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RULES CHANGE NOTICE No. 2
Part 1 Seagoing Ships

RULES FOR SHIPS CARRYING LIQUEFIED GASES IN BULK

Volume IX

May 2024

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Foreword

This Rules Change Notices (RCN) No.2 provide amendment and corrigenda to the Rules for Ships Carrying Liquefied Gases in Bulk Consolidated Edition 2022 along with effective date from which these changes are applicable.

Amendments to the preceding edition are marked by strikethrough, red color, and expanded text. However, if the changes involves the whole section or sub section normally only the title will be in red colour. These new additions and amendments are to be read in conjunction with the requirements given in the 2022 Consolidated Edition; Corrigenda No.1-April 2022; and RCN No.1-October 2023 of the Rules.

The summary of current amendments for each section including the implementation date are indicated in *Table 1 - Amendments Incorporates in This Notice*.

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Any quires or comments concerning these Rules are welcomed through communication with BKI Head Office.

Rules Changes Notice No. 2 – May 2024

Table 1 – Amendments Incorporates in This Notice

These amendments will come into force for ship contracted for construction on or after 1 July 2024 unless otherwise specified in table.

Paragraph	Title/Subject	Status/Remark
Section 1 – General, Character of Classification, Definitions, Surveys and Certification		
A.	**General**	
A.4.	-	To update the references of IMO resolution which adopted in this Rules as mentioned in IGC Code (ref. IACS UR G2 Rev.3). Also, to modify the paragraph structure for better understanding
A.5.	Notes	To clarify the requirements
A.7	**Application and implementation of the IGC-Code**	
A.7.6	**Product not covering in IGC-Code Chapter 19**	
A.7.6.1	-	To change term “Code” by “IGC-Code” for better understanding
A.7.8	-	To remove amendment version of IGC-Code and to change term “Code” by “IGC-Code” for better understanding.
A.7.9-7.12	-	To change term “Code” by “IGC-Code” for better understanding
D.	**Surveys and Certification**	
D.2	**Survey and certification according to IGC- Code**	
D.2	Survey and certification according to IGC- Code	To remove the amendment version for better understanding
Section 2 – Ship Survival Capability and Location of Cargo Tanks		
2.7	**Survival requirements**	
2.7.1.1	-	To add requirements according to Res.MSC.492(104)
2.7.2	Notes	To add interpretation reference according to IACS UI GC 17 and corrigenda
Section 3 – Ship Arrangements		
3.2	**Accommodation, service and machinery spaces and control stations**	
3.2.5	-	To partially delete the requirement according to Res.MSC.411(97)
3.2.6	Notes	To add interpretation & reference according to IACS UI GC 15
3.5	**Access to spaces in the cargo area**	
3.5.3.1	Notes	To add interpretation reference according to IACS UI GC 16
3.7	**Bilge, ballast and oil fuel arrangements**	
3.7.5	Note	To modify interpretation and to add reference according to IACS UI GC 14
Section 4 – Cargo Containment		
4.6	**Design of secondary barriers**	
4.6.2.4	Notes	To add interpretation reference according to IACS UI GC 12

Paragraph	Title/Subject	Status/Remark
4.19	**Materials**	
4.19.1.6	Notes	To add interpretation reference according to IACS UI GC 23
4.20	**Construction processes**	
4.20.1	**Weld joint design**	
4.20.1.1	Notes	To add interpretation reference according to IACS UI GC 20
4.20.1.2	Notes	To add interpretation reference according to IACS UI GC 21
4.20.3	**Testing**	
4.20.3.5 & 4.20.3.7	-	To add interpretation & reference according to IACS UI GC 13
4.23	**Type C independent tanks**	
4.23.1	**Design basis**	
C4.23.1.1	-	To add reference for finite element analysis procedure for single cylinder and multi-lobe shape type C tanks as mentioned in IACS Rec. 174.
4.23.1.2	-	To add interpretation reference according to IACS UI GC 7
4.23.3	**Ultimate design condition**	
C4.23.3.3	-	To add interpretation reference according to IACS UI GC 8
Section 5 – Process Pressure Vessels and Liquid, Vapour and Pressure Piping Systems		
5.4	**Design pressure**	
5.4.4	Notes	To add interpretation & reference according to IACS UI GC 32
5.6	**Cargo transfer arrangements**	
5.6.5	**Cargo sampling connections**	
5.6.5.1	Note	To add interpretation & reference according to IACS UI GC 33
5.6.6	Cargo filters - Notes	To add interpretation & reference according to IACS UI GC 34
5.9	**Welding, post-weld heat treatment and non-destructive testing**	
5.9.3	**Non-destructive testing**	
5.9.3.1	-	Corrigenda according to MSC 93/22/Add.1/Corr.5
5.11	**Piping system component requirements**	
5.11.2.2	-	Corrigenda in formula explanation
5.11.6	**Flanges, valves and fittings**	
5.11.6.3		Corrigenda according to MSC 93/22/Add.1/Corr.5
5.12	**Materials**	
5.12.1	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
5.12.3.1	Notes	To add interpretation reference according to IACS UI GC 25
5.13	**Testing requirements**	
5.13.1	**Type testing of piping components**	

Paragraph	Title/Subject	Status/Remark
5.13.1.1	**Valves**	
5.13.1.1.4	Note	To add interpretation reference according to IACS UI GC 24
5.13.2.4	-	To add reference according to Note in 5.4.4
C.5.14	Cargo Pumps and Gas/ Reliquefication/ Refrigeration Compressors	To supersede the requirements according to IACS UR G3 *The amendments are effective on ships constructed on or after 1 January 2025*
Section 6 – Materials of Construction and Quality Control		
6.5	**Welding of metallic materials and non-destructive testing**	
6.5.3	**Welding procedure tests for cargo tanks and process pressure vessels**	
6.5.3.5	-	Corrigenda in accordance with Res.MSC.476(102)
Section 7 – Cargo Pressure/Temperature Control		
7.8	**Availability**	
7.8.4	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
Section 8 – Vent Systems for Cargo Containment		
8.1	**General** - Notes	To modify the notes according to interpretation of IACS UI GC 28.
8.2	**Pressure relief systems**	
8.2.18	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
8.4	**Sizing of pressure relieving system**	
8.4.1	**Sizing of pressure relief valves**	
8.4.1.2	Notes	To add interpretation reference according to IACS UI GC 19
C.8.5	**Pressure relief device**	
C.8.5.1	**General**	
C8.5.1.2	-	To add interpretation reference according to IACS UI GC 28
Section 11 – Fire Protection and Extinction		
11.1	**Fire safety requirements**	
11.1.1	-	To change term “Code” by “IGC-Code” for better understanding
11.1.4	-	To add reference according to Note in 11.3.6
11.2	**Fire mains and hydrants**	
11.2.1	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
11.3	**Water-spray system**	
11.3.1.4	Notes	To add interpretation & reference according to IACS UI GC 39
11.3.1.7	Notes	To add interpretation reference according to IACS UI GC 22
11.3.3.1	Notes	To add interpretation reference according to IACS UI GC 22
11.3.4	Notes 1	To add interpretation & reference according to IACS UI GC 22
11.3.4	Notes 2	To add interpretation & reference according to IACS UI GC 30

Paragraph	Title/Subject	Status/Remark
11.3.6	Notes	To add interpretation & reference according to IACS UI GC 38
11.4	**Dry chemical powder fire-extinguishing systems**	
11.4.1	-	To add reference according to Note in 11.3.1.4
11.4.3	-	To add reference according to Note in 11.3.1.4
11.4.8	Notes	To add interpretation reference according to IACS UI GC 31
Section 13 – Instrumentation and Automation Systems		
13.2	**Level indicators for cargo tanks**	
13.2.2	Notes	To add interpretation reference according to IACS UI GC 27
13.3	**Overflow control**	
13.3.5	Notes	To add interpretation reference according to IACS UI GC 18
13.6	**Gas detection**	
13.6.4	-	Corrigenda according to MSC 93/22/Add.1/Corr.5
13.6.4	Notes	To add interpretation reference according to IACS UI GC 36
13.6.11	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
13.9	**System integration**	
13.9.3	Notes	To add interpretation reference according to IACS UI GC 29
Section 16 – Use of Cargo as Fuel		
16.4	**Gas fuel supply**	
16.4.6	**Spaces containing gas consumers**	
16.4.6.1	Note	To change term “Society” by “BKI” for better understanding.
16.7	**Special requirements for gas-fired internal combustion engines**	
16.7.1.4	Notes	To add interpretation & reference according to IACS UI GC 37
16.9	**Alternative fuels and technologies**	
16.9.5	-	Corrigenda according to MSC 93/22/Add.1/Corr.3
Section 17 – Special Requirements		
17.8	**Inhibition**	
17.8.4	-	To supersede requirement regarding inhibitors
Section 18 – Operating Requirements		
18.9	**Cargo sampling**	
18.9.1 & 18.9.5	Footnote	To add reference according to Note in 5.6.5.1
18.10	**Cargo emergency shutdown (ESD) system**	
Table 18.1	Footnote	To add interpretation & reference according to IACS UI GC 35
18.10.2.1.2	-	To supersede requirement regarding ESC valve

Paragraph	Title/Subject	Status/Remark
18.10.3.2	-	To add reference according to Note in 11.3.1.4

Section 1 General, Character of Classification, Definitions, Surveys and Certification

A. General

1. These Rules apply to ships having their machinery aft and built for the carriage in bulk of liquefied gases and some other products which are listed in Section 19.

2. In addition to these Rules the relevant requirements of Rules for Classification and Surveys (Part 1, Vol. I), Rules for Hull (Pt. 1, Vol. II) Sec. 1 through 22, 24 and 36 through 38 apply.

3. For the machinery, the electrical plant and the refrigerating installation of these ships, Rules for Machinery Installations (Pt. 1, Vol. III), Rules for Electrical Installations (Pt. 1, Vol. IV) and Rules for Automation (Pt. 1, Vol. VII), apply.

4. These Rules incorporate the ~~IMO-Resolution MSC.5 (48)~~ "International Code for the Construction and Equipment of Ships carrying liquefied Gases in Bulk" (IGC-Code), ~~1993~~ 2014 edition as amended by IMO Resolutions MSC.370(93), MSC.411(97), MSC.441(99), MSC.476(102), MSC.492(104). ~~Specific requirements of BKI which are additional to the provisions of the IGC-Code have been identified by a special paragraph. No. (e.g. C3.5) and highlighted.~~

Differing from the standard construction of the Rules, which is given in this Section 1, Sections 2 – 19 for direct comparison with the IGC-Code are arranged accordingly with additional and alteration as necessary.

In the following Sections (Section 2 to Section 19), specific requirements of BKI which are additional to the provisions of the IGC-Code have been identified by a special paragraph number (e.g. C3.5) or highlighted.

For interpretation of IGC-Code, Guidance for Code and Convention Interpretation (Pt.1, Vol.Y) is to be observed.

5. Certain requirements of the IGC-Code that are not within the scope of classification, e.g. paragraph 6. "Equivalents", Section 14, "Personnel Protection", certain operational requirements in Section 17 "Special Requirements" and Section 18 "Operating Requirements" have been included in these rules.

Except for paragraph 6 and for operational requirements as mentioned above they will, however, be applied in such instances where

.1 BKI is authorized by Administrations to issue on their behalf the "Certificate of Fitness for the Carriage of Liquefied Gases in Bulk" or where

.2 BKI 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 Liquefied Gases in Bulk" will be issued by the Administrations, or where

.3 BKI is requested to certify compliance with the IGC-Code and BKI will also issue a Statement of Compliance with respect to all or part of the IGC Code for the purpose of confirming to National Authorities that the ship complies fully with the applicable requirements.

Notes:

~~The term "should be" in the respective Paragraphs or Sections is in such cases to be read as "is" or "are to be" or "Shall be"~~. Operating Requirements have been included for guidance only and will not be looked at by the BKI.

For the purpose of classification, the words "Administration" and "Code", wherever mentioned, are to be understood as equivalent to the words "BKI" and "Rules", respectively.

However, for exemptions, waivers, and equivalents, are to be given by Administration.

~~Alterations to the preceding Edition are marked by red colour and expanded text.~~

----------*end*----------

7. Application and implementation of the IGC-Code

7.6 Product not covering in IGC-Code Chapter 19

7.6.1 Where it is proposed to carry products which may be considered to come within the scope of the IGC-Code but are not at present designated in Chapter 19[1] of the IGC-Code, the Administrations and the Port Administrations involved in such carriage shall establish a Tripartite Agreement based on a provisional assessment and lay down preliminary suitable conditions of carriage based on the principles of the IGC-Code.

7.6.2 For the evaluation of such products, the manufacturer of the product shall submit to the Administration a completed assessment form (see Appendix 1 of this Rules), which includes the proposed ship type and carriage requirements.

7.6.3 When a provisional assessment for a pure or technically pure product has been completed and agreed with the other parties, the Administration shall submit the assessment form and a proposal for a new and complete entry in the IGC-Code, to the relevant sub-committee of the Organization (see Appendix 1 of this Rules).

7.6.4 After provisional assessment by Tripartite Agreement and express or tacit agreement has been established, an addendum to the relevant ship's certificate may be issued (see Appendix 3 of the IGC-Code).

7.7 Ships carrying one or more cargo which are cover in both of IGC Code and IBC Code

7.7.1 The requirements of the IGC-Code should take precedence when a ship is designed and constructed for the carriage of the following products:

.1 those listed exclusively in Section 19 of these Rules[1]; and

.2 one or more of the products which are listed both in Section 19 of these Rules[1] and Rules for Carrying Dangerous Chemical in Bulk (Pt. 1, Vol. X), Sec. 172. These products are marked with an asterisk (*) in column "a" of Section 19.

7.7.2 When a ship is intended exclusively to carry one or more of the products noted in 7.7.1.2 the requirement of Rules for Carrying Dangerous Chemical in Bulk (Pt. 1, Vol. X), i.e. those of the IBC-Code as amended shall apply.

7.8 The ship's compliance with the requirements of the International Gas Carrier Code shall be shown by its International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk, as described in International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC-Code)~~, as amended by IMO Resolution MSC. 370(93)~~ Chapter 1.4. Compliance with the amendments to the

[1] Chapter 19 of the IGC-Code corresponds to Section 19 of this Rules.
[2] Chapter 17 of the IBC-Code corresponds to Rules for Carrying Dangerous Chemical in Bulk (Pt. 1, Vol. X), Sec. 17.

IGC-Code, as appropriate, should also be indicated in the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk.

7.9 Where reference is made in the IGC-Code to a paragraph, all the provisions of the subparagraph of that designation shall apply.

7.10 When a ship is intended to operate for periods at a fixed location[3] in a re-gasification and gas discharge mode or a gas receiving, processing, liquefaction and storage mode, the Administration and port Administrations involved in the operation shall take appropriate steps to ensure implementation of the provisions of the IGC-Code as are applicable to the proposed arrangements. Furthermore, additional requirements shall be established based on the principles of the IGC-Code as well as recognized standards that address specific risks not envisaged by it. Such risks may include, but not be limited to:

.1 fire and explosion;

.2 evacuation;

.3 extension of hazardous areas;

.4 pressurized gas discharge to shore;

.5 high-pressure gas venting;

.6 process upset conditions;

.7 storage and handling of flammable refrigerants;

.8 continuous presence of liquid and vapour cargo outside the cargo containment system;

.9 tank over-pressure and under-pressure;

.10 ship-to-ship transfer of liquid cargo; and

.11 collision risk during berthing manoeuvres.

7.11 Where a risk assessment or study of similar intent is utilized within the Rule, the results shall also include, but not be limited to, the following as evidence of effectiveness:

.1 description of methodology and standards applied;

.2 potential variation in scenario interpretation or sources of error in the study;

.3 validation of the risk assessment process by an independent and suitable third party;

.4 quality system under which the risk assessment was developed;

.5 the source, suitability and validity of data used within the assessment;

.6 the knowledge base of persons involved within the assessment;

.7 system of distribution of results to relevant parties; and

.8 validation of results by an independent and suitable third party.

7.12 Although the IGC-Code is legally treated as a mandatory instrument under the SOLAS Convention, the provisions of Section 4.28 and Appendix 1, 3 and 4 of the IGC Code are recommendatory or informative.

[3] For classification of ship is intended to operate at a fixed location, the Guidelines for Floating Offshore Liquefied Gas Terminals (Pt. 5, Vol. 2), may also apply

----------*end*----------

D. Surveys and Certification

1. Surveys for class maintenance

The relevant requirements are given in Rules for Classification and Surveys (Pt. 1, Vol. I), Sec. 4-II, A.

2. Survey and certification according to IGC-Code

The relevant requirements are given in Rules for Classification and Surveys (Pt.1, Vol. I), Sec. 4-II, A. and also refer to International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)~~, as amended by IMO Resolution MSC. 370(93)~~ Chapter 1.4

----------*end*----------

Section 2 Ship Survival Capability and Location of Cargo Tanks

2.7 Survival requirements

Ships subject to the Rules shall be capable of surviving the assumed damage specified in 2.3, to the standard provided in 2.6, in a condition of stable equilibrium and shall satisfy the following criteria.

2.7.1 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 that 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 that 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 side scuttles of the non-opening type;

.2 the maximum angle of heel due to unsymmetrical flooding shall not exceed 30°; and

.3 the residual stability during intermediate stages of flooding shall not be less than that required by 2.7.2.1.

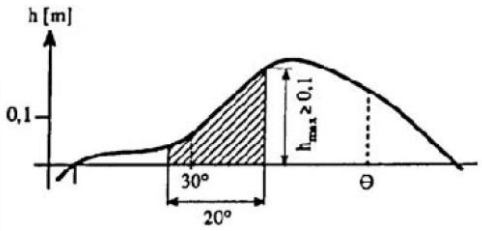
2.7.2 At final equilibrium after flooding:

.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. 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). 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 2.7.1.1 and other openings capable of being closed weathertight may be permitted; and

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

Notes[1]*:*

1. *The 20° range may be measured from any angle commencing between the position of equilibrium and the angle of 30° see Fig. C2.7.*



h = righting lever
Θ = progressive flooding angle

Fig. C2.7 Range of positive stability where the residual stability is to be evaluated

2. *Other openings capable of being closed weathertight do not include ventilators (complying with ICLL 19(4)) that for operational reasons have to remain open to supply air to the engine room or emergency generator*

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 17.

room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship.

----------*end*----------

Section 3 Ship Arrangements

3.2 Accommodation, service and machinery spaces and control stations

3.2.5 Windows and side scuttles facing the cargo area and on the sides of the superstructures and deckhouses within the limits specified in 3.2.4, except wheelhouse windows, shall be constructed to "A-60" class. ~~Wheelhouse windows shall be constructed to not less than "A-0" class (for external fire load).~~ Side scuttles in the shell below the uppermost continuous deck and in the first tier of the superstructure or deckhouse shall be of fixed (non-opening) type.

3.2.6 All air intakes, outlets and other openings into the accommodation spaces, service spaces and control stations shall be fitted with closing devices. When carrying toxic products, they shall be capable of being operated from inside the space. The requirement for fitting air intakes and openings with closing devices operated from inside the space for toxic products need not apply to spaces not normally manned, such as deck stores, forecastle stores, workshops. In addition, the requirement does not apply to cargo control rooms located within the cargo area.

Notes:

1. *Compliance with other relevant paragraphs of the Rules and in particular with paragraphs 3.2.4.1, 3.2.4.2, 3.2.4.3, 3.8, Section 8.2.10 and 12.1.6 where applicable would also ensure compliance with this paragraph.*
2. *Air outlets are subject to the same requirements as air inlets and air intakes. This interpretation also applies to paragraphs 3.2.2, 3.8.4.1, 3.8.4.2, 3.8.4.3, 3.8.4.4 and Section 8.2.10.*
3. *Doors facing the cargo area or located in prohibited zones in the sides are to be restricted to stores for cargo-related and safety equipment, cargo control stations as well as decontamination showers and eye wash.*

   The item 3.2.6 above is to be interpreted[1] as follows: ~~in accordance with Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Section 4, GC 15:~~

   a) *The closing devices that need not be operable from within the single spaces and may be located in centralized positions.*

   b) *Engine room casings, cargo machinery spaces, electric motor rooms and steering gear compartments are generally considered as spaces not covered by paragraph 3.2.6 and therefore the requirement for closing devices need not be applied to these spaces.*

   c) *The closing devices shall to give a reasonable degree of gas tightness. Ordinary steel fire-flaps without gaskets/seals shall not to be considered satisfactory.*

   d) *Regardless of this interpretation, the closing devices shall be operable from outside of the protected space (SOLAS regulation II-2/5.2.1.1).*

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3.5 Access to spaces in the cargo area

3.5.1 Visual inspection of at least one side of the inner hull structure shall be possible without the removal of any fixed structure or fitting. If such a visual inspection, whether combined with those inspections required in 3.5.2, Section 4.6.2.4 or 4.20.3.7 or not, is only possible at the outer face of the inner hull, the inner hull shall not be a fuel-oil tank boundary wall.

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 15.

3.5.2 Inspection of one side of any insulation in hold spaces shall 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, cargo tanks and other spaces classified as hazardous areas, shall be such as to allow entry and inspection of any such space by personnel wearing protective clothing and breathing apparatus and shall also allow for the evacuation of injured and/or unconscious personnel. Such arrangements shall comply with the following:

.1 Access shall be provided as follows:

1.1 access to all cargo tanks. Access shall be direct from the weather deck;

1.2 access through horizontal openings, hatches or manholes. The dimensions shall 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 shall be not less than 600 mm x 600 mm;

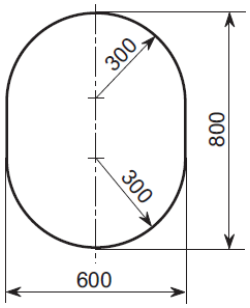
1.3 access through vertical openings or manholes providing passage through the length and breadth of the space. The minimum clear opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom plating unless gratings or other footholds are provided; and

Notes[2]*:*

For the purpose of subparagraph 3.5.3.1.2 and 3.5.3.1.3 the following applies:

1. *The minimum clear opening of 600 mm x 600 mm may have corner radii up to 100 mm maximum. In such a case where as a consequence of structural analysis of a given design the stress is to be reduced around the opening, it is considered appropriate to take measures to reduce the stress such as making the opening larger with increased radii, e.g. 600 x 800 with 300 mm radii, in which a clear opening of 600 mm x 600 mm with corner radii up to 100 mm maximum fits.*

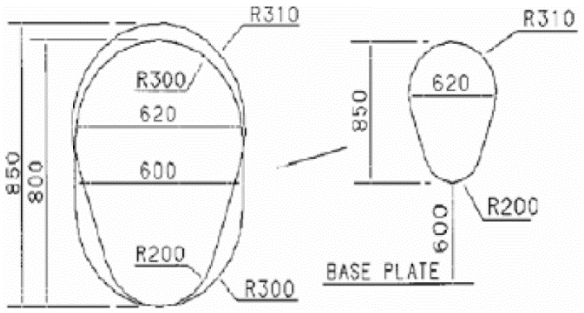
2. *The minimum clear opening of not less than 600 mm x 800 mm may also include an opening with corner radii of 300 mm. An opening of 600 mm in height x 800 mm in width may be accepted as access openings in vertical structures where it is not desirable to make large opening in the structural strength aspects, i.e. girders and floors in double bottom tanks.*



3. *Subject to verification of easy evacuation of injured person on a stretcher the vertical opening 850 mm x 620 mm with wider upper half than 600 mm, while the lower half may be less than 600 mm with the overall height not less than 850 mm is considered an*

[2] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 16.

acceptable alternative to the traditional opening of 600 mm x 800 mm with corner radii of 300 mm.



4. *If a vertical opening is at a height of more than 600 mm steps and handgrips are to be provided. In such arrangements it is to be demonstrated that an injured person can be easily evacuated.*

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3.7 Bilge, ballast and oil fuel arrangements

3.7.1 Where cargo is carried in a cargo containment system not requiring a secondary barrier, suitable drainage arrangements for the hold spaces that are not connected with the machinery space shall be provided. Means of detecting any leakage shall be provided.

3.7.2 Where there is a secondary barrier, suitable drainage arrangements for dealing with any leakage into the hold or insulation spaces through the adjacent ship structure shall be provided. The suction shall not lead to pumps inside the machinery space. Means of detecting such leakage shall be provided.

3.7.3 The hold or inter barrier spaces of type A independent tank ships shall be provided with a drainage system suitable for handling liquid cargo in the event of cargo tank leakage or rupture. Such arrangements shall provide for the return of any cargo leakage to the liquid cargo piping.

3.7.4 Arrangements referred to in 3.7.3 shall be provided with a removable spool piece.

3.7.5 Ballast spaces, including wet duct keels used as ballast piping, oil fuel tanks and non-hazardous 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 is led directly overboard with no valves or manifolds in either line that could connect the line from the duct keel to lines serving non-hazardous spaces. Pump vents shall not be open to machinery spaces.

Note[3]:

The requirements of ~~"Pump vents should not be open to machinery spaces" and~~ "Pump vents shall not be open to machinery spaces" apply only to pumps in the machinery spaces serving dry duct keels through which ballast piping passes.

----------*end*----------

[3] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 14.

Section 4 Cargo Containment

A. Cargo Containment

4.6 Design of secondary barriers

4.6.1 Where the cargo temperature at atmospheric pressure is not below -55°C, the hull structure may act as a secondary barrier based on the following:

.1 the hull material shall be suitable for the cargo temperature at atmospheric pressure as required by 4.19.1.4; and

.2 the design shall be such that this temperature will not result in unacceptable hull stresses.

4.6.2 The design of the secondary barrier shall be such that:

.1 it is capable of containing any envisaged leakage of liquid cargo for a period of 15 days, unless different criteria apply for particular voyages, taking into account the load spectrum referred to in 4.18.2.6;

.2 physical, mechanical, or operational events within the cargo tank that could cause failure of the primary barrier shall not impair the due function of the secondary barrier, or vice versa;

.3 failure of a support or an attachment to the hull structure will not lead to loss of liquid tightness of both the primary and secondary barriers;

.4 it is capable of being periodically checked for its effectiveness by means acceptable to the Administration or recognized organization acting on its behalf. This may be by means of a visual inspection or a pressure/vacuum test or other suitable means carried out according to a documented procedure agreed with the Administration;

Notes[1]***:***

1. *For effectiveness assessment of containment systems with glued secondary barriers:*
   - *At the time of construction, a tightness test should be carried out in accordance with approved system designers' procedures and acceptance criteria before and after initial cool down. Low differential pressures tests are not considered an acceptable test.*
   - *If the designer's threshold values are exceeded, an investigation is to be carried out and additional testing such as thermographic or acoustic emissions testing should be carried out.*
   - *The values recorded should be used as reference for future assessment of secondary barrier tightness.*
2. *For containment systems with welded metallic secondary barriers, a tightness test after initial cool down is not required.*

----------*end*----------

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 12.

D. Materials and construction

4.19 Materials

4.19.1 Materials forming ship structure

4.19.1.6 The means of heating referred to in 4.19.1.5 shall comply with the following requirements:

.1 the heating system shall be arranged so that, in the event of failure in any part of the system, standby heating can be maintained equal to not less than 100% of the theoretical heat requirement;

.2 the heating system shall be considered as an essential auxiliary. All electrical components of at least one of the systems provided in accordance with 4.19.1.5.1 shall be supplied from the emergency source of electrical power; and

.3 the design and construction of the heating system shall be included in the approval of the containment system by the Administration.

Notes[2]*:*

1. Heating system referred to in 4.19.1.6.1 is to be such that, in case of a single failure of a mechanical or electrical component in any part of the system, heating can be maintained at not less than 100% of the theoretical heat requirement.

2. Where the above requirements are met by duplication of the system components, i.e., heaters, glycol circulation pumps, electrical control panel, auxiliary boilers etc., all electrical components of at least one of the systems are to be supplied from the emergency source of electrical power.

3. Where duplication of the primary source of heat, e.g., oil-fired boiler is not feasible, alternative proposals can be accepted such as an electric heater capable of providing 100% of the theoretical heat requirement provided and supplied by an individual circuit arranged separately on the emergency switchboard. Other solutions may be considered towards satisfying the requirements of 4.19.1.6.1, provided a suitable risk assessment is conducted to the satisfaction of the Administration. The requirement in paragraph 2 of this note continues to apply to all other electrical components in the system.

----------*end*----------

4.20 Construction processes

4.20.1 Weld joint design

4.20.1.1 All welded joints of the shells of independent tanks shall be of the in-plane butt weld full penetration type. For dome-to-shell connections only, tee welds of the full penetration type may be used depending on the results of the tests carried out at the approval of the welding procedure. Except for small penetrations on domes, nozzle welds shall also be designed with full penetration.

Notes[3]*:*

The item 4.20.1.1 is applicable to independent tanks of type A or type B, primarily constructed of plane surfaces. This includes the tank corners which are constructed using bent plating which is aligned with the tank surfaces and connected with in-plane welds.

[2] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 23.
[3] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 20.

The applicability of the expression "For dome-to-shell connections only" is clarified as follows:

- *Welded corners (i.e. corners made of weld metal) shall not be used in the main tank shell construction, i.e. corners between shell side (sloped plane surfaces parallel to hopper or top side inclusive if any) and bottom or top of the tank, and between tank end transverse bulkheads and bottom, top or shell sides (sloped plane surfaces inclusive if any) of the tank. Instead, tank corners which are constructed using bent plating aligned with the tank surfaces and connected with in-plane welds are to be used.*
- *Tee welds can be accepted for other localised constructions of the shell such as suction well, sump, dome, etc. where tee welds of full penetration type shall also be used.*

4.20.1.2 Welding joint details for type C independent tanks, and for the liquid-tight primary barriers of type B independent tanks primarily constructed of curved surfaces, shall be as follows:

.1 all longitudinal and circumferential joints shall be of butt welded, full penetration, double vee or single vee type. Full penetration butt welds shall be obtained by double welding or by the use of backing rings. If used, backing rings shall be removed except from very small process pressure vessels. Other edge preparations may be permitted, depending on the results of the tests carried out at the approval of the welding procedure; and

.2 the bevel preparation of the joints between the tank body and domes and between domes and relevant fittings shall be designed according to a standard acceptable to the Administration. All welds connecting nozzles, domes or other penetrations of the vessel and all welds connecting flanges to the vessel or nozzles shall be full penetration welds.

Notes[4]***:***

The item 4.20.1.2 is applicable to type C independent tanks including bi-lobe tanks, primarily constructed of curved surfaces fitted with a centreline bulkhead.

The applicability of the expression "Other edge preparations" is clarified as follows:

- *Cruciform full penetration welded joints in a bi-lobe tank with centreline bulkhead can be accepted for the tank structure construction at tank centreline welds with bevel preparation subject to the approval of the Administration or recognised organisation acting on its behalf, based on the results of the tests carried out at the approval of the welding procedure.(see below Fig.C4.3)*

----------*end*----------

4.20.3 Testing

4.20.3.5 The overall performance of the cargo containment system shall be verified for compliance with the design parameters during the first cool-down, full loading and discharging of the cargo, in accordance with the survey procedure and requirements in Section 1, D and the requirements of the Administration[5]. Records of the performance of the components and equipment essential to verify the design parameters, shall be maintained and be available to the Administration.

4.20.3.6 Heating arrangements, if fitted in accordance with 4.19.1.5 and 4.19.1.6, shall be tested for required heat output and heat distribution.

4.20.3.7 The cargo containment system shall be inspected for cold spots during, or immediately following, the first loaded voyage[5]. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked shall be carried out in accordance with recognized standards.

----------*end*----------

[4] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 21.
[5] For interpretation may refer to Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 13.

E. Tank types

4.23 Type C independent tanks

4.23.1 Design basis

C4.23.1.1 The hull design shall be carried out according to main class requirements given in Rules for Hull (Pt.1, Vol. II). In addition, the present rules for Liquefied Gas Carriers, this section give additional design requirements for Liquefied Gas Carriers with independent type C tanks. The procedure for finite element analysis to assess yielding, buckling and fatigue strength should be refer to ke Guidance for Marine Industry (Pt.1, Vol.AC), Sec. 9, R-174.

4.23.1.1 The design basis for type C independent tanks is based on pressure vessel criteria modified to include fracture mechanics and crack propagation criteria. The minimum design pressure defined in 4.23.1.2 is intended to ensure that the dynamic stress is sufficiently low, so that an initial surface flaw will not propagate more than half the thickness of the shell during the lifetime of the tank.

4.23.1.2 Type C independent tanks (also referred to as pressure vessels) are tanks meeting pressure vessel criteria and having a design vapour pressure shall not be less than:

$$P_0 = 0{,}2 + A \cdot C \left(\rho_r\right)^{1{,}5} \text{ [Mpa]}$$

where:

$A = 0{,}00185 \cdot \left(\frac{\sigma_m}{\Delta\sigma_A}\right)^2$

σ_m = design primary membrane stress;

$\Delta\sigma_A$ = allowable dynamic membrane stress (double amplitude at probability level $Q = 10^{-8}$) and equal to:

= 55 N/mm^2 for ferritic-perlitic, martensitic and austenitic steel;

= 25 N/mm^2 for aluminium alloy (5083-O);

C = a characteristic tank dimension to be taken as the greatest of the following:

= max [h; 0,75·b; 0,45·ℓ]

h = tank (dimension in ship's vertical direction) [m];

b = tank (dimension in ship's transverse direction)[m];

ℓ = tank (dimension in ship's longitudinal direction) [m];

ρ_r = density of the cargo (ρ_r = 1 for fresh water) at the design temperature.

When a specified design life of the tank is longer than 10^8 wave encounters, $\Delta\sigma_A$ shall be modified to give equivalent crack propagation corresponding to the design life.

If other materials than those specified above are used, the allowable dynamic membrane stress $\Delta\sigma_A$ shall be agreed with BKI.[6]

[6] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 7.

The determination of the maximum dynamic membrane stress ranges for other materials should be based on a crack propagation analysis, assuming a defined initial surface flaw, to ensure a suitable low probability for a crack to propagate through thickness of the shell.

C4.23.1.2 If the carriage of products not covered by Section 19 is intended, the relative density of which exceeds 1,0, it is to be verified that the double amplitude of the primary membrane stress $\Delta\sigma_m$ created by the maximum dynamic pressure differential Δp does not exceed the allowable double amplitude of the dynamic membrane stress $\Delta\sigma_A$ as specified in 4.23.1.2, i.e.[6]:

$$\Delta\sigma_m \leq \Delta\sigma_A$$

$$\Delta p = \frac{\rho}{1{,}02\ x\ 10^5}\left[a_{\beta 1} \cdot z_{\beta 1} - a_{\beta 2} \cdot z_{\beta 2}\right]$$

Where:

ρ is maximum liquid cargo density in kg/m^3 at the design temperature

a_β and z_β are as defined in 4.28.1.2, see also Fig.C4.4

$a_{\beta 1}$ and $z_{\beta 1}$ are the a_β and z_β values giving the maximum liquid pressure (P_{gd})max

$a_{\beta 2}$ and $z_{\beta 2}$ are the a_β and z_β values giving the minimum liquid pressure (P_{gd})min,

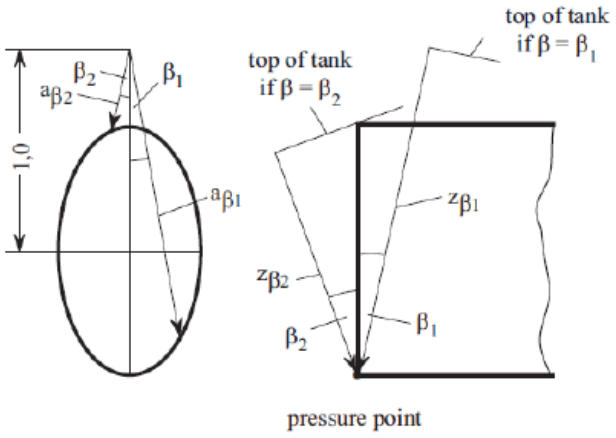

Fig.C4.4 Determination of Δp

In order to evaluate the maximum pressure differential Δp, pressure differentials are to be evaluated over the full range of the acceleration ellipse.

----------*end*----------

4.23.3 Ultimate design condition

C4.23.3.3 Permissible stresses in stiffening rings[7]

The circumferential stresses at supports shall be calculated by a procedure acceptable to BKI for a sufficient number of load cases.

C4.23.3.3.1 For horizontal cylindrical tanks made of C-Mn steel supported in saddles, the equivalent stress in the stiffening rings shall not exceed the following values if calculated using finite element method:

$$\sigma_e \leq \sigma_{all}$$

[7] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 8.

where:

σ_{all} = min (0,57 R_m ; 0,85 R_e)

σ_e = $\sqrt{(\sigma_n + \sigma_b)^2 + 3\tau^2}$

σ_e = Von Misses equivalent stress in N/mm^2

σ_n = Normal stress in N/mm^2 in the circumferential direction of the stiffening ring

σ_b = Bending stress in N/mm^2 in the circumferential direction of the stiffening ring

τ = Shear stress in N/mm^2 in the stiffening ring

R_e, R_m see 4.18.1.3

Equivalent stress values σ_e should be calculated over the full extent of the stiffening ring by a procedure acceptable to BKI, for a sufficient number of load cases.

C4.23.3.3.2 Assumptions for stiffening rings

.1 The stiffening ring may be considered as a circumferential beam formed by web, face plate, doubler plate, if any, and associated shell plating. The effective width of the associated plating may be taken as:

– For cylindrical shells: on each side of the web

$b_m = 0{,}78\sqrt{r \cdot t}$

r = Mean radius of the cylindrical shell in [mm]

t = Shell thickness [mm].

A doubler plate, if any, may be included within that distance.

– For longitudinal bulkheads (in the case of lobe tanks): the effective width may be determined according to Rules for Hull (Pt.1, Vol. II), Sec.3.E The following value on each side of the web may be taken as a guidance value:

$b_m = 20 \cdot t_b$

t_b = Bulkhead thickness.

.2 The stiffening ring shall be loaded with circumferential forces, on each side of the ring, due to the shear stress, determined by the bi-dimensional shear flow theory from the shear forces of the tank.

C4.23.3.3.3 If finite element calculation methods are applied, assumption for calculations is to be specially agreed with BKI.

C4.23.3.3.4 The buckling strength of the stiffening rings is to be examined in accordance with the requirements of Rules for Hull (Pt.1, Vol.II), Sec.3. F

C4.23.3.3.5 For calculation of reaction forces at the supports, the following factors shall be taken into account:

.1 Elasticity of support material (intermediate layer of wood or similar material)

.2 Change in contact surface between tank and support for the different load cases, and of the relevant reactions, due to:

- Thermal shrinkage of tank

- Elastic deformations of tank and support material.

The final distribution of the reaction forces at the supports shall not show any tensile forces.

-

----------*end*----------

Section 5 Process Pressure Vessels and Liquid, Vapour and Pressure Piping Systems

5.4 Design pressure

5.4.1 The design pressure P_o, used to determine minimum scantlings of piping and piping system components, shall be not less than the maximum gauge pressure to which the system may be subjected in service. The minimum design pressure used shall not be less than 1 MPa gauge, except for open-ended lines or pressure relief valve discharge lines, where it shall be not less than the lower of 0,5 MPa gauge, or 10 times the relief valve set pressure.

5.4.2 The greater of the following design conditions shall be used for piping, piping systems and components, based on the cargoes being carried:

.1 for vapour piping systems or components that may be separated from their relief valves and which may contain some liquid, the saturated vapour pressure at a design temperature of 45°C. Higher or lower values may be used (see Section 4.13.2.2); or

.2 for systems or components that may be separated from their relief valves and which contain only vapour at all times, the superheated vapour pressure at 45°C. Higher or lower values may be used (see Section 4.13.2.2), assuming an initial condition of saturated vapour in the system at the system operating pressure and temperature; or

.3 the MARVS of the cargo tanks and cargo processing systems; or

.4 the pressure setting of the associated pump or compressor discharge relief valve; or

.5 the maximum total discharge or loading head of the cargo piping system considering all possible pumping arrangements or the relief valve setting on a pipeline system.

5.4.3 Those parts of the liquid piping systems that may be subjected to surge pressures shall be designed to withstand this pressure.

5.4.4 The design pressure of the outer pipe or duct of gas fuel systems shall not be less than the maximum working pressure of the inner gas pipe. Alternatively, for gas fuel piping systems with a working pressure greater than 1 MPa, the design pressure of the outer duct shall not be less than the maximum built-up pressure arising in the annular space considering the local instantaneous peak pressure in way of any rupture and the ventilation arrangements.

Notes[1]:

1. *The expression "duct" in 5.4.4 and 5.13.2.4 means to include the equipment enclosure required in Section 16.4.3.1 and Section 16.4.3.2 (e.g. GVU enclosure) as well as the structural pipe duct intended to contain any release of gas from inner pipe or equipment. The term "structural pipe duct" means an outer duct forming part of a structure such as a hull structure or superstructure or deck house, where permitted, other than gas valve unit rooms.*

The gas valve unit rooms are to be:

1.1 *gastight toward other enclosed spaces;*

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 32

1.2 equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour and arranged to maintain a pressure less than the atmospheric pressure; and

1.3 able to withstand the maximum built-up pressure arising in the room in case of a gas pipe rupture, as documented by suitable calculations taking into account the ventilation arrangements.

2. The expression "design pressure of the outer pipe or duct" in 5.4.4 is either of the following:

2.1 the maximum pressure that can act on the outer pipe or equipment enclosure after the inner pipe rupture as documented by suitable calculations taking into account the venting arrangements; or

2.2 for gas fuel systems with inner pipe working pressure greater than 1 MPa, the "maximum built-up pressure arising in the annular space", after the inner pipe rupture, which is to be calculated in accordance with Guidelines for the Use of Gas or other Low-Flashpoint Fuels for Ships (Pt.1, Vol.1), Sec 9.8.2

3. The expression "maximum pressure at gas pipe rupture" in 5.13.2.4 is the maximum pressure to which the outer pipe or duct is subjected after the inner pipe rupture and for testing purposes it is the same as the design pressure used in 5.4.4.

----------*end*----------

5.6 Cargo transfer arrangements

5.6.1 Where cargo transfer is by means of cargo pumps that are not accessible for repair with the tanks in service, at least two separate means shall be provided to transfer cargo from each cargo tank, and the design shall be such that failure of one cargo pump or means of transfer will not prevent the cargo transfer by another pump or pumps, or other cargo transfer means.

5.6.2 The procedure for transfer of cargo by gas pressurization shall preclude lifting of the relief valves during such transfer. Gas pressurization may be accepted as a means of transfer of cargo for those tanks where the design factor of safety is not reduced under the conditions prevailing during the cargo transfer operation. If the cargo tank relief valves or set pressure are changed for this purpose, as it is permitted in accordance with Section 8.2.7 and 8.2.8, the new set pressure shall not exceed P_h as is defined in Section 4.13.2.

5.6.3 Vapour return connections

Connections for vapour return to the shore installations shall be provided.

5.6.4 Cargo tank vent piping systems

The pressure relief system shall be connected to a vent piping system designed to minimize the possibility of cargo vapour accumulating on the decks, or entering accommodation spaces, service spaces, control stations and machinery spaces, or other spaces where it may create a dangerous condition.

5.6.5 Cargo sampling connections

5.6.5.1 Connections to cargo piping systems for taking cargo liquid samples shall be clearly marked and shall be designed to minimize the release of cargo vapours. For vessels permitted to carry toxic products, the sampling system shall be of a closed loop design to ensure that cargo liquid and vapour are not vented to atmosphere.

Note[2]:

These requirements are only applicable if such a sampling system is fitted on board. Connections used for control of atmosphere in cargo tanks during inerting or gassing up are not considered as cargo sampling connections.

5.6.5.2 Liquid sampling systems shall be provided with two valves on the sample inlet. One of these valves shall be of the multi-turn type to avoid accidental opening, and shall be spaced far enough apart to ensure that they can isolate the line if there is blockage, by ice or hydrates for example.

5.6.5.3 On closed loop systems, the valves on the return pipe shall also comply with 5.6.5.2.

5.6.5.4 The connection to the sample container shall comply with recognized standards and be supported so as to be able to support the weight of a sample container. Threaded connections shall be tack-welded, or otherwise locked, to prevent them being unscrewed during the normal connection and disconnection of sample containers. The sample connection shall be fitted with a closure plug or flange to prevent any leakage when the connection is not in use.

5.6.5.5 Sample connections used only for vapour samples may be fitted with a single valve in accordance with 5.5, 5.8 and 5.13, and shall also be fitted with a closure plug or flange.

5.6.5.6 Sampling operations shall be undertaken as prescribed in Section 18.9.

5.6.6 Cargo filters

The cargo liquid and vapour systems shall be capable of being fitted with filters to protect against damage by extraneous objects. Such filters may be permanent or temporary, and the standards of filtration shall be appropriate to the risk of debris, etc., entering the cargo system. Means shall be provided to indicate that filters are becoming blocked, and to isolate, depressurize and clean the filters safely.

Notes[3]:

Means to indicate grade of filter clogging and need for maintenance shall be provided for fixed in-line filter arrangement and portable filter installations where dedicated filter housing piping is provided.

Where portable filters for fitting to manifold presentation flanges are used without dedicated filter housing, and these can be visually inspected after each loading and discharging operation, no additional arrangements for indicating blockage or facilitating drainage are required.

Blockage of filters can be determined by use of the pressure indicators in the cargo system.

----------*end*----------

5.9 Welding, post-weld heat treatment and non-destructive testing

5.9.3 Non-destructive testing

In addition to normal controls before and during the welding, and to the visual inspection of the finished welds, as necessary for proving that the welding has been carried out correctly and according to the requirements of this paragraph, the following tests shall be required:

[2] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 33.
[3] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 34.

.1 100% radiographic or ultrasonic inspection of butt-welded joints for piping systems with design temperatures colder than -10°C, ~~or~~ and with inside diameters of more than 75 mm, or wall thicknesses greater than 10 mm;

.2 when such butt-welded joints of piping sections are made by automatic welding procedures approved by The Administration or recognized organization acting on its behalf, then a progressive reduction in the extent of radiographic or ultrasonic inspection can be agreed, but in no case to less than 10% of each joint. If defects are revealed, the extent of examination shall be increased to 100% and shall include inspection of previously accepted welds. This approval can only be granted if well-documented quality assurance procedures and records are available to assess the ability of the manufacturer to produce satisfactory welds consistently; and

.3 for other butt-welded joints of pipes not covered by 5.9.3.1 and 5.9.3.2, spot radiographic or ultrasonic inspection or other non-destructive tests shall be carried out depending upon service, position and materials. In general, at least 10% of butt-welded joints of pipes shall be subjected to radiographic or ultrasonic inspection.

C5.9.3 Non-destructive testing is to meet the requirements of the Rules for Materials (Pt. 1, Vol. V), Sec. 3 for pressure piping. The radiographs shall be assessed according to ISO 10675 and shall meet the criteria for level 1.Ultrasonic testing shall be assessed according to ISO 11666 and shall at least meet the criteria for level 2.

----------*end*----------

5.11 Piping system component requirements

5.11.1 Piping scantlings. Piping systems shall be designed in accordance with BKI Rules and recognized standards.

5.11.2.1 The following criteria shall be used for determining pipe wall thickness.

5.11.2.2 The wall thickness of pipes shall not be less than:

$$t = \frac{t_0 + b + c}{1 - \frac{a}{100}} \quad [mm]$$

where:

t_0 = theoretical thickness, determined by the following formula:

$$t_0 = \frac{P \cdot D}{2K \cdot e + P} \quad [mm]$$

with:

P = design pressure [Mpa] referred to in 5.4;

D = outside diameter [mm];

K = allowable stress [N/mm²] referred to in 5.11.3;

e = efficiency factor equal to 1 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, that 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, 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:

$$b = \frac{D \cdot t_0}{2{,}5 \cdot r} \quad [mm]$$

with:

r = mean radius of the bend [mm];

c = corrosion allowance [mm]. If corrosion or erosion is expected, the wall thickness of the piping shall be increased over that required by other design requirements. This allowance shall be consistent with the expected life of the piping; and

~~e~~ a = negative manufacturing tolerance for thickness (%).

----------*end*----------

5.11.6 Flanges, valves and fittings

5.11.6.1 Flanges, valves and other fittings shall comply with recognized standards, taking into account the material selected and the design pressure defined in 5.4. For bellows expansion joints used in vapour service, a lower minimum design pressure may be accepted.

5.11.6.2 For flanges not complying with a recognized standard, the dimensions of flanges and related bolts shall be to the satisfaction of the Administration or recognized organization acting on its behalf.

5.11.6.3 All emergency shutdown valves shall be of the "~~fire~~ fail-closed" type (see 5.13.1.1 and Section 18.10.2).

Note:

Fail-closed type means closed on loss of actuating power and the valve shall be made of materials having melting temperature above 925°C see C5.13.1.1.1.4.

----------*end*----------

5.12 Materials

5.12.1 The choice and testing of materials used in piping systems shall comply with the requirements of Section 6, taking into account the minimum design temperature. However, some relaxation may be permitted in the quality of material of open-ended vent piping, provided that the temperature of the cargo at the pressure relief valve setting is not lower than -55°C, and that no liquid discharge to the vent piping can occur. Similar relaxations may be permitted under the same temperature conditions to open-ended piping inside cargo tanks, excluding discharge piping and all piping inside membrane and semi-membrane tanks.

5.12.2 Materials having a melting point below 925°C shall not be used for piping outside the cargo tanks except for short lengths of pipes attached to the cargo tanks, in which case fire-resisting insulation shall be provided.

C5.12.2 For an outer pipe or duct equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour, the effects of both pressure and possible low temperature in the event of a high pressure line failure shall be taking into account.

5.12.3 Cargo piping insulation system

5.12.3.1 Cargo piping systems shall be provided with a thermal insulation system as required to minimize heat leak into the cargo during transfer operations and to protect personnel from direct contact with cold surfaces.

Notes[4]*:*

1. The expression 'a thermal insulation system as required to minimize heat leak into the cargo during transfer operations' means that the properties of the thermal insulation for cargo piping systems shall be taken into consideration when calculating the heat balance of the containment system and the capacity of the pressure/ temperature control system.

2. The expression 'cargo piping systems shall be provided with a thermal insulation system as required (...) to protect personnel from direct contact with cold surfaces' means that surfaces of cargo piping systems with which personnel is likely to contact under normal conditions shall be protected by a thermal insulation, with the exception of the following examples:

a) Surfaces of cargo piping systems which are protected by physical screening measures to prevent such direct contact.

b) Surfaces of manual valves, having extended spindles that protect the operator from the cargo temperature.

c) Surfaces of cargo piping systems whose design temperature (to be determined from inner fluid temperature) is above -10°C.

5.12.3.2 Where applicable, due to location or environmental conditions, insulation materials shall have suitable properties of resistance to fire and flame spread and shall be adequately protected against penetration of water vapour and mechanical damage.

5.12.4 Where the cargo piping system is of a material susceptible to stress corrosion cracking in the presence of a salt-laden atmosphere, adequate measures to avoid this occurring shall be taken by considering material selection, protection of exposure to salty water and/or readiness for inspection.

----------*end*----------

5.13 Testing requirements

5.13.1 Type testing of piping components

5.13.1.1 Valves

C5.13.1.1.1 Prototype testing

Each type of valve intended to be used at a working temperature below -55°C shall be subject to the following type tests:

1) each size and type of valve shall be subjected to seat tightness testing over the full range of operating pressures for bi-directional flow and temperatures, at intervals, up to the rated design pressure of the valve. Allowable leakage rates shall be to the requirements of the Administration or recognized organization acting on its behalf. During the testing, satisfactory operation of the valve shall be verified;

[4] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 25.

2) the flow or capacity shall be certified to a BKI Rules for each size and type of valve;

Notes[5]*:*

The expression "Each type of valve…shall be certified to a recognized standard" means that:

1. *for pressure relief valves (PRVs) that are subject to Section 8.2.5, the flow or capacity are to be certified by the Administration or Recognized Organization acting on its behalf; and*
2. *for other types of valves, the manufacturer is to certify the flow properties of the valves based on tests carried out according to recognized standards.*

3) pressurized components shall be pressure tested to at least 1,5 times the rated pressure; and

4) for emergency shutdown valves, with materials having melting temperatures lower than 925°C, the type testing shall include a fire test to a standard acceptable to the Administration.

Note[6]*:*

"Emergency shutdown valves, with materials having melting temperatures lower than 925°C" does not include an emergency shutdown valve in which components made of materials having melting temperatures lower than 925°C do not contribute to the shell or seat tightness of the valve.

----------*end*----------

5.13.2 System testing requirements

5.13.2.1 The requirements of this section shall apply to piping inside and outside the cargo tanks.

5.13.2.2 After assembly, all cargo and process piping shall be subjected to a strength test with a suitable fluid. The test pressure shall be at least 1,5 times the design pressure (1,25 times the design pressure where the test fluid is compressible) for liquid lines and 1,5 times the maximum system working pressure (1,25 times the maximum system working pressure where the test fluid is compressible) for vapour lines. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the test may be conducted prior to installation on board the ship. Joints welded on board shall be tested to at least 1,5 times the design pressure.

Note:

If testing is done with a compressible fluid, safety considerations must be taken.

5.13.2.3 After assembly on board, each cargo and process piping system shall be subjected to a leak test using air, or other suitable medium, to a pressure depending on the leak detection method applied.

5.13.2.4 In double wall gas-fuel piping systems, the outer pipe or duct shall also be pressure tested to show that it can withstand the expected maximum pressure at gas pipe rupture.[7]

5.13.2.5 All piping systems, including valves, fittings and associated equipment for handling cargo or vapours, shall be tested under normal operating conditions not later than at the first loading operation, in accordance with recognized standards.

----------*end*----------

[5] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 26.
[6] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 24.
[7] See Notes in paragraph 5.4.4.

~~C5.14 Cargo Pumps~~

~~C5.14.1 Prototype Testing~~

~~Each size and type of pump is to be approved through design assessment and prototype testing. Prototype testing is to be witnessed in the presence of the BKI Surveyor.~~

~~In lieu of prototype testing, satisfactory in-service experience, of an existing pump design approved by BKI submitted by the manufacturer may be considered.~~

~~Prototype testing is to include hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water. In addition, for shaft driven deep well pumps, a spin test to demonstrate satisfactory operation of bearing clearances, wear rings and sealing arrangements is to be carried out at the minimum design temperature. The full length of shafting is not required for the spin test, but must be of sufficient length to include at least one bearing and sealing arrangements. After completion of tests, the pump is to be opened out for examination.~~

~~C5.14.2 Unit Production Testing~~

~~All pumps are to be tested at the plant of manufacturer in the presence of the BKI Surveyor. Testing is to include hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water. As an alternative to the above, if so requested by the relevant Manufacturer, the certification of a pump may be issued subject to the following:The pump has been approved as required by 5.14.1, and~~

- ~~The manufacturer has a recognised quality system that has been assessed and certified by the Administration subject to periodic audits, and~~
- ~~The quality control plan contains a provision to subject each pump to a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. The manufacturer is to maintain records of such tests.~~

C5.14 Cargo Pumps and Gas/ Reliquefication/Refrigeration Compressors

Compressors and pumps are to be suitable for their intended purpose. All equipment and machinery are to be adequately designed to ensure suitability within a marine environment with due consideration to Guidance for the Design, Construction and Testing of Pumps (Pt.1, Vol.v), Guidance for The Approval and Type Approval of Materials & Equipment for Marine Use (Pt.1, Vol.W) and Rules for Machinery Installations (Pt.1, Vol.III). Such items to be considered would include, but not be limited to:

a) environmental;

b) shipboard vibrations and accelerations;

c) effects of pitch, heave and roll motions, etc.; and

d) physical and chemical properties of product

The manufacturer is to submit documentation indicating the equipment has been designed to comply with the above criteria.

C5.14.1 Cargo Pumps

Each size and type of pump is to be approved through design assessment and prototype testing. Prototype testing is to be witnessed in the presence of the BKI Surveyor.

For the design assessment of the pumps, ISO 13709:2009 and ISO 24490:2016, as applicable, can be used. Other applicable recognized standards by acceptable to the-BKI may be considered.

1) Material Testing

Tests for pump materials need not be witnessed by the BKI Surveyorrepresentative except for the boundary components, which are in direct contact with the medium and for a design temperature below – 55°C in accordance with Section 6.2.2.

Note:

The following pump components can, for example, be considered boundary components:

- *For centrifugal type pump: impeller, inducer, guide vane, casing, shaft and coupling.*
- *For reciprocating type pump: cylinder cover, valve cover, cylinder liner, piston and piston rod, crankshaft, crank case.*

2) Prototype Testing

Prototype testing is to include hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water. In addition, for shaft driven deep well pumps, a spin test to demonstrate satisfactory operation of bearing clearances, wear rings and sealing arrangements is to be carried out at the minimum design temperature. The full length of shafting is not required for the spin test but must be of sufficient length to include at least one bearing and sealing arrangements. After completion of tests, the pump is to be opened out for examination.

The vibration criteria of machinery and equipment are to be provided by the pump manufacturer. These are to be compared against an applicable internationally recognised standard[8], as applied to the design, and are to be accepted by BKI.

3) Unit Production Testing

All pumps are to be tested at the plant of manufacturer in the presence of the BKI Surveyor. Testing is to include hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity

[8] The following standards can be used as guidance:

- ISO 7919-3:2009/AMD 1:2017, Mechanical vibration — Evaluation of machine vibration by measurements on rotating shafts – Part3 Coupled industrial machines
- ISO 10816-3:2009/AMD 1: 2017, Evaluation of machine vibration by measurements on non-rotating parts — Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15 000 r/min when measured in situ.
- ISO 10816-7:2009, Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts — Part 7: Rotodynamic pumps for industrial applications, including measurements on rotating shafts
- ISO 10816-8:2014, Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts — Part 8: Reciprocating compressor systems
- ISO 20816-1:2016, Mechanical vibration — Measurement and evaluation of machine vibration – Part 1: General Guidelines
- ISO 20816-8:2018, Mechanical vibration — Measurement and evaluation of machine vibration — Part 8: Reciprocating compressor systems.

test. For submerged electric motor driven pumps, the capacity test is to be carried out with the design medium or with a medium below the minimum working temperature. For shaft driven deep well pumps, the capacity test may be carried out with water.

As an alternative to the above, if so, requested by the relevant Manufacturer, the certification of a pump may be issued subject to the following:

- The pump has been approved as required by 1) and 2), and
- The manufacturer has a recognised quality system that has been assessed and certified by the BKI subject to periodic audits, and
- The quality control plan contains a provision to subject each pump to a hydrostatic test of the pump body equal to 1,5 times the design pressure and a capacity test. The manufacturer is to maintain records of such tests.

C5.14.2 Gas Cargo and Reliquefication/Refrigeration Compressors

Each size and type of compressor is to be approved through design assessment and prototype testing. Prototype testing is to be witnessed in the presence of the BKI Surveyor.

For the design assessment of the gas compressors, API standards. 617:2014 (w. Errata 1:2016), 618:2016 or 619:2010, as applicable, can be used. Other applicable recognized standards acceptable to the BKI may be considered.

1) Material Testing:

Tests for compressor materials need not be witnessed by the BKI Surveyor except for the boundary components, which are in direct contact with the medium and for a design temperature below –55°C in accordance with Section 6.2.2.

Note:

The following compressor components can, for example, be considered boundary components:

- *For centrifugal type compressor: impeller, inducer, guide vane, casing, shaft and coupling.*
- *For reciprocating type compressor: cylinder cover, valve cover, cylinder liner, piston and piston rod, crankshaft, crank case.*

2) Prototype Testing:

Prototype testing is to be consistent with the applicable standard as applied for design assessment and is to include hydrostatic test of the compressor pressure boundary components, mechanical running test and a performance test. The hydrostatic test is to be carried out at a pressure equal to 1,5 times the design pressure (or 1,25 times the design pressure where the test fluid is compressible) and for, at least, 30 minutes. The mechanical running test and performance tests should include recording of the gas used, temperatures, pressures, testing of alarms and shut down, pressure relief devices and vibration measurements to ensure that the limits do not exceed those proposed by the manufacturer and that other features relating to the performance of the equipment are in accordance with the specification. Similarly, during the performance test, power consumption and the gas loads are to be recorded.

The vibration criteria of machinery and equipment are to be provided by manufacturers, consistent with the applicable recognized standard[8] as applied to the design. Otherwise, when the data on the vibration criteria are not available, justification is to be submitted for criteria used as reference in terms of overall Root Mean Square (RMS) vibrational velocity value for normal operation conditions. Alternative limits, demonstrated by fatigue calculations, may be accepted by BKI.

3) Unit Production Testing

Each compressor is to be tested at the plant of manufacture in the presence of BKI Surveyor. Testing is to include hydrostatic test of the compressor pressure boundary components. The hydrostatic test

is to be carried out at a pressure equal to 1,5 times the design pressure (or 1,25 times the design pressure where the test fluid is compressible) and for, at least, 30 minutes.

As an alternative to the above, if so, requested by the relevant Manufacturer, the certification of a compressor may be issued subject to the following:

- The compressor has been approved as required by 1) and 2), and
- The manufacturer has a recognised quality system that has been assessed and certified by BKI subject to periodic audits, and
- The quality control plan contains a provision to subject each compressor to the hydrostatic test of the compressor body equal to 1,5 times the design pressure (or 1,25 times the design pressure where the test fluid is compressible) for, at least, 30 minutes, and a mechanical running and performance test. The manufacturer is to maintain records of such tests.

4) Installation

The complete compressor assembly connected to the vessel systems is to be subjected to a leak test using air or other suitable medium, to a pressure depending on the leak detection method applied. The test is to be performed in presence of the BKI Surveyor and considered satisfactory when no joint leaks are observed.

----------*end*----------

Section 6 Materials of Construction and Quality Control

6.5 Welding of metallic materials and non-destructive testing

6.5.3 Welding procedure tests for cargo tanks and process pressure vessels

6.5.3.5 Each test shall satisfy the following requirements:

.1 tensile tests: cross-weld tensile strength shall not be less than the specified minimum tensile strength for the appropriate parent materials. For materials such as aluminium alloys, reference shall be made to Section 4.18.1.3 with regard to the requirements for weld metal strength of under-matched welds (where the weld metal has a lower tensile strength than the parent metal). In every case, the position of fracture shall be recorded for information;

.2 bend tests: no fracture is acceptable after a 180° bend over a former of a diameter four times the thickness of the test pieces; and

.3 Charpy V-notch impact tests: Charpy V-notch tests shall be conducted at the temperature prescribed for the base material being joined. The results of weld metal impact tests, minimum average energy (KV), shall be no less than 27 J. The weld metal requirements for subsize specimens and single energy values shall be in accordance with 6.3.2. The results of fusion line and heat-affected zone impact tests shall show a minimum average energy (KV) in accordance with the transverse or longitudinal requirements of the base material, whichever is applicable, and for subsize specimens, the minimum average energy (KV) shall be in accordance with 6.3.2. If the material thickness does not permit machining either full-size or standard subsize specimens, the testing procedure and acceptance standards shall be in accordance with ~~the discretion of the Administration. n accordance with~~ Rules for Welding (Pt. 1, Vol. VI) and other recognized standards. In such cases, consumables shall be so selected that exhibit satisfactory impact properties.

----------*end*----------

Section 7 Cargo Pressure/Temperature Control

7.8 Availability

The availability of the system and its supporting auxiliary services shall be such that:

.1 in case of a single failure of a mechanical non-static component or a component of the control systems, the cargo tanks' pressure and temperature can be maintained within their design range without affecting other essential services;

.2 redundant piping systems are not required;

.3 heat exchangers that are solely necessary for maintaining the pressure and temperature of the cargo tanks within their design ranges shall have a standby heat exchanger, unless they have a capacity in excess of 25% of the largest required capacity for pressure control and they can be repaired on board without external resources. Where an additional and separate method of cargo tank pressure and temperature control is fitted that is not reliant on the sole heat exchanger, then a standby heat exchanger is not required; and

.4 for any cargo heating or cooling medium, provisions shall be made to detect the leakage of toxic or flammable vapours into an otherwise non-hazardous area or overboard in accordance with 13.6. Any vent outlet from this leak detection arrangement shall be to a ~~non-hazardous~~ safe location area and be fitted with a flame screen.

----------*end*----------

Section 8 Vent Systems for Cargo Containment

8.1 General

All cargo tanks shall be provided with a pressure relief system appropriate to the design of the cargo containment system and the cargo being carried. Hold spaces and interbarrier spaces, which may be subject to pressures beyond their design capabilities, shall also be provided with a suitable pressure relief system. Pressure control systems specified in Section 7 shall be independent of the pressure relief systems.

Notes[1]*:*

Hold spaces and interbarrier spaces, which may be subject to pressures beyond their design capabilities, shall also be provided with a suitable pressure relief system according to below interpretation:

- *The formula for determining the relieving capacity given in C8.5 is developed for interbarrier spaces surrounding independent type A cargo tanks, where the thermal insulation is fitted to the cargo tanks.*
- *The relieving capacity of pressure relief devices of interbarrier spaces surrounding independent type B cargo tanks may be determined on the basis of the method given in C8.5, however, the leakage rate is to be determined in accordance with Section 4.7.2.*
- *The relieving capacity of pressure relief devices for interbarrier spaces of membrane and semi- membrane tanks is to be evaluated on the basis of specific membrane/semi- membrane tank design.*
- *The relieving capacity of pressure relief devices for interbarrier spaces adjacent to integral type cargo tanks may, if applicable, be determined as for type A independent cargo tanks.*
- ~~*Interbarrier space pressure relief devices in the scope of this interpretation are emergency devices for protecting the hull structure from being unduly overstressed in case of a pressure rise in the interbarrier space due to primary barrier failure. Therefore such devices need not comply with the requirements of 8.2.10, 8.2.11.1 and 8.2.11.2.*~~

----------*end*----------

8.2 Pressure relief systems

8.2.18 The adequacy of the vent system fitted on tanks loaded in accordance with Section 15.5.2 shall be demonstrated ~~by the Administration~~, taking into account the recommendations developed by the Organization[2]. A relevant certificate shall be permanently kept on board the ship. For the purposes of this paragraph, vent system means:

.1 the tank outlet and the piping to the PRV;

.2 the PRV; and

.3 the piping from the PRVs to the location of discharge to the atmosphere, including any interconnections and piping that joins other tanks.

----------*end*----------

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 28.

[2] Refer to the *Guidelines for the evaluation of the adequacy of type C tank vent systems* (resolution A.829(19)).

8.4 Sizing of pressure relieving system

8.4.1 Sizing of pressure relief valves

PRVs shall have a combined relieving capacity for each cargo tank to discharge the greater of the following, with not more than a 20% rise in cargo tank pressure above the MARVS:

8.4.1.1 The maximum capacity of the cargo tank inerting system, if the maximum attainable working pressure of the cargo tank inerting system exceeds the MARVS of the cargo tanks; or

8.4.1.2 Vapours generated under fire exposure computed using the following formula:

$$Q = F \cdot G \cdot A^{0.82} \qquad [m^3/s]$$

where:

Q = minimum required rate of discharge of air at standard conditions of 273,15 Kelvin (K) and 0,1013 MPa;

F = fire exposure factor for different cargo types as follows:

= 1 for tanks without insulation located on deck;

= 0,5 for tanks above the deck, when insulation is approved by the Administration. Approval will be based on the use of a fireproofing material, the thermal conductance of insulation and its stability under fire exposure;

= 0,5 for uninsulated independent tanks installed in holds;

= 0,2 for insulated independent tanks in holds (or uninsulated independent tanks in insulated holds);

= 0,1 for insulated independent tanks in inerted holds (or uninsulated independent tanks in inerted, insulated holds);

= 0,1 for membrane and semi-membrane tanks. For independent tanks partly protruding through the weather decks, the fire exposure factor shall be determined on the basis of the surface areas above and below deck.

G = gas factor according to formula:

$$G = \frac{12,4}{L \cdot D}\sqrt{\frac{Z \cdot T}{M}}$$

with:

T = temperature in degrees Kelvin at relieving conditions, i.e. 120% of the pressure at which the pressure relief valve is set;

L = latent heat of the material being vaporized at relieving conditions, in kJ/kg;

D = a constant based on relation of specific heats k and is calculated as follows:

$$D = \sqrt{k\left(\frac{2}{k+1}\right)\frac{k+1}{k-1}}$$

where:

k = ratio of specific heats at relieving conditions, and the value of which is between 1 and 2,2. If k is not known, D = 0,606 shall be used;

Z = compressibility factor of the gas at relieving conditions. If not known, Z = 1 shall be used; and

M = molecular mass of the product.

The gas factor of each cargo to be carried shall be determined and the highest value shall be used for PRV sizing.

A = external surface area of the tank (m^2), as defined in Section 1,C.14, for different tank types, as shown in Fig. 8.1.

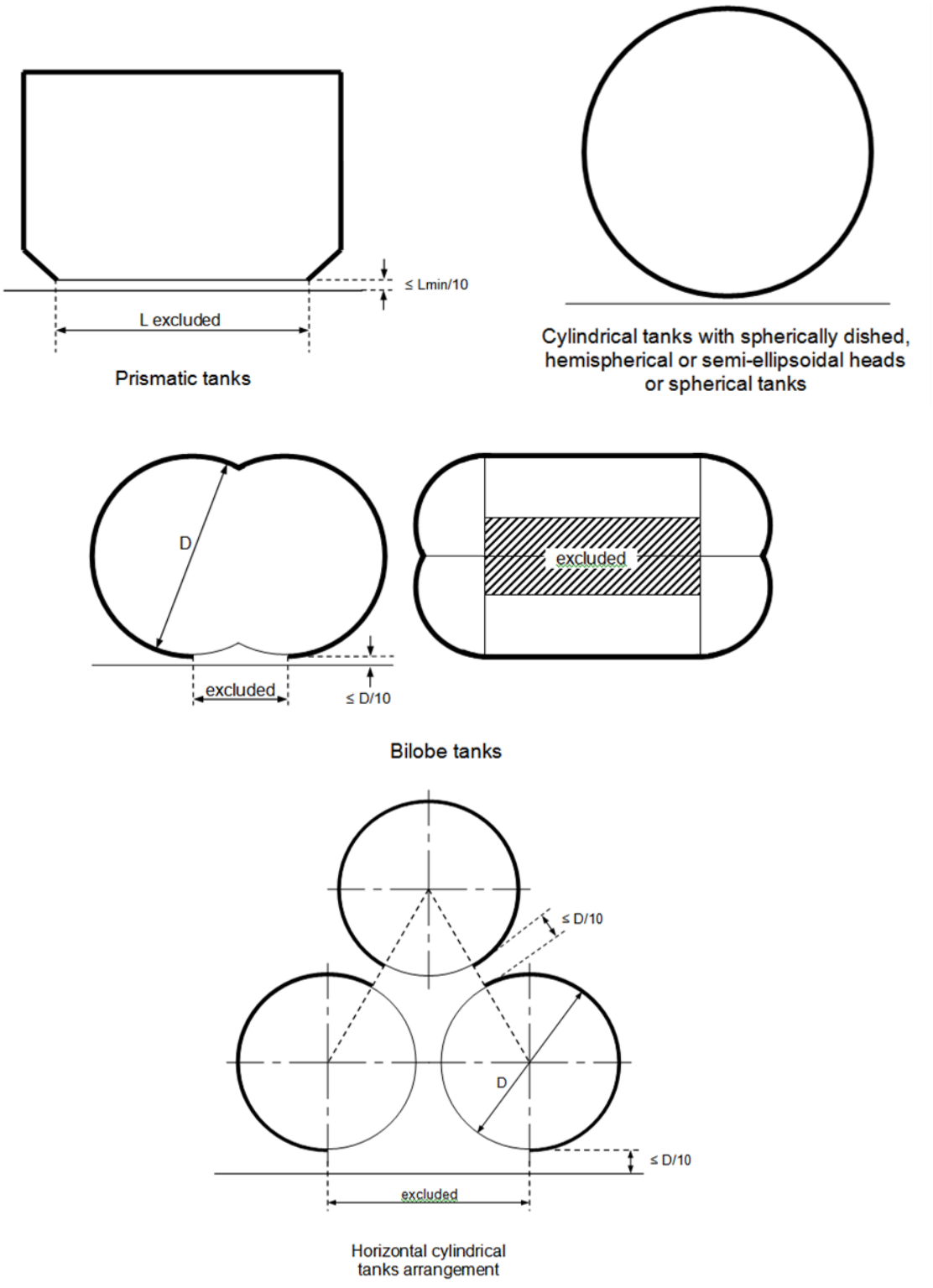

Fig. 8.1 External surface area of tank

Notes [3]*:*

For prismatic tank L_{min}, and the associated external surface area of the tank, A, are to be taken as follows:

- *L_{min}, for non-tapered tanks, is the smaller of the horizontal dimensions of the flat bottom of the tank.*
- *For tapered tanks, as would be used for the forward tank, L_{min} is the smaller of the length and the average width.*
- *For prismatic tanks whose distance between the flat bottom of the tank and bottom of the hold space is equal to or less than $L_{min}/10$:*

  A = external surface area minus flat bottom surface area.
- *For prismatic tanks whose distance between the flat bottom of the tank and bottom of the hold space is greater than $L_{min}/10$:*

  A = external surface area

----------*end*----------

C8.5 Pressure relief device

C8.5.1 General

C8.5.1.1 If independent tanks are surrounded by a secondary barrier, the spaces between the primary and secondary barriers shall be equipped with blow-out membranes or pressure relief devices which shall open when the pressure exceeds 0,025 MPa.

C8.5.1.2 The combined relieving capacity of the pressure relief devices for interbarrier spaces surrounding type A independent cargo tanks where the insulation is fitted to the cargo tanks may be determined by the following formula[1]:

$$Q_{sa} = 3{,}4 \cdot A_c \cdot \frac{\rho}{\rho_v}\sqrt{h} \qquad [m^3/s]$$

Where:

Q_{sa} = minimum required discharge rate of air at standard conditions of 273 [K] and 0,1013 [MPa]

A_c = design crack opening area (m^2)

= $\frac{\pi}{4} \cdot \delta \cdot \ell$ [m^2]

δ = max, crack opening width (m)

δ = 0,2 t (m)

t = thickness of tank bottom plating (m)

ℓ = design crack length (m) equal to the diagonal of the largest plate panel of the tank bottom, see Fig. C8.2

h = max liquid height above tank bottom plus 10 x MARVS (m)

ρ = density of product liquid phase (kg/m^3) at the set pressure of the interbarrier space relief device

ρ_v = density of product vapour phase (kg/m^3) at the set pressure of the interbarrier space relief device and a temperature of 273 K

MARVS = max allowable relief valve setting of the cargo tank (Mpa).

[3] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 19.

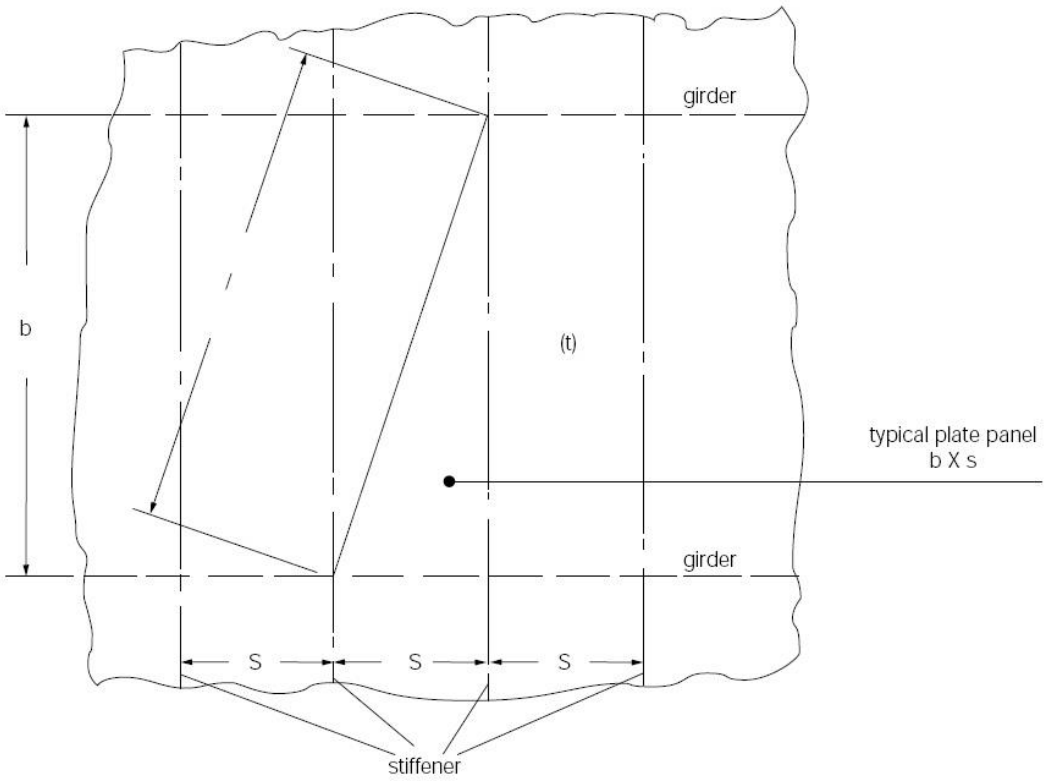

Fig. C8.2 Design crack length, ℓ

C8.5.1.3 The pressure relief hatches covered by C8.5.1.2 shall be constructed to avoid risk of damage by expected external forces. [1]

C8.5.1.4 Pressure relief devices covered by C8.5.1.2 need not be arranged to comply with the requirements of 8.2.10, 8.2.11.1 and 8.2.11.2 related to vent outlets.

----------*end*----------

Section 11 Fire Protection and Extinction

11.1 Fire safety requirements

11.1.1 The requirements for tankers in SOLAS chapter II-2[1] shall apply to ships covered by the IGC-Code, irrespective of tonnage including ships of less than 500 gross tonnage, except that:

.1 regulations 4.5.1.6 and 4.5.10 do not apply;

.2 regulations 10.4 and 10.5 shall apply as they would apply to tankers of 2,000 gross tonnage and over;

.3 regulation 10.5.6 shall apply to ships of 2,000 gross tonnage and over;

.4 the following regulations of SOLAS chapter II-2 related to tankers do not apply and are replaced by chapters and sections of the IGC-Code as detailed below:

Regulation:	Replaced by:
10.10	11.6
4.5.1.1 and 4.5.1.2	Chapter 3
4.5.5	Relevant sections in the IGC-Code
10.8	11.3 and 11.4
10.9	11.5
10.2	11.2.1 to 11.2.4;

.5 regulations 13.3.4 and 13.4.3 shall apply to ships of 500 gross tonnage and over.

11.1.2 All sources of ignition shall be excluded from spaces where flammable vapour may be present, except as otherwise provided in Sections 10 and 16.

11.1.3 The provisions of this section shall apply in conjunction with Section 3.

11.1.4 For the purposes of firefighting, any weather deck areas above cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space shall be included in the cargo area.[2]

11.2 Fire mains and hydrants

11.2.1 Irrespective of size, ships carrying products that are subject to the Code shall comply with the requirements of regulation II-2/10.2 of the SOLAS Convention, as applicable to cargo ships, except that the required fire pump capacity and fire main and water service pipe diameter shall not be limited by the provisions of regulations II-2/10.2.2.4.1 and II-2/10.2.1.3, when a fire pump is used to supply the water-spray system, as permitted by 11.3.3 of the Code[3]. The capacity of this fire pump shall be such that these areas can be protected when simultaneously supplying two jets of water from fire hoses with 19 mm nozzles at a pressure of at least 0,5 MPa gauge.

----------*end*----------

[1] The structural fire protection provisions of Chapter II-2 of the 1974 SOLAS Convention, applicable to liquefied gas carriers, are given in Rules for Hull (Pt. 1, Vol. II), Section 22

[2] See Notes in paragraph 11.3.6.

[3] Regarding Regulations 4.2.1 and 4.4.1 of Chapter II-2 of the 1974 SOLAS Convention see also Rules for Machinery Installations (Pt. 1, Vol. III), Sec. 12, E.1 and E.2.

11.3 Water-spray system

11.3.1 On ships carrying flammable and/or toxic products, a water-spray system, for cooling, fire prevention and crew protection shall be installed to cover:

.1 exposed cargo tank domes, any exposed parts of cargo tanks and any part of cargo tank covers that may be exposed to heat from fires in adjacent equipment containing cargo such as exposed booster pumps/heaters/re-gasification or re-liquefaction plants, hereafter addressed as gas process units, positioned on weather decks;

.2 exposed on-deck storage vessels for flammable or toxic products;

.3 gas process units positioned on deck;

.4 cargo liquid and vapour discharge and loading connections, including the presentation flange and the area where their control valves are situated, which shall be at least equal to the area of the drip trays provided;

Notes[4]:

1. *Due to the specifics of liquefied gas bunkering ships, some of these vessels may be provided with additional cargo transfer equipment including transfer loading arms, bunkering booms, transfer hoses, reducers, spool pieces and transfer hoses reels. This additional equipment can be installed in different locations around the ship.*
2. *When in use, this additional cargo transfer equipment shall comply, where appropriate, with the requirements of paragraphs 11.3.1.4, 11.3.1.5, 11.4.1, 11.4.3 and 18.10.3.2 of this Rules for fire detection and fire protection in the cargo area (such as fusible elements, ESD functionality, water spray system protection, dry chemical powder fire-extinguishing systems and drip trays) including hull protection from low temperatures.*

.5 all exposed emergency shut-down (ESD) valves in the cargo liquid and vapour pipes, including the master valve for supply to gas consumers; [5]

.6 exposed boundaries facing the cargo area, such as bulkheads of superstructures and deckhouses normally manned, cargo machinery spaces, store-rooms containing high fire-risk items and cargo control rooms. Exposed horizontal boundaries of these areas do not require protection unless detachable cargo piping connections are arranged above or below. Boundaries of unmanned forecastle structures not containing high fire-risk items or equipment do not require water-spray protection;

.7 exposed lifeboats, liferafts and muster stations facing the cargo area, regardless of distance to cargo area[6]; and

Notes[7]:

Survival crafts protection:

With reference to sub-paragraph 11.3.1.7. The survival crafts on board including remote survival crafts (see SOLAS III/Reg. 31.1.4) facing the cargo area shall be protected by a water-spray system taking into consideration cargo area extension for firefighting purposes as stated in 11.1.4. Remote liferafts located in areas covered by water-spray protection as required in 11.3.1.6 may be considered as adequately protected.

.8 any semi-enclosed cargo machinery spaces semi-enclosed cargo motor room.

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[4] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 39.
[5] See Notes in paragraph 11.3.1.4.
[6] Water spray protection should be considered in accordance with Guidance for Marine Industry (Pt.1, Vol.AC), Section 8, R-152.
[7] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 22.

Ships intended for operation as listed in Section 1, A.7.12 shall be subject to special consideration (see 11.3.3.2).

11.3.2.1 The system shall be capable of covering all areas mentioned in 11.3.1.1 to 11.3.1.8, with a uniformly distributed water application rate of at least 10 $\ell/m^2/min$ for the largest projected horizontal surfaces and 4 $\ell/m^2/min$ for vertical surfaces. For structures having no clearly defined horizontal or vertical surface, the capacity of the water-spray system shall not be less than the projected horizontal surface multiplied by 10 $\ell/m^2/min$.

11.3.2.2 On vertical surfaces, spacing of nozzles protecting lower areas may take account of anticipated rundown from higher areas. Stop valves shall be fitted in the main supply line(s) in the water-spray system, at intervals not exceeding 40 m, for the purpose of isolating damaged sections. Alternatively, the system may be divided into two or more sections that may be operated independently, provided the necessary controls are located together in a readily accessible position outside the cargo area. A section protecting any area included in 11.3.1.1 and .2 shall cover at least the entire athwartship tank grouping in that area. Any gas process unit(s) included in 11.3.1.3 may be served by an independent section.

11.3.3 The capacity of the water-spray pumps shall be capable of simultaneous protection of the greater of the following:

.1 any two complete athwartship tank groupings, including any gas process units within these areas; or

.2 for ships intended for operation as listed in Section 1, A.7.12, necessary protection subject to special consideration under 11.3.1 of any added fire hazard and the adjacent athwartship tank grouping,

in addition to surfaces specified in 11.3.1.4 to 11.3.1.8. Alternatively, the main fire pumps may be used for this service, provided that their total capacity is increased by the amount needed for the water-spray system. In either case, a connection, through a stop valve, shall be made between the fire main and water-spray system main supply line outside the cargo area.

Notes[8]:

Tank groups in cargo area:

1. *Expression 'two complete athwartship tank groupings' in 11.3.3.1 means any two groups of tanks where one group is defined as tanks located in transverse direction from ship side to ship side. Where there is only one cargo tank occupying a hold space from ship side to ship side, it will be considered as a 'grouping' for the purpose a hold space from ship side to ship side, it will be considered as a 'grouping' for the purpose of this interpretation*
2. *Any two complete athwartship tank groupings' represents an area equal to the combined area of the two largest tank groupings including any gas process units within these areas.*

11.3.4 The boundaries of superstructures and deckhouses normally manned, and lifeboats, liferafts and muster areas facing the cargo area, shall also be capable of being served by one of the fire pumps or the emergency fire pump, if a fire in one compartment could disable both fire pumps.

Notes 1[8]:

In cases where the emergency fire pump is used to meet this requirement, its capacity, in addition to being capable of maintaining two jets of water as required by Rules for Machinery Installations (Pt.1, Vol.III), Sec. 12, E.1.4.1, shall be increased taking into account the spray application rates stated in paragraph 11.3.2.1, but limiting coverage to boundaries of

[8] See Notes in paragraph 11.3.1.7

normally manned superstructures and deckhouses, survival crafts and their muster areas. For the purpose of this requirement:

1. *the expression "one of the fire pumps or emergency fire pump" is related to fire pumps required by SOLAS regulation II-2/10.2.2 installed outside the space where spray pump(s) are located; and .*
2. *the expression "fire in one compartment" means a compartment provided with A-class boundaries in which is located the fire pump(s), or the source of power of the fire pump(s), serving the water-spray system in accordance with paragraph 11.3.3.*

Notes 2[9]*:*

1. *The term 'fire pumps' where not qualified by the word 'emergency' refers to the fire pumps required in accordance with SOLAS Reg.II-2/10.2.2.2.2.*
2. *If all the fire pumps mentioned in paragraph 1. above supplying the water spray system (for covering the superstructures and deckhouses) are disabled due to a fire in any one compartment, then the emergency fire pump shall be sized to cover:*

2.1 the water spray system for the boundaries of the superstructures and deckhouses, and lifeboats, liferafts and muster areas facing the cargo area, (as per paragraph 11.3.4); and

2.2 two fire hydrants (as per paragraph 11.2.).

3. *When the ship is fitted with a total flooding high expansion foam system protecting the engine room (to comply with SOLAS II-2/10.4.1.1.2 and 10.5.1.1) and the emergency fire pump is intended to supply sea water to this system, the emergency fire pump shall also be dimensioned to cover the foam system for dealing with an engine room fire, when the main fire pumps are disabled.*
4. *Based on the principle of dealing with one single fire incident at a time, the emergency fire pump does not need to be sized to cover all three systems in 2. and 3. above (i.e. water spray, hydrants and foam) at the same time and need only be sized to cover the most demanding area and required systems, as follows:*

4.1 the foam system + two hydrants, or

4.2 the water spray system + two hydrants

whichever is greater.

11.3.5 Water pumps normally used for other services may be arranged to supply the water-spray system main supply line.

11.3.6 All pipes, valves, nozzles and other fittings in the water-spray system shall be resistant to corrosion by seawater. Piping, fittings and related components within the cargo area (except gaskets) shall be designed to withstand 925°C. The water-spray system shall be arranged with in-line filters to prevent blockage of pipes and nozzles. In addition, means shall be provided to back-flush the system with fresh water.

Notes:

1. *Water spray pipes should be provided with drain holes or valves at the lowest points.*
2. *The sentence 'In addition, means shall be provided to back-flush the system with fresh water', should be understood to mean that arrangements should be provided so that the water-spray system as a whole (i.e. piping, nozzles and in-line filters) can be flushed or back-flushed, as appropriate, with fresh water to prevent the blockage of pipes, nozzles and filters. Reference is made to MSC.1/Circ.1559*

[9] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 22.

3. Where 'F.O. tanks' are installed at the after end of the aftermost hold space or at the forward end of the forwardmost hold space instead of cofferdams as allowed for in Section 3.1.2 and Section 3.1.3, the weather deck area above these tanks should be regarded as a 'cargo area' for the purpose of applying this paragraph (See MSC.1/Circ.1617) [10]

11.3.7 Remote starting of pumps supplying the water-spray system and remote operation of any normally closed valves in the system shall be arranged in suitable locations outside the cargo area, adjacent to the accommodation spaces and readily accessible and operable in the event of fire in the protected areas.

11.3.8 After installation, the pipes, valves, fittings and assembled system shall be subject to a tightness and function test.

----------*end*----------

11.4 Dry chemical powder fire-extinguishing systems

11.4.1 Ships in which the carriage of flammable products is intended shall be fitted with fixed dry chemical powder fire-extinguishing systems, approved by the Administration based on the guidelines developed by the Organization[11], for the purpose of firefighting on the deck in the cargo area, including any cargo liquid and vapour discharge and loading connections on deck and bow or stern cargo handling areas, as applicable.[12]

Note:

Drawings of the system and details of the dry chemical powder are to be submitted to the BKI for approval.

11.4.2 The system shall be capable of delivering powder from at least two hand hose lines, or a combination of monitor/hand hose lines, to any part of the exposed cargo liquid and vapour piping, load/unload connection and exposed gas process units.

11.4.3 The dry chemical powder fire-extinguishing system shall be designed with not less than two independent units. Any part required to be protected by 11.4.2 shall be capable of being reached from not less than two independent units with associated controls, pressurizing medium fixed piping, monitors or hand hose lines. For ships with a cargo capacity of less than 1000 m^3, only one such unit need be fitted. A monitor shall be arranged to protect any load/unload connection area and be capable of actuation and discharge both locally and remotely. The monitor is not required to be remotely aimed, if it can deliver the necessary powder to all required areas of coverage from a single position. One hose line shall be provided at both port- and starboard side at the end of the cargo area facing the accommodation and readily available from the accommodation.[13]

11.4.4 The capacity of a monitor shall be not less than 10 kg/s. Hand hose lines shall be non-kinkable and be fitted with a nozzle capable of on/off operation and discharge at a rate not less than 3,5 kg/s. The maximum discharge rate shall allow operation by one man. The length of a hand hose line shall not exceed 33 m. Where fixed piping is provided between the powder container and a hand hose line or monitor, the length of piping shall not exceed that length which is capable of maintaining the powder in a fluidized state during sustained or intermittent use, and which can be purged of powder when the system is shut down.

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[10] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 38.

[11] Refer to the Guidelines for the approval of fixed dry chemical powder fire-extinguishing systems for the protection of ships carrying liquefied gases in bulk (MSC.1/Circ.1315).

[12] See Notes in paragraph 11.3.1.4

[13] See Notes in paragraph 11.3.1.4..

Hand hose lines and nozzles shall be of weather-resistant construction or stored in weather resistant housing or covers and be readily accessible.

11.4.5 Hand hose lines shall be considered to have a maximum effective distance of coverage equal to the length of hose. Special consideration shall be given where areas to be protected are substantially higher than the monitor or hand hose reel locations.

11.4.6 Ships fitted with bow/stern load/unload connections shall be provided with independent dry powder unit protecting the cargo liquid and vapour piping, aft or forward of the cargo area, by hose lines and a monitor covering the bow/stern load/unload complying with the requirements of 11.4.1 to 11.4.5.

11.4.7 Ships intended for operation as listed in Secion 1, A.7.12 shall be subject to special consideration.

11.4.8 After installation, the pipes, valves, fittings and assembled systems shall be subjected to a tightness test and functional testing of the remote and local release stations. The initial testing shall also include a discharge of sufficient amounts of dry chemical powder to verify that the system is in proper working order. All distribution piping shall be blown through with dry air to ensure that the piping is free of obstructions.

Notes[14]***:***

Testing arrangements should involve the discharge using dry chemical powder from all monitors and hand hose lines on board but it is not required that there is a full discharge of the installed quantity of dry powder. This testing may also be used to satisfy the requirement that the piping is free of obstructions, in lieu of blowing through with dry air all the distribution piping. However, after the completion of this testing, the system, including all monitors and hand hose lines, should be blown through with dry air but only for the purpose of the system subsequently being clear from any residues of dry chemical powder

----------*end*----------

[14] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 31.

Section 13 Instrumentation and Automation Systems

13.2 Level indicators for cargo tanks

13.2.1 Each cargo tank shall be fitted with liquid level gauging device(s), arranged to ensure that a level reading is always obtainable whenever the cargo tank is operational. The device(s) shall be designed to operate throughout the design pressure range of the cargo tank and at temperatures within the cargo operating temperature range.

13.2.2 Where only one liquid level gauge is fitted, it shall be arranged so that any part of the level gauge can be maintained in an operational condition without the need to empty or gas-free the tank.

Notes[1]:

In order to assess whether or not only one level gauge is acceptable in relation to the aforesaid sentence, the expression 'can be maintained' means that any part of the level gauge other than passive parts can be overhauled while the cargo tank is in service.

Passive parts are those parts assumed not subject to failures under normal service conditions.

----------*end*----------

13.3 Overflow control

13.3.5 The position of the sensors in the tank shall be capable of being verified before commissioning. At the first occasion of full loading after delivery and after each dry-docking, testing of high-level alarms shall be conducted by raising the cargo liquid level in the cargo tank to the alarm point.

Notes[2]:

The expression "each dry docking" is considered to be the survey of the outside of the ship's bottom required for the renewal of the Cargo Ship Safety Construction Certificate and or the Cargo Ship Safety Certificate.

13.3.6 All elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overfill alarms, shall be capable of being functionally tested. Systems shall be tested prior to cargo operation in accordance with Section 18.6.2.

13.3.7 Where arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated, continuous visual indication shall be given at the relevant control station(s) and the navigation bridge.[3]

----------*end*----------

13.6 Gas detection

13.6.1 Gas detection equipment shall be installed to monitor the integrity of the cargo containment, cargo handling and ancillary systems, in accordance with this section.

13.6.2 A permanently installed system of gas detection and audible and visual alarms shall be fitted in:

1 As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 27.
2 As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 18.
3 See Note 4 of Table 18.1

.1 all enclosed cargo and cargo machinery spaces (including turrets compartments) containing gas piping, gas equipment or gas consumers;

.2 other enclosed or semi-enclosed spaces where cargo vapours may accumulate, including interbarrier spaces and hold spaces for independent tanks other than type C tanks;

.3 airlocks;

.4 spaces in gas-fired internal combustion engines, referred to in Section 16.7.3.3;

.5 ventilation hoods and gas ducts required by Section 16;

.6 cooling/heating circuits, as required by Section 7.8.4;

.7 inert gas generator supply headers; and

.8 motor rooms for cargo handling machinery.

Note:

Gas detection, with regard to 13.6.2.7, should be fitted for the pipe section between the inert gas generator and devices preventing back flow.

13.6.3 Gas detection equipment shall be designed, installed and tested in accordance with recognized standards[4] and shall be suitable for the cargoes to be carried in accordance with column *"f"* in table of Section 19.

13.6.4 Where indicated by an "A" in column *"f"* in the table of Section 19 ships certified for carriage of non-flammable products, oxygen deficiency monitoring shall be fitted in cargo machinery spaces and ~~cargo tank~~ hold spaces for independent tanks other than type C tanks. Furthermore, oxygen deficiency monitoring equipment shall be installed in enclosed or semi-enclosed spaces containing equipment that may cause an oxygen-deficient environment such as nitrogen generators, inert gas generators or nitrogen cycle refrigerant systems.

Note[5]:

Two oxygen sensors are to be positioned at appropriate locations in the space or spaces containing the inert gas system, in accordance with paragraph 15.2.2.4.5.4 of the FSS Code, for all gas carriers, irrespective of the carriage of cargo indicated by an "A" in column "f" in the table in Section 19 of this Rules.

----------*end*----------

13.6.11 When gas sampling equipment is located in a non-hazardous space, a flame arrester and a manual isolating valve shall be fitted in each of the gas sampling lines. The isolating valve shall be fitted on the non-hazardous side. Bulkhead penetrations of sample pipes between hazardous and non-hazardous areas shall maintain the integrity of the division penetrated. The exhaust gas shall be discharged to the open air in a ~~non-hazardous area~~ safe location.

----------*end*----------

13.9 System integration

13.9.1 Essential safety functions shall be designed such that risks of harm to personnel or damage to the installation or the environment are reduced to a level acceptable to the Administration, both in normal

[4] IEC 60079-29-1 – Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable gases.

[5] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 36.

operation and under fault conditions. Functions shall be designed to fail-safe. Roles and responsibilities for integration of systems shall be clearly defined and agreed by relevant parties.

13.9.2 Functional requirements of each component subsystem shall be clearly defined to ensure that the integrated system meets the functional and specified safety requirements and takes account of any limitations of the equipment under control.

13.9.3 Key hazards of the integrated system shall be identified using appropriate risk-based techniques.

Notes[6] *:*

1. The expression 'integrated system' means a combination of computer-based systems which are used for the control, monitoring/alarm and safety functions required for the carriage, handling and conditioning of cargo liquid and vapours and are interconnected in order to allow communication between computer-based systems and to allow centralized access to monitoring/alarm and safety information and/or command/control.

2. Referenced Guidelines: MSC/Circ.891 – Guidelines for the on-board use and application of computers

2.1 Computer:

A programmable electronic device for storing and processing data, making calculations, or any programmable electronic system (PES), including main-frame, mini-computer or micro-computer.

2.2 Computer-based system:

A system of one or more computers, associated software, peripherals and interfaces.

2.3 Integrated system:

A combination of computer-based systems which are interconnected in order to allow centralized access to sensor information and/or command/control.

13.9.4 The integrated system shall have a suitable means of reversionary control.

13.9.5 Failure of one part of the integrated system shall not affect the functionality of other parts, except for those functions directly dependent on the defective part.

13.9.6 Operation with an integrated system shall be at least as effective as it would be with individual stand-alone equipment or systems.

13.9.7 The integrity of essential machinery or systems, during normal operation and fault conditions, shall be demonstrated.

----------*end*----------

[6] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 29

Section 16 Use of Cargo as Fuel

16.4 Gas fuel supply

16.4.6 Spaces containing gas consumers

16.4.6.1 It shall be possible to isolate the gas fuel supply to each individual space containing a gas consumer(s) or through which fuel gas supply piping is run, with an individual master valve, which is located within the cargo area. The isolation of gas fuel supply to a space shall not affect the gas supply to other spaces containing gas consumers if they are located in two or more spaces, and it shall not cause loss of propulsion or electrical power.

Note:

High-pressure gas piping, which according to 16.4.3.2 is installed in a ventilated pipe or duct, is to be subdivided into sections between master gas fuel valve and gas utilization unit by quick-closing valves, if a major volume of gas may penetrate into the duct or pipe in the event of pipe burst. The number of quick-closing valves is to be agreed with the ~~Society~~ BKI, taking into account the gas pressure and the volume of the gas piping. Under the same criteria the quick-closing valves must close automatically like the master gas fuel valves mentioned in 16.4.6.1.

----------*end*----------

16.7 Special requirements for gas-fired internal combustion engines

Dual fuel engines are those that employ gas fuel (with pilot oil) and oil fuel. Oil fuels may include distillate and residual fuels. Gas only engines are those that employ gas fuel only.

16.7.1 Arrangements

16.7.1.1 When gas is supplied in a mixture with air through a common manifold, flame arrestors shall be installed before each cylinder head.

16.7.1.2 Each engine shall have its own separate exhaust.

16.7.1.3 The exhausts shall be configured to prevent any accumulation of unburnt gaseous fuel.

16.7.1.4 Unless designed with the strength to withstand the worst case overpressure due to ignited gas leaks, air inlet manifolds, scavenge spaces, exhaust system and crank cases shall be fitted with suitable pressure relief systems. Pressure relief systems shall lead to a safe location, away from personnel.

Note[1]:

A suitable pressure relief system for air inlet manifolds, scavenge spaces and exhaust system is to be provided unless designed to accommodate the worst-case overpressure due to ignited gas leaks or justified by the safety concept of the engine. A detailed evaluation regarding the hazard potential of overpressure in air inlet manifolds, scavenge spaces and exhaust system is to be carried out and reflected in the safety concept of the engine.

In the case of crankcases, the explosion relief valves, as required by Regulation 27.4 of SOLAS Chapter II-1 as amended by IMO resolutions up to MSC.436(99), are to be considered suitable for the gas operation of the engine. For engines not covered by said Regulation, a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase is to be carried out.

[1] As mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 37.

----------*end*----------

16.9 Alternative fuels and technologies

16.9.1 If acceptable to the Administration, other cargo gases may be used as fuel, providing that the same level of safety as natural gas in this Rule is ensured.

16.9.2 The use of cargoes identified as toxic products shall not be permitted.

16.9.3 For cargoes other than LNG, the fuel supply system shall comply with the requirements of 16.4.1, 16.4.2, 16.4.3 and 16.5, as applicable, and shall include means for preventing condensation of vapour in the system.

16.9.4 Liquefied gas fuel supply systems shall comply with 16.4.5.

16.9.5 In addition to the requirements of 16.4.3.2, both ventilation inlet and outlet shall be ~~in a non-hazardous area external to~~ outside the machinery space. The inlet shall be in a non-hazardous area and the outlet shall be in a safe location.

C16.9.6 Equivalent safety as methane as fuel shall be documented through a risk assessment. Relevant fuel product will be given in register information where C indicates fuel product.

----------*end*----------

Section 17 Special Requirements

17.8 Inhibition

Care shall be taken to ensure that the cargo is sufficiently inhibited to prevent self-reaction (e.g. polymerization or dimerization) at all times during the voyage. Ships shall be provided with a certificate from the manufacturer stating:

.1 name and amount of inhibitor added;

.2 date inhibitor was added and the normally expected duration of its effectiveness;

.3 any temperature limitations affecting the inhibitor; and

.4 the action to be taken ~~should~~ shall the length of the voyage exceed the effective lifetime of the inhibitors.

----------*end*----------

Section 18 Operating Requirements

18.9 Cargo sampling

18.9.1 Any cargo sampling shall be conducted under the supervision of an officer who shall ensure that protective clothing appropriate to the hazards of the cargo is used by everyone involved in the operation[1].

18.9.2 When taking liquid cargo samples, the officer shall ensure that the sampling equipment is suitable for the temperatures and pressures involved, including cargo pump discharge pressure, if relevant.

18.9.3 The officer shall ensure that any cargo sample equipment used is connected properly to avoid any cargo leakage.

18.9.4 If the cargo to be sampled is a toxic product, the officer shall ensure that a "closed loop" sampling system as defined in Section 1.2.15 is used to minimize any cargo release to atmosphere.

18.9.5 After sampling operations are completed, the officer shall ensure that any sample valves used are closed properly and the connections used are correctly blanked.[1]

----------*end*----------

18.10 Cargo emergency shutdown (ESD) system

18.10.1 General

18.10.1.3 The ESD system shall be activated by the manual and automatic initiations listed in Table 18.1. Any additional initiations shall only be included in the ESD system if it can be shown that their inclusion does not reduce the integrity and reliability of the system overall.

[1] See Note in Section 5.6.5.1

Table 18.1 – ESD functional arrangements

	Pumps		Compressor systems				Valves	Link
Shutdown action → Initiation ↓	Cargo pumps/ cargo booster pumps	Spray/ stripping pumps	Vapour return compressors	Fuel gas compressors	Reliquefaction plant***, including condensate return pumps, if fitted	Gas combustion unit	ESD valves	Signal to ship/ shore link****
Emergency push buttons (see 18.10.3.1)	✓	✓	✓	Note 2	✓	✓	✓	✓
Fire detection on deck or in compressor house* (see 18.10.3.2)	✓	✓	✓	✓	✓	✓	✓	✓
High level in cargo tank (see Section 13.3.2 and 13.3.3)	✓	✓	✓	Note 1 Note 2	Note1 Note 3	Note 1	Note 6	✓
Signal from ship/shore link (see 18.10.1.4)	✓	✓	✓	Note 2	Note 3	n/a	✓	n/a
Loss of motive power to ESD valves**	✓	✓	✓	Note 2	Note 3	n/a	✓	✓
Main electric power failure ("blackout")	Note 7	Note 7	Note 7	Note 7	Note 7	Note 7	✓	✓
Level alarm override (see Section 13.3.7)	Note 4	Note 4 Note 5	✓	Note 1	Note1	Note 1	✓	✓

Note 1: These items of equipment can be omitted from these specific automatic shutdown initiators, provided the equipment inlets are protected against cargo liquid ingress.

Note 2: If the fuel gas compressor is used to return cargo vapour to shore, it shall be included in the ESD system when operating in this mode.

Note 3: If the reliquefaction plant compressors are used for vapour return/shore line clearing, they shall be included in the ESD system when operating in that mode.

Note 4: The override system permitted by Section 13.3.7 may be used at sea to prevent false alarms or shutdowns. When level alarms are overridden, operation of cargo pumps and the opening of manifold ESD valves shall be inhibited except when high-level alarm testing is carried out in accordance with Section 13.3.5 (see 18.10.3.4)[2].

Note 5: Cargo spray or stripping pumps used to supply forcing vaporizer may be excluded from the ESD system only when operating in that mode.

Note 6: The sensors referred to in Section 13.3.2 may be used to close automatically the tank filling valve for the individual tank where the sensors are installed, as an alternative to closing the ESD valve referred to in 18.10.2.2. If this option is adopted, activation of the full ESD system shall be initiated when the high-level sensors in all the tanks to be loaded have been activated.

Note 7: These items of equipment shall be designed not to restart upon recovery of main electric power and without confirmation of safe conditions.

* Fusible plugs, electronic point temperature monitoring or area fire detection may be used for this purpose on deck.

** Failure of hydraulic, electric or pneumatic power for remotely operated ESD valve actuators.

*** Indirect refrigeration systems which form part of the reliquefaction plant do not need to be included in the ESD function if they employ an inert medium such as nitrogen in the refrigeration cycle.

**** Signal need not indicate the event initiating ESD.

✓ Functional requirement.

N/A Not applicable.

[2] In applying the second sentence of Note 4 of Table 18.1, a hardware system such as an electric or mechanical interlocking device is to be provided to prevent inadvertent operation of cargo pumps and inadvertent opening of manifold ESD valves.(as mentioned in Guidance for Code and Convention Interpretations (Pt.1, Vol.Y), Sec. 4, GC 35)

----------*end*----------

18.10.2 ESD valve requirements

18.10.2.1 General

18.10.2.1.1 The term ESD valve means any valve operated by the ESD system.

18.10.2.1.2 ESD valves shall be remotely operated, be of the fail-closed type (closed on loss of actuating power), be capable of local manual closure and have positive indication of the actual valve position. As an alternative to the local manual closing of the ESD valve, a manually operated shut-off valve in series with the ESD valve shall be permitted. The manual valve shall be located adjacent to the ESD valve. Provisions shall be made to handle trapped liquid ~~should~~ shall the ESD valve close while the manual valve is also closed.

C18.10.2.1.2 When ESD valve is actuated by hydraulic or pneumatic system, the following shall be complied with.

- Audible and visible alarm shall be given in the event of loss of pressure that causes activation of fail-close action. The alarm shall be provided in a normally manned control station (e.g. Cargo Control Room and/or the navigation bridge, etc.).
- The following conditions shall also be complied to ensure the fail-close action:
  1. Failure of hydraulic or pneumatic system shall not lead to loss of fail-close functionality (i.e. activated by spring or weight); or
  2. Hydraulic or pneumatic system for fail-close action shall be arranged with stored power and separated from normal valve operation

----------*end*----------

18.10.3 ESD system controls

18.10.3.2 The ESD system shall be automatically activated on detection of a fire on the weather decks of the cargo area and/or cargo machinery spaces. As a minimum, the method of detection used on the weather decks shall cover the liquid and vapour domes of the cargo tanks, the cargo manifolds and areas where liquid piping is dismantled regularly. Detection may be by means of fusible elements designed to melt at temperatures between 98°C and 104°C, or by area fire detection methods.[3]

----------*end*----------

[3] See Notes in Section 11.3.1.4.