement
23	A	Bilge and ballast system in cargo area
24	A	Gas freeing system in cargo tanks including inert gas system
25	A	Hold space drainage, inerting and pressurisation systems
26	A	Ventilation system in cargo area
27	A	Hull structure heating system, if any
28	A	Refrigeration plant system diagram, if any
29	A	Details of electrical equipment installed in cargo area, including the list of certified safe equipment and apparatus and electrical bonding of cargo tanks and piping
30	A	Schematic electrical wiring diagram in cargo area
31	A	Gas detection system
32	A	Cargo tank instrumentation, including cargo and hull temperature and pressure monitoring system
33	A	Emergency shutdown system
34	A	Blow down system, if any
35	A	Details of fire-extinguishing appliances and systems in cargo area
36	A	Loading and unloading operation description, including cargo tank pressure filling limits
37	A	Cargo tank testing and inspection procedures
38	A	Programme of gas trials

No	A/I	Documents
39	I	When applicable, P & A manual
40	I	Documented Quantified Risk Assessment
41		For machinery using gas as fuel
	I	a) General arrangement plan of the machinery plant
	I	b) Description of the entire plant
	A	c) Gas piping plans for the machinery plant
	A	d) Complete list of the safety, gas detection and warning equipment
	A	e) Drawings of the boilers/ diesel engines using gas as fuel
	I	f) Detailed drawings of the gas inlet and fuel inlet equipment
	I	g) Gas characteristics
	A	h) General arrangement plan of the gas treatment plant, including gas compressors, prime movers and gas preheaters
	A	i) Drawings of the gas storage tanks
	A	j) Drawings of the gas compressors and preheaters
Note 1: A = to be submitted for approval in four copies I = to be submitted for information in duplicate		

1.5 Cargo equipment trials

1.5.1 Scope

1.5.1.1 Trials in working conditions

All the equipment to which this Rule Note is applicable is to be tested in actual working conditions.

1.5.1.2 Trials to be carried out when the ship is loaded

Those trials which may only be carried out when the ship is loaded are to be held at the first loading of the ship.

1.5.2 Extent of the tests

1.5.2.1 Cargo equipment testing procedure

The cargo equipment testing procedure is to be submitted to the Society for review.

1.5.2.2 Ships with mechanical refrigeration units

Ships fitted with a mechanical refrigeration unit are to be subjected to an initial testing procedure in order to check the suitability of the plant in respect of the applicable requirements. The recording of the data of the refrigeration system, such as working duration and ambient conditions, may be carried out during the first loaded voyage.

1.5.2.3 Use of cargo as fuel

The arrangements for using cargo as fuel are to be subjected to a special testing procedure.

1.6 Hazards

Hazards of natural gases considered in this Rule Note include fire, low temperature and pressure. Toxicity is not normally considered as it is assumed that the toxic components which may be present in the natural gas have been removed from the gas before introduction in tanks

1.7 Definitions

Except where expressly provided otherwise, the following definitions apply to this Rule Note. Additional definitions are given in chapter 4.

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

1.7.2. 'A' class divisions means divisions as defined in SOLAS regulation II-2/3.2.

1.7.3.1. Administration means the Government of the State whose flag the ship is entitled to fly.

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

1.7.3.3. N/A

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

1.7.5. Breadth (B) 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. The breadth (B) is to be measured in metres.

1.7.6. Cargo area is that part of the ship which contains the cargo containment system and cargo pump and compressor rooms and includes deck areas over the full length and breadth of the part of the ship over the above-mentioned spaces. Where fitted, the cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space are excluded from the cargo area.

1.7.7. Cargo containment system is the arrangement for containment of cargo including, where fitted, associated insulation and any intervening spaces, and adjacent structure if necessary for the support of these elements.

1.7.8. Cargo control room is a space used in the control of cargo handling operations and complying with the requirements of 3.4.

1.7.9. Cargoes are products carried in bulk by ships subject to this Rule Note.

1.7.10. Cargo service spaces are spaces within the cargo area used for workshops, lockers and store-rooms of more than 2 m² in area, used for *cargo handling equipment*.

1.7.11. Cargo tank is the *Gas-tight shell or shells connected together in assemblies* designed to be the primary container of the cargo and includes all such containers whether or not associated with insulation or secondary barriers or both *up to the first stop valve*.

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

1.7.13. Control stations are those spaces in which ships' 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.

1.7.14. Flammable products are *the various types of natural gases*.

1.7.15. Flammability limits 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.

1.7.16. CNG carrier is a cargo ship constructed or adapted and used for the carriage in bulk of *compressed natural gas*.

1.7.17. Gas-dangerous space or zone is:

- .1. a space in the cargo area which is not arranged or equipped in an approved manner to ensure that its atmosphere is at all times maintained in a gas-safe condition;
- .2. an enclosed space outside the cargo area through which any piping containing condensate or gaseous products passes, or within which such piping terminates, unless approved arrangements are installed to prevent any escape of product vapour into the atmosphere of that space;
- .3. a cargo containment system and cargo piping;
- .4. a hold space where cargo is carried
- .5. a space separated from a hold space described in 4 by a single gastight steel boundary;
- .6. a *cargo handling equipment* room;
- .7. a zone on the open deck, or semi-enclosed space on the open deck, within 3 m of any cargo tank outlet, gas or vapour outlet, cargo pipe flange or cargo valve or of entrances and ventilation openings to *cargo handling equipment* rooms;
- .8. the open deck over the cargo area and 3 m forward and aft of the cargo area on the open deck up to a height of 2.4 m above the weather deck;
- .9. a zone within 2.4 m of the outer surface of a cargo containment system where such surface is exposed to the weather;
- .10. an enclosed or semi-enclosed space in which pipes containing products are located. A space which contains gas detection equipment complying with 13.6.5 and a space utilizing *cargo* gas as fuel and complying with chapter 16 are not considered gas-dangerous spaces in this context;
- .11. a compartment for cargo hoses; or

.12. an enclosed or semi-enclosed space having a direct opening into any gas-dangerous space or zone.

1.7.18. Gas-safe space is a space other than a gas-dangerous space.

1.7.19. Hold space is the space enclosed by the ship's structure in which a cargo containment system is situated.

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

1.7.21. Insulation space is the space occupied wholly or in part by insulation.

1.7.22. N/A

1.7.23. Length (L) 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 are to be parallel to the designed waterline. The length (L) are to be measured in metres.

1.7.24. 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.

1.7.25. 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.

1.7.26. MARVS is the maximum allowable relief valve setting of a cargo tank.

1.7.27. 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 pressure of more than 1.8 bar gauge.

1.7.28. Organization is the International Maritime Organization (IMO).

1.7.29. 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.

1.7.30. Recognized standards are applicable international or national standards acceptable to the Society.

1.7.31. Relative density is the ratio of the mass of a volume of a product to the mass of an equal volume of fresh water.

1.7.32. Separate means that a cargo piping system or cargo vent system, for example, is not connected to another cargo piping or cargo vent system. This separation may be achieved by the use of design or operational methods. Operational methods are not to be used within a cargo tank and are to 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.

1.7.33. Service spaces are those 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.

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

1.7.35.

1.7.36. Tank cover is the protective structure intended to protect the cargo containment system against damage where it protrudes through the weather deck or to ensure the continuity and integrity of the deck structure.

1.7.37.

1.7.38. Toxic products are *natural gases containing toxic components*.

1.7.39. Vapour pressure is the equilibrium pressure of the saturated vapour above the liquid expressed in bars absolute at a specified temperature.

1.7.40. Void space is an enclosed space in the cargo area external to a cargo containment system, other than a hold space, ballast space, fuel oil tank, *cargo handling equipment* room, or any space in normal use by personnel

1.8 Equivalents

1.8.1. Where this Rule Note requires that a particular fitting, material, appliance, apparatus, item of equipment or type thereof are to be fitted or carried in a ship, or that any particular provision are to be made, or any procedure or arrangement are to be complied with, the Society may allow any other fitting, material, appliance, apparatus, item of equipment or type 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 this Rule Note. However, the Society 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 is prescribed by this Rule Note.

1.9 Classification and Surveys

Classification and surveys are detailed in Ship Rules Pt A.

2. Ship Survival Capability and Location of Cargo Tanks

2.1 General

2.1.1. Ships subject to this Rule Note are to 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 are to 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 damage to be assumed and the proximity of the tanks to the ship's shell are to be dependent upon the degree of hazard presented by the product to be carried.

2.1.2. Ships subject to this Rule Note are to be designed either:

1. To the **type 2G ship** standard which is a gas carrier intended to transport products which require significant preventive measures to preclude the escape of such cargo; or
2. To the **type 2PG ship** standard which is a gas carrier of 150 m in length or less intended to transport products which require significant preventive measures to preclude the escape of such cargo and where the products are carried in independent type C tanks designed to a temperature of -55 or above .

*Damage stability will be assessed when the notation **SDS** is assigned*

2.2 Freeboard and intact stability

2.2.1. Ships subject to this Rule Note may be assigned the minimum freeboard permitted by the International Convention on Load Lines in force. However, the draught associated with the assignment is not to be greater than the maximum draught otherwise permitted by this Rule Note.

2.2.2. *The stability of the ship for the loading conditions in Ship Rules, Pt B, Ch 3, App 2, [1.2.8] is to be in compliance with the requirements of Ship Rules, Pt B, Ch 3, Sec 2.*

2.2.3. When calculating the effect of free surfaces of consumable liquids for loading conditions it are to 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 are to be those where the effect of free surfaces is the greatest. *The free surface effect is to be calculated in accordance with Ship Rules, Pt B, Ch 3, Sec 2, [4].*

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

2.2.5. *The Master of the ship is to be supplied with a Loading Manual as specified in Ship Rules, Pt B, Ch 11, Sec 2, [3] and a Trim and Stability booklet as specified in Ship Rules, Pt B, Ch 3, App 2.*

2.3 Shiplside 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 superstructures and deckhouses on the freeboard deck fitted with weathertight doors are to comply with the requirements of the relevant regulation of the International Convention on Load Lines in force, except that the choice of valves are to 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 chapter “summer load waterline” and “freeboard deck”, have the meanings 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 are to 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 are to comply with recognized standards.

2.4 Conditions of loading

2.4.1. Damage survival capability are to be investigated on the basis of loading information submitted to the Society for all anticipated conditions of loading and variations in draught and trim. The survival requirements need not be applied to the ship when in the ballast condition provided that any cargo retained on board is solely used for cooling, circulation or fuelling purposes.

Loading conditions other than those in the Loading Manual and the Trim and Stability booklet are to be previously submitted to the Society. Alternatively, such cases may be examined by the Master or a delegated officer when a loading instrument approved in accordance with the requirements of Ship Rules, Pt B, Ch 11, Sec 2, [4] is installed on board.

2.5 Damage assumptions

2.5.1. The assumed maximum extent of damage is to 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: from the moulded line of the bottom shell plating at centreline upwards without limit

.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 2 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.3). $B/15$ or 2 m, whichever is less measured from the moulded line of the bottom shell plating at centreline (see 2.6.3).

2.5.2. Other damage:

.1. 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 are to be assumed.

.2. Local side damage anywhere in the cargo area extending inboard 760 mm measured normal to the hull shell are to be considered and transverse bulkheads are to be assumed damaged when also required by the applicable subparagraphs of 2.8.1.

2.6 Location of cargo tanks

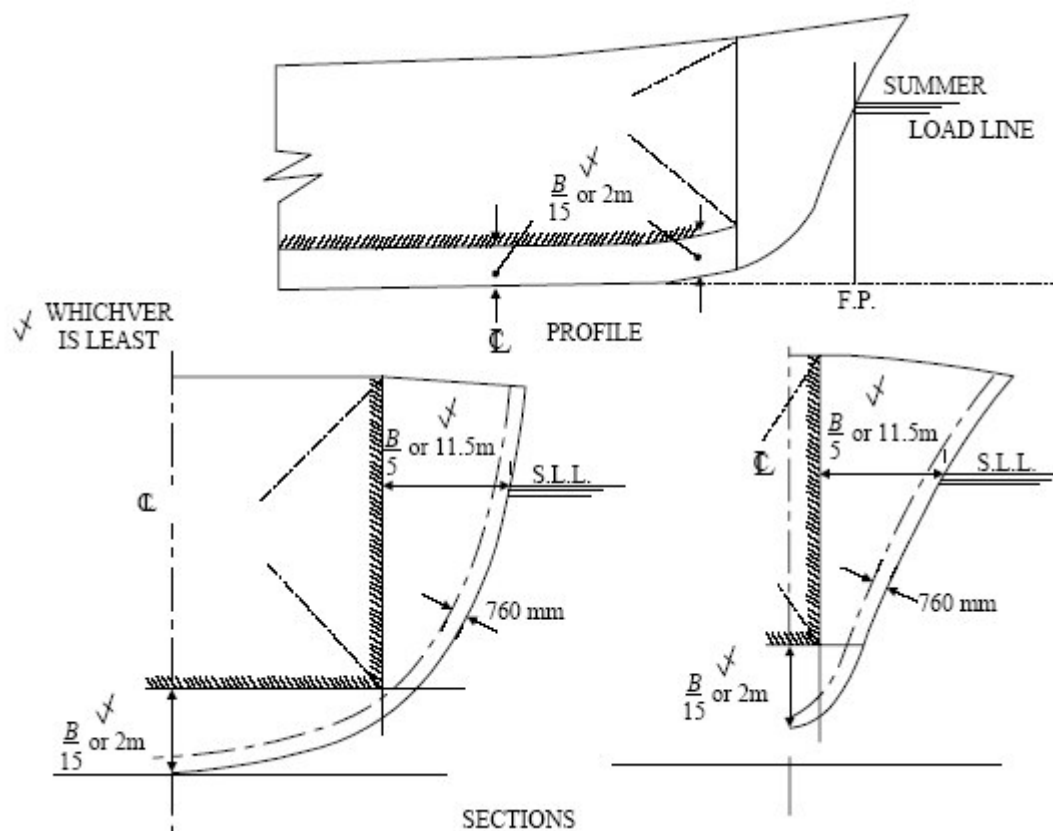
2.6.1. Cargo tanks are to be located at a distance inboard from the moulded line of the bottom shell plating at centreline not less than the vertical extent of damage specified in 2.5.1.2.3 and nowhere less than 760 mm from the shell plating.

2.6.2. For the purpose of tank location, the vertical extent of bottom damage are to be measured to the bottom of the cargo tanks. The transverse extent of side damage is to be measured to the side of the cargo tanks (see figure 2.1).

2.6.3. 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 below the upper limit of bottom damage is not to exceed 350 mm. Suction wells installed in accordance with this paragraph may be ignored in determining the compartments affected by damage.

2.6.4 A Quantified Collision and Grounding Risk Assessment should be performed to verify that the above mentioned damage assumptions are still valid.

Figure 2.1 tank location



2.7 Flooding assumptions

2.7.1. The requirements of 2.9 are to 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 are to 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

2.7.3. Wherever damage penetrates a tank containing liquids, it are to 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. Where the damage between transverse watertight bulkheads is envisaged as specified in 2.8.1.4, .5, and .6, transverse bulkheads are to be spaced at least at a distance equal to the longitudinal extent of damage specified in 2.5.1.1.1 in order to be considered effective. Where transverse bulkheads are spaced at a lesser distance, one or more of these bulkheads within such extent of damage are to be assumed as non-existent for the purpose of determining flooded compartments. Further, any portion of a transverse bulkhead bounding side compartments or double bottom compartments are to be assumed damaged if the watertight bulkhead boundaries are within the extent of vertical or horizontal penetration required by 2.5. Also, any transverse bulkhead are to be assumed damaged if it contains a step or recess of more than 3 m in length located within the extent of penetration of assumed damage. The step formed by the after peak bulkhead and after peak tank top is not to be regarded as a step for the purpose of this paragraph.

2.7.5. The ship is to 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, are not to be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of 2.9.1 and sufficient residual stability are to 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.

2.7.7. If pipes, ducts, trunks or tunnels are situated within the assumed extent of damage penetration, as defined in 2.5, arrangements are to 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 are to 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 2.9.1.1 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 2.9.2.1; however, the immersion of any other openings capable of being closed weathertight may be permitted.

2.8 Standard of damage

2.8.1. Ships are to 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:

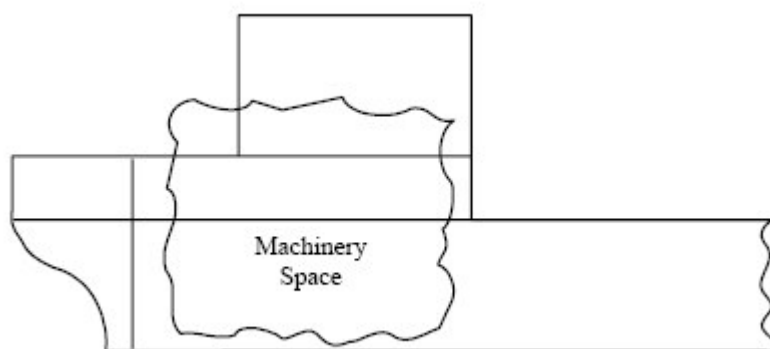
.2. A type 2G ship of more than 150 m in length is to be assumed to sustain damage anywhere in its length;

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

2.8.2. In the case of small type 2G ships which do not comply in all respects with the appropriate requirements of 2.8.1.3, .4, and .6, special dispensations may only be considered by the Society provided that alternative measures can be taken which maintain the same degree of safety.

The longitudinal extent of damage to the superstructure (see also 2.7.8) in the case of side damage to a machinery space aft, as per 2.8.1, is to be the same as the longitudinal extent of the side damage to the machinery space (see Fig 2.2).

Figure 2.2: Longitudinal extension of superstructures damage



2.9 Survival requirements

Ships subject to this Rule Note are to be capable of surviving the assumed damage specified in IGC Code 2.5.1 and 2.5.2 to the standard provided in IGC Code 2.8.1 and for the loading conditions in Ship Rules, Pt B, Ch 3, App 2, [1.2.8] in a condition of stable equilibrium and such as to satisfy the criteria in 2.9. and are to satisfy the following criteria.

2.9.1. In any stage of flooding:

- .1. the waterline, taking into account sinkage, heel and trim, are to be below the lower edge of any opening through which progressive flooding or downflooding may take place. Such openings are to 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, and sidescuttles of the non-opening type;
- .2. the maximum angle of heel due to unsymmetrical flooding is not to exceed 30°; and
- .3. the residual stability during intermediate stages of flooding are to be to the satisfaction of the Society. However, it never be significantly less than that required by 2.9.2.1.

2.9.2. At final equilibrium after flooding:

.1. the righting lever curve is to 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 is not to be less than 0.0175 m.rad. Unprotected openings are not to 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 2.9.1.1 and other openings capable of being closed weathertight may be permitted; and

.2. the emergency source of power are to be capable of operating.

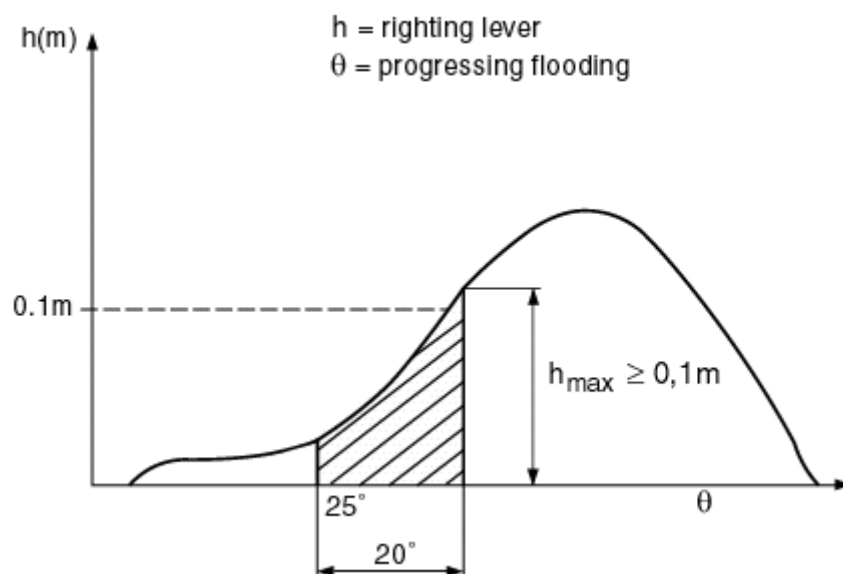
2.9.3. Intermediate stages of flooding

The criteria applied to the residual stability during intermediate stages of flooding are to be those relevant to the final stage of flooding as specified in 2.9.2. However, small deviations from these criteria may be accepted by the Society on a case-by-case basis.

2.9.4. Definition of range of positive stability

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) (see Fig 2.3).

Figure 2.3: Range of positive stability



3. Ship Arrangements

3.1 Segregation of the cargo area

3.1.1. Hold spaces are to be segregated from machinery and boiler spaces, accommodation spaces, service spaces and control stations, chain lockers, drinking and domestic water tanks and from stores. Hold spaces are to be located forward of machinery spaces of category A, other than those deemed necessary by the Society for the safety or navigation of the ship.

Bow thrusters are allowed to be fitted forward of the hold spaces.

3.1.2. Segregation of hold spaces from spaces referred to in 3.1.1 or spaces either below or outboard of the hold spaces may be effected by cofferdams, fuel oil tanks or a single gastight bulkhead of all-welded construction forming an A-60 class division. A gastight A-0 class division is satisfactory if there is no source of ignition or fire hazard in the adjoining spaces.

Hold spaces may be separated from each other by single bulkheads. Where cofferdams are used instead of single bulkheads, they may be used as ballast tanks subject to special approval by the Society

3.1.3 N/A

3.1.4. N/A

3.1.5. Any piping system which may contain cargo or cargo vapour:

1. is to be segregated from other piping systems, except where inter-connections are required for cargo-related operations such as purging, gas-freeing or inerting. In such cases, precautions are to be taken to ensure that cargo or cargo vapour cannot enter such other piping systems through the inter-connections.
2. Except as provided for a fuel gas system, is not to pass through any accommodation space, service space or control station or through a machinery space other than a cargo pump room or cargo compressor space.
3. Except for bow or stern loading and unloading arrangements in accordance with Subsection/8 and except as provided for fuel gas systems is to be located in the cargo area above the open deck.
4. Except for athwartship shore connection piping not subject to internal pressure at sea is to be located inboard of the transverse tank location requirements of 2.6.1

3.1.6. Any emergency cargo blow down piping system is to comply with 3.1.5 as appropriate and may be led aft externally to accommodation spaces, service spaces or control stations or machinery spaces, but is not to pass through them.

The location of the cold vent or flare outlet is to be subject to a gas dispersion, a flare radiation and a noise analysis as appropriate.

3.1.7. Arrangements are to be made for sealing the weather decks in way of openings for cargo containment systems.

3.2 Accommodation, service and machinery spaces and control stations

3.2.1. No accommodation space, service space or control station is to be located within the cargo area. The bulkhead of accommodation spaces, service spaces or control stations which face the cargo area are to be so located as to avoid the entry of gas from the hold space to such spaces through a single failure of a deck or bulkhead

Some acceptable arrangements of accommodation spaces, with respect to cargo tanks, are shown in Fig 3.1

3.2.2. In order to guard against the danger of hazardous vapours, due consideration are to be given to the location of air intakes and openings into accommodation, service and machinery spaces and control stations in relation to cargo piping, cargo vent systems and machinery space exhausts from gas burning arrangements.

Compliance with the relevant requirements of this Rule Note, in particular with 3.2.4, 3.8, 8.2.10 and 12.1.6, as applicable, also ensures compliance with the requirements in 3.2.2, relevant to precautions against hazardous vapours.

3.2.3. Access through doors, gastight or otherwise, is not to be permitted from a gas-safe space to a gas-dangerous space, except for access to service spaces forward of the cargo area through air-locks as permitted by 3.6.1 when accommodation spaces are aft.

3.2.4. Entrances, air inlets and openings to accommodation spaces, service spaces, machinery spaces and control stations are not to face the cargo area. They are to be located on the end bulkhead not facing the cargo area or on the outboard side of the superstructure or deck house or on both 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. Windows and sidescuttles facing the cargo area and on the sides of the superstructure of deck house within the distance mentioned above are to be of the fixed (non-opening) type. Wheelhouse windows may be non-fixed and wheelhouse doors may be located within the above limits so long as they are so designed that a rapid and efficient gas and vapour tightening of the wheelhouse can be ensured.

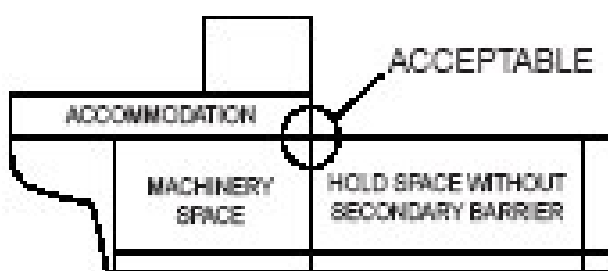
3.2.5. Sidescuttles in the shell below the uppermost continuous deck and in the first tier of the superstructure or deck house are to be of the fixed (non-opening) type.

3.2.6. All air intakes and openings into the accommodation spaces, service spaces and control stations are to be fitted with closing devices..

The closing devices are to give a reasonable degree of gas-tightness. Ordinary steel fire-flaps without gaskets/seals are normally not considered satisfactory.

Bolted plates of A60 class for removal of machinery may be accepted on bulkheads facing cargo areas, provided signboards are fitted to warn that these plates may only be opened when the ship is in gas-free condition

Figure 3.1 Acceptability of common corners between hold space and other spaces



3.3 Cargo handling systems rooms

3.3.1.1. Cargo handling systems rooms are to be situated above the weather deck and located within the cargo area unless specially approved by the Society. Cargo *handling equipment* rooms are to be treated as cargo pump rooms for the purpose of fire protection according to SOLAS regulation II-2/9.2.4 .

3.3.1.2. When cargo *handling equipment* rooms are permitted to be fitted above or below the weather deck at the after end of the aftermost hold space or at the forward end of the forwardmost hold space, the limits of the cargo area as defined in 1.3.6 are to be extended to include the cargo *handling equipment* rooms for the full breadth and depth of the ship and deck areas above those spaces.

3.3.1.3. Where the limits of the cargo area are extended by 3.3.1.2, the bulkhead which separates the cargo *handling equipment* rooms from accommodation and service spaces, control stations and machinery spaces of category A are to be so located as to avoid the entry of gas to these spaces through a single failure of a deck or bulkhead.

3.3.1.4. When cargo handling equipment rooms are permitted to be fitted at the after end of the aftermost hold space, the bulkhead which separates the cargo pump handling equipment rooms from accommodation and service spaces, control stations and machinery spaces of category A is to be so located as to avoid the entry of gas to these spaces through a single failure of a deck or bulkhead. The same condition is also to be satisfied when cargo handling equipment rooms fitted within the cargo area have a bulkhead in common with accommodation and service spaces, control stations and machinery spaces of category A.

3.3.2. Where *handling equipment* are 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 are to be fitted in way of the bulkhead or deck.

3.3.3. Arrangements of cargo handling equipment rooms are to be such as to ensure safe unrestricted access for personnel wearing protective clothing and breathing apparatus, and in the event of injury to allow unconscious personnel to be removed. All valves necessary for cargo handling are to be readily accessible to personnel wearing protective clothing. Suitable arrangements are to be made to deal with drainage of cargo handling rooms.

3.3.4. *Cargo handling equipment rooms may not contain electrical equipment, except as provided for in Chapter 10, or other ignition sources such as internal combustion engines or steam engines with operating temperature which could cause ignition or explosion of mixtures of gases, if any, with air.*

3.4 Cargo control rooms

3.4.1. Any cargo control room are to be above the weather deck and may be located in the cargo area. The cargo control room may be located within the accommodation spaces, service spaces or control stations provided the following conditions are complied with:

- .1. the cargo control room is a gas-safe space; and
- .2.1. if the entrance complies with 3.2.4, the control room may have access to the spaces described above;
- .2.2. if the entrance does not comply with 3.2.4, the control room is to have no access to the spaces described above and the boundaries to such spaces are to be insulated to A-60 class integrity.

3.4.2. If the cargo control room is designed to be a gas-safe space, instrumentation is to, as far as possible, be by indirect reading systems and is to in any case be designed to prevent any escape of gas into the atmosphere of that space. Location of the gas detector within the cargo control room will not violate the gas-safe space if installed in accordance with 13.6.5.

3.4.3. If the cargo control room is a gas-dangerous space, sources of ignition are to be excluded. Consideration is to be paid to the safety characteristics of any electrical installations.

3.5 Access to spaces in the cargo area

3.5.1. Visual inspection is to be possible of at least one side of the inner hull structure without the removal of any fixed structure or fitting. If such a visual inspection, whether combined with those inspections required in 3.5.2, 4.7.7 or 4.10.16 or not, is only possible at the outer face of the inner hull, the inner hull is not to be a fuel-oil tank boundary wall.

3.5.2. Inspection of one side of any insulation in hold spaces is to be possible. If the integrity of the insulation system can be verified by inspection of the outside of the hold space boundary when tanks are at service temperature, inspection of one side of the insulation in the hold space need not be required.

3.5.3. Arrangements for hold spaces, void spaces and other spaces that could be considered gas-dangerous and cargo tanks are to be such as to allow entry and inspection of any such space by personnel wearing protective clothing and breathing apparatus and in the event of injury to allow unconscious personnel to be removed from the space and are to comply with the following:

.1. Access is to be provided:

.1.1. *in general and if possible* to cargo tanks direct from the open deck;

.1.2. through horizontal openings, hatches or manholes, the dimensions of which are to be sufficient to allow a person wearing a breathing apparatus 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 are to be not less than 600 mm x 600 mm; and

.1.3. through vertical openings, or manholes providing passage through the length and breadth of the space, the minimum clear opening of which are to be not less than 600 mm by 800 mm at a height of not more than 600 mm from the bottom plating unless gratings or other footholds are provided.

.2. The dimensions referred to in 3.5.3.1.2 and .1.3 may be decreased if the ability to traverse such openings or to remove an injured person can be proved to the satisfaction of the Society.

.3. The requirements of 3.5.3.1.2 and .1.3 do not apply to spaces described in 1.3.17.5. Such spaces are to be provided only with direct or indirect access from the open weather deck, not including an enclosed gas-safe space.

.4. *when access is not possible due to the design then alternative means of inspection are to be provided and submitted for special consideration by the Society*

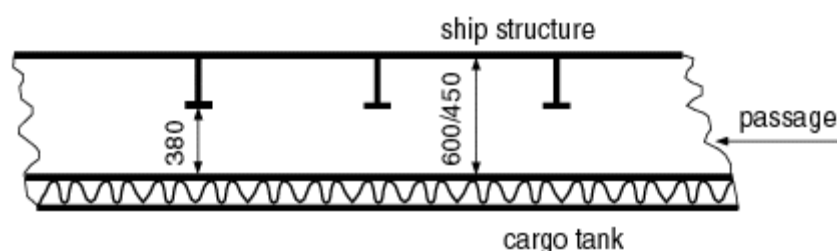
3.5.4. Access from the open weather deck to gas-safe spaces are to be located in a gas-safe zone at least 2.4 m above the weather deck unless the access is by means of an air-lock in accordance with 3.6.

3.5.5. *Designated passageways below and above cargo tanks are to have at least the cross-sections as specified in 3.5.3.1.*

3.5.6. *For the purpose of the requirements in 3.5.1 and 3.5.2, the following applies:*

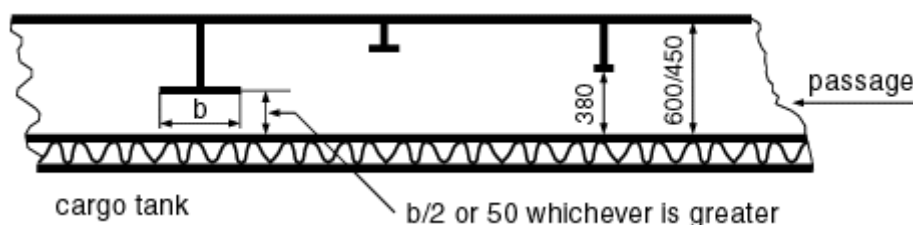
Where the Surveyor needs to pass between the flat or curved surface to be inspected and structural elements such as deck beams, stiffeners, frames, girders etc., the distance between that surface and the free edge of the structural elements is to be at least 380 mm. The distance between the surface to be inspected and the surface to which the above structural elements are fitted, e.g. deck, bulkhead or shell, is to be at least 450 mm in the case of a curved tank surface (e.g. type C-tank) or 600 mm in case of a flat tank surface (e.g. type B-tank) (see Fig 3.2).

Figure 3.2 : Minimum passage over cargo tanks



Where the Surveyor does not need to pass between the surface to be inspected and any part of the structure, for visibility reasons the distance between the free edge of that structural element and the surface to be inspected is to be at least 50 mm or half the breadth of the structure's face plate, whichever is the greater (see Fig 3.3).

Figure 3.3: Minimum distance of structures from cargo tank to allow visual inspection



If for inspection of a curved surface the Surveyor needs to pass between that surface and another flat or curved surface, to which no structural elements are fitted, the distance between both surfaces is to be at least 380 mm (see Fig 3.4). Where the Surveyor does not need to pass between a curved surface and another surface, a smaller distance than 380 mm may be accepted taking into account the shape of the curved surface.

If for inspection of an approximately flat surface the Surveyor needs to pass between two approximately flat and approximately parallel surfaces, to which no structural elements are fitted, the distance between those surfaces is to be at least 600 mm (see Fig 3.5).

The minimum distances between a cargo tank sump and adjacent double bottom structure in way of a suction well may not be less than that defined in Fig 3.6. If there is no suction well, the distance between the cargo tank sump and the inner bottom may not be less than 50 mm.

The distance between a cargo tank dome and deck structures may not be less than 150 mm (see Fig 3.7).

Where necessary for inspection, fixed or portable staging is to be installed. This staging may not impair the distances specified in 3.5.3.

Where fixed or portable ventilation ducting is to be fitted in compliance with 12.2, such ducting may not impair the distances specified in 3.5.3.

Figure 3.4: Minimum passage between curved surfaces

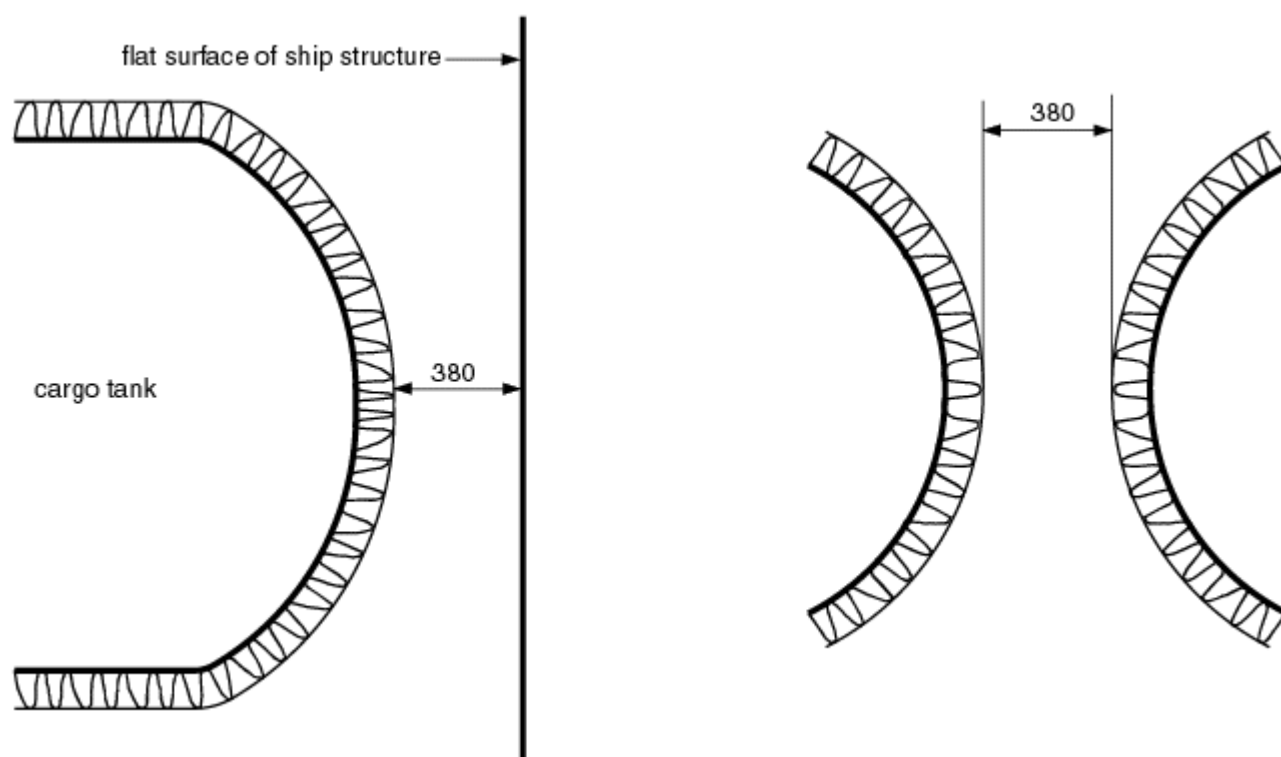


Figure 3.5 : Minimum passage between flat surfaces

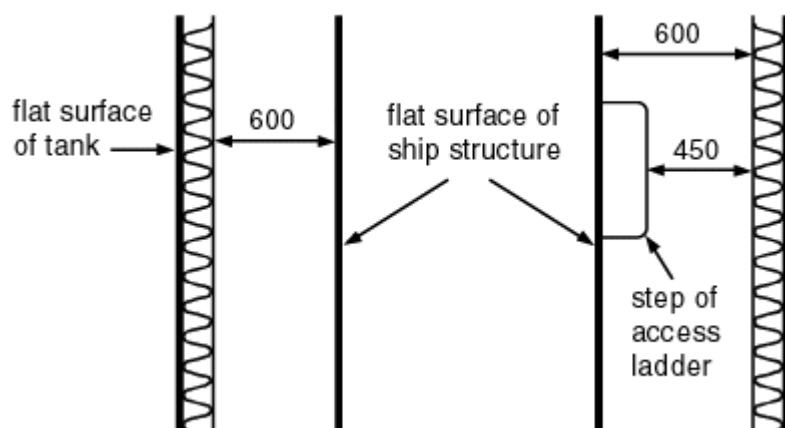


Figure 3.6: Minimum distance of cargo tank sump and inner bottom

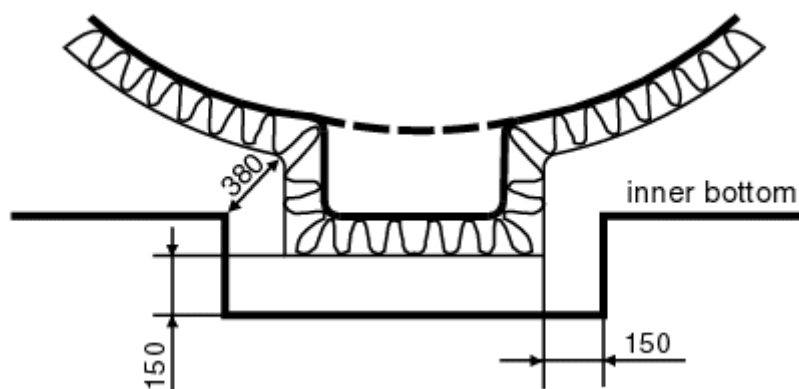
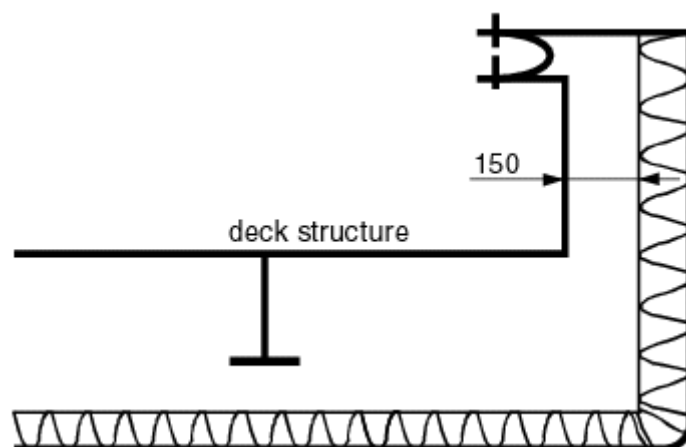


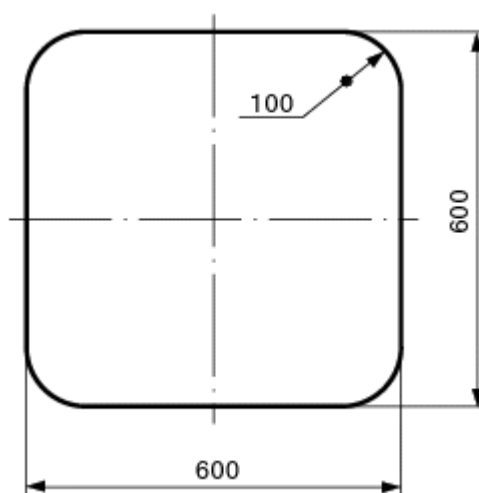
Figure 3.7: Minimum distance between cargo dome and deck structures



For the purpose of the requirements in 3.5.3, the following applies:

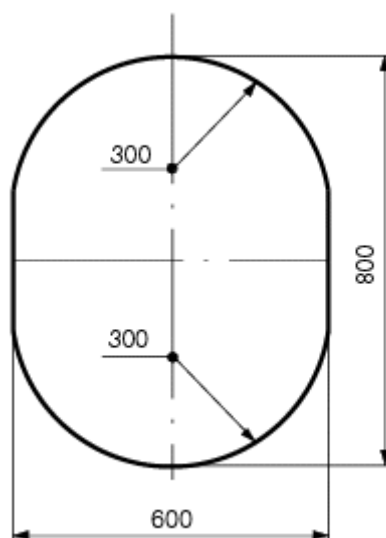
The term "minimum clear opening of not less than 600 x 600 mm" means that such openings may have corner radii up to a maximum of 100 mm (see Fig 3.8).

Figure 3.8: Minimum horizontal hatch size



The term "minimum clear opening of not less than 600 x 800 mm" also includes an opening of the size specified in Fig 3.9:

Figure 3.9: Minimum size of manholes



Circular access openings in type C cargo tanks are to have diameters of not less than 600 mm.

Where fitted, cofferdams are to have sufficient size for easy access to all their parts. The width of the cofferdams may not be less than 600 mm.

Pipe tunnels are to have enough space to permit inspection of pipes. The pipes in pipe tunnels are to be installed as high as possible from the ship's bottom

Access to pipe tunnels through manholes in the engine space is not permitted.

3.6 Air-locks

3.6.1. An airlock is to be only permitted between a gas-dangerous zone on the open weather deck and a gas-safe space and is to consist of two steel doors substantially gastight spaced at least 1.5 m but not more than 2.5 m apart.

Air-locks are to be such as to provide easy passage and are to cover a deck area of not less than 1.5 m². Air-locks are to be kept unobstructed and may not be employed for other uses, such as storage.

3.6.2. The doors are to be self-closing and without any holding back arrangements.

3.6.3. An audible and visual alarm system to give a warning on both sides of the airlock are to be provided to indicate if more than one door is moved from the closed position.

The alarm systems are to be of the intrinsically safe type. However, signalling lamps may be of a safe type authorised for the dangerous spaces in which they are installed

3.6.4. In ships carrying flammable products, electrical equipment which is not of the certified safe type in spaces protected by airlocks are to be de-energized upon loss of overpressure in the space (see also 10.2.5.4). Electrical equipment which is not of the certified safe type for manoeuvring, anchoring and mooring equipment as well as the emergency fire pumps are not to be located in spaces to be protected by airlocks.

The following means are considered acceptable alternatives to differential pressure sensing devices in spaces having a ventilation rate not less than 30 air changes per hour:

- *Monitoring of current or power in the electrical supply to the ventilation motors; or*
- *Air flow sensors in the ventilation ducts.*

In spaces where the ventilation rate is less than 30 air changes per hour and where one of the above alternatives is fitted, in addition to the alarms required in 3.6.3, arrangements are to be made to de-energise electrical equipment which is not of the certified safe type if more than one air-lock door is moved from the closed position.

3.6.5. The airlock spaces are to be mechanically ventilated from a gas-safe space and maintained at an overpressure to the gas-dangerous zone on the open weather deck.

The spaces protected by air-locks are to be ventilated for the time necessary to give at least 10 air changes prior to energising the non-safe type electrical installations.

3.6.6. The airlock spaces are to be monitored for cargo vapour.

3.6.7. Subject to the requirements of the International Convention on Load Lines in force, the door sill is not to be less than 300 mm in height.

3.7 Bilge, ballast and fuel oil arrangements

3.7.1.1. Hold spaces are to be provided with suitable drainage arrangements not connected with the machinery space. Means of detecting any leakage are to be provided.

3.7.1.2.. N/A

3.7.2.1. N/A

3.7.2.2.. N/A

3.7.3. N/A

3.7.4. Ballast spaces, including wet duct keels used as ballast piping, fuel-oil tanks and gas-safe spaces may be connected to pumps in the machinery spaces. Dry duct keels with ballast piping passing through, may be connected to pumps in the machinery spaces, provided the connections are led directly to the pumps and the discharge from the pumps lead directly overboard with no valves or manifolds in either line which could connect the line from the duct keel to lines serving gas-safe spaces. Pump vents are not to be open to machinery spaces.

3.7.5. Dry spaces within the cargo area are to be fitted with a bilge or drain arrangement not connected to the machinery space. Spaces not accessible at all times are to be fitted with sounding arrangements. Spaces without a permanent ventilation system are to be fitted with a pressure/vacuum relief system or with air pipes.

Bilge arrangements for holds containing cargo tanks are to be operable from the weather deck.

The diameter of the bilge main may be smaller than the diameter specified in Ship Rules, Pt C, Ch 1, Sec 10, [6.8.1], provided that this diameter is not less than twice the value given in Ship Rules, Pt C, Ch 1, Sec 10, [6.8.3]. This reduction of diameter, however, is not applicable to the determination of the capacity of fire pumps according to Ship Rules, Pt C, Ch 1, Sec 10, [6.7.4].

With reference to the means to ascertain leakages in holds, the following requirements apply:

- *The above-mentioned means is to be suitable to ascertain the presence of water in holds containing type C independent tanks*
- *The above-mentioned means is to be suitable to ascertain the presence of condensate cargo in the spaces adjacent to cargo tanks which are not type C independent tanks.*

Where the aforesaid spaces may be affected by water leakages from the adjacent ship structures, the means is also to be suitable to ascertain the presence of water.

Where the above-mentioned means is constituted by electrical level switches, the relevant circuits are to be of the intrinsically safe type and signals are to be transduced to the wheelhouse and to the cargo control station, if fitted.

3.8 Bow or stern loading and unloading arrangements

3.8.1. Subject to the requirements of this section, cargo piping may be arranged to permit bow or stern loading and unloading.

3.8.1.1. N/A.

3.8.2. Portable arrangements are not to be permitted.

3.8.3. In addition to the requirements of chapter 5 the following provisions apply to cargo piping and related piping equipment:

.1. Cargo piping and related piping equipment outside the cargo area is to have only welded connections. The piping outside the cargo area is to run on the open deck and are to be at least 760 mm inboard except for athwartships shore connection piping. Such piping are to 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 is also to be capable of being separated by means of a removable spool piece and blank flanges when not in use.

.2. The piping is to be full penetration butt welded, and fully radiographed regardless of pipe diameter and design temperature. Flange connections in the piping are only permitted within the cargo area and at the shore connection.

.3. Arrangements are to be made to allow such piping to be purged and gas-freed after use. When not in use, the spool pieces are to be removed and the pipe ends be blank-flanged. The vent pipes connected with the purge are to be located in the cargo area.

3.8.4. Entrances, air inlets and openings to accommodation spaces, service spaces, machinery spaces and control stations are not to face the cargo shore connection location of bow or stern loading and unloading arrangements. They are to be located on the outboard side of the superstructure or deckhouse at a distance of at least 4% of the length of the ship but not less than 3 m from the end of the superstructure or deck 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 deckhouse within the distance mentioned above are to 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 deckhouse side are to be kept closed. Where, in the case of small ships, compliance with 3.2.4 and this paragraph is not possible, the Society may approve relaxations from the above requirements.

3.8.5. Deck openings and air inlets to spaces within distances of 10 m from the cargo shore connection location are to be kept closed during the use of bow or stern loading or unloading arrangements.

3.8.6. Electrical equipment within a zone of 3 m from the cargo shore connection location are to be in accordance with chapter 10.

3.8.7. Fire-fighting arrangements for the bow or stern loading and unloading areas are to be in accordance with 11.3.1.3 and 11.4.7.

Devices to stop cargo handling equipment and to close cargo valves are to be fitted in a position from which it is possible to keep under control the loading/unloading manifolds.

3.8.8. Means of communication between the cargo control station and the shore connection location are to be provided and if necessary certified safe.

3.8.9. In case of turret mooring the requirements of the STL notation are to be fulfilled.

4. Cargo Containment

4.1 General

4.1.1 N/A

4.1.2. In addition to the definitions in 1.3, the definitions given in this chapter apply throughout this Rule Note.

Independent cargo containment systems of the following types are considered in this Rule Note:

- *Full metal pressure vessels*
- *Composite reinforced pressure vessels*
- *Full composite pressure vessels.*

Their design and construction are to comply with relevant Recognised Codes and Standards within their limits of validity (i.e. High Pressure Vessel Code for a tank like design or Piping Code for a piping like design such as BV PV code, ASME BPV Codes, Code Case 2390 "Composite Reinforced Pressure Vessels (CRPV)", BS 5500, CODAP, ANSI B31.3, etc.). As an alternative, the requirements of 4.4, 4.5, 4.9, 4.10, 4.11 and 4.13 can be used.

The applicability of Codes and Standards to sea going containment system is to be demonstrated Subject to special consideration by the Society these Codes and Standards may be amended to take into account specificities of the proposed design.

The "leak before failure" principle is to be used for the design of cargo tanks

In general accesses are to be provided to allow for external and internal inspection of cargo tanks. Reference is made to the designer/manufacturer specifications.

If internal or external inspection is not possible then alternative means of inspection are to be provided and submitted for special consideration by the Society

4.2 Definitions

4.2.1 N/A

4.2.2 N/A

4.2.3 N/A

4.2.4 Cargo tanks

4.2.4.1. Independent tanks are self-supporting; they do not form part of the ship's hull and are not essential to the hull strength.

There are two types of cargo tanks:

- *Type 1. cargo tanks - cargo tanks consisting of long length small diameter (less than 200 mm) coiled pressurized piping supported independently up to first stop valve.*
- *Type 2. cargo tanks – cargo tanks consisting of assembly of multiple individual vertical or horizontal cylindrical pressure vessels connected by a common manifold and supported individually inside the cargo hold up to first stop valve. Type two tanks can be metallic, composites and hybrids (combination of metallic and non-metallic materials).*

There are two categories of Cargo tanks referred to in 4.2.4.3 and 4.2.4.4.

4.2.4.2. N/A

4.2.4.3. Type B independent tanks are tanks which are designed using model tests, refined analytical tools and analysis methods to determine stress levels, fatigue life and crack propagation characteristics.

4.2.4.4. Type C independent tanks (also referred to as pressure vessels) are tanks meeting pressure vessel criteria

However, the Society may allocate a tank complying with the criterion of this subparagraph to type B, dependent on the configuration of the tank and the arrangement of its supports and attachments.

4.2.5 N/A

4.2.6 Design vapour pressure

4.2.6.1. The design vapour pressure P_0 is the maximum gauge pressure at the top of the tank which has been used in the design of the tank.

4.2.6.2. For cargo tanks where there is no temperature control and where the pressure of the cargo is dictated only by the ambient temperature, P_0 is not to be less than the gauge pressure of the cargo at a temperature of 45°C. However, lesser values of this temperature may be accepted by the Society 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. Conversely, higher values of this temperature may be required for ships permanently operating in areas of high ambient temperature.

4.2.6.3. In all cases, including 4.2.6.2, P_0 is not to be less than MARVS.

4.2.6.4. N/A

4.2.7 Design temperature

The design temperature for selection of materials is the minimum temperature at which cargo may be loaded or transported in the cargo tanks. Provisions to the satisfaction of the Society are to be made to ensure that the tank or cargo temperature cannot be lowered below the design temperature.

Possibilities to have lower temperatures due to blow down, leak or jet impingement are to be considered.

4.3 Design loads

4.3.1 General

4.3.1.1. Tanks together with their supports and other fixtures are to be designed taking into account proper combinations of the following loads:

- internal pressure
- external pressure
- dynamic loads due to the motions of the ship
- thermal loads
- loads corresponding to ship deflection
- tank and cargo weight with the corresponding reactions in way of supports
- insulation weight
- Loads in way piping connections and other attachments.
- *Cargo transfer liquid head*
- Cyclic loads
- Accidental loads
- *Residual loads due to fabrication*

The extent to which these loads are to be considered depends on the type of tank, and is more fully detailed in the following paragraphs.

4.3.1.2. Account is to be taken of the loads corresponding to the pressure test referred to in 4.10.

4.3.1.3.. N/A