Subject

Summary of the Outcomes of MSC 109

**ClassNK**
# Technical Information

No. TEC-1350
Date 1 May 2025

To whom it may concern

The 109th session of the Maritime Safety Committee (MSC 109) was held from 2 to 6 December 2024. Since the minutes, resolutions and circulars of the meeting were recently released from the IMO, a summary of the decisions taken at MSC 109 is provided below for your information.

1. Adopted mandatory requirements
   Mandatory requirements adopted at MSC 109 are as follows:

   (1) Amendments to IGC Code (See attachment 1, 2)
   Amendments to chapter 16 of the IGC Code to make cargos identified as toxic products conditionally usable as fuel, in view of the launch of ammonia-fuelled vessels were adopted. In addition, the MSC circular to invite a voluntary early implementation of the amendments was also released.

   Applied: on or after 1 July 2026.

   (2) Amendments to IGF Code (See attachment 3)
   Amendments to IGF Code regarding suction wells installed in fuel tanks, pressure relief valves of piping system, segregation and insulation of boundary of accommodation spaces and others facing the fuel tanks, hazardous area etc. were adopted as a part of the task for amendments to the IGF Code and development of guidelines for alternative fuels and related technologies.

   Applied: ships that fall under the following:
   1. for which the building contract is placed on or after 1 January 2028;
   2. in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 July 2028; or
   3. the delivery of which is on or after 1 January 2032.

   However, the requirements concerning the extent to which the suction wells installed in fuel tanks may protrude into the vertical distance from the bottom shell plating (5.3.3.5.1, 5.3.4.2) apply also to existing ships;

(To be continued)

2. Approved mandatory requirements

The following mandatory requirements were approved at this session and are expected to be adopted at MSC 110 to be held in June 2025.

(1) Amendments to HSC Code (See attachment 4)

Amendments to 1994 HSC Code and 2000 HSC Code regarding the numbers of lifejackets for infants and adults weighing up to 140 kg.

(2) Amendments to IGC Code (See attachment 5)

Amendments to Chapter 1 to 5, 8 to 13 and 15 to 19 of the IGC Code regarding the filling limit, requirements of using cargo other than LNG as a fuel, special requirements for carbon dioxide, etc.

(3) Amendments to SOLAS regulation II-1 (See attachment 6)

Amendments to SOLAS regulation II-1/56 to include gaseous fuels irrespective of flashpoint in application of IGF Code in addition to low-flashpoint fuels.

3. Approved unified interpretations, etc.

The following unified interpretations (UIs), guidelines, guidance and etc. were approved during MSC 109.

3.1 Unified interpretations

(1) Unified interpretation of SOLAS regulation III/20.8.4 and 20.11, and resolution MSC.402(96) (See attachment 7)

Unified interpretation of SOLAS regulation III/20.8.4 and 20.11 to clarify that SOLAS regulation III/20.11 and resolution MSC.402(96) should also be applicable to inflated rescue boats

(2) Unified interpretation of SOLAS regulation II-2/4.5.6.1 and 20.11, and paragraph 3.1.2, 3.1.4 and 3.5.3 of the IBC Code (See attachment 8)

Unified interpretation of SOLAS regulation II-2/4.5.6.1 and 20.11, and paragraph 3.1.2, 3.1.4 and 3.5.3 of the IBC Code regarding gas-freeing air-supply piping system located outside of the cargo area

(3) Unified interpretation of SOLAS regulation II-2 (See attachment 9)

1. Unified interpretation of SOLAS regulation II-2/4.5.3.2.2 and 11.6.3.2 clarifying the secondary means of venting cargo tanks; and
2. Unified interpretation of SOLAS regulation II-2/11.4.1 regarding the definition of crowns for machinery spaces of category A

(4) Unified interpretation of SOLAS regulation II-1 (See attachment 10)

Unified interpretation of SOLAS regulation II-1/26.2 regarding the reliability of single essential propulsion components

(To be continued)

3.2 Guidelines and guidance etc.

(1) Revised standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks in tankers (See attachment 11)
Amendments to standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks in tankers (MSC.1/Circ.677) to incorporate the previous amendment made (MSC.1/Circ.1324) and updating references.

(2) Interim guidelines for ships using ammonia as fuel (See attachment 12)
Interim guidelines for ships using ammonia as fuel, as a part of the task for amendments to the IGF Code and development of guidelines for alternative fuels and related technologies. The interim guidelines do not address ships using ammonia cargo as fuel.

4. Goal-based Standards (GBS)

GBS, as stipulated in SOLAS II-1/3-10, is applied to oil tankers and bulk carriers of 150m in length and above. Design and construction of these ships shall comply with rules deemed as compliant with GBS.
Further, GBS requires maintenance of verification to the rules as conforming to the goals and functional requirements of GBS based on the GBS Verification Guidelines (MSC.454(100)).
At this session, the GBS audit report and actions taken by the IACS for the 2022 amendments to IACS Recommendation No.34 (Rec.34/Rev.2), which provides wave scatter diagram to be used as the basis for the IACS Common Structural Rules (CSR) were considered, and it was agreed to add more detailed information about the wave data.

5. Consideration of requirements for Maritime Autonomous Surface Ships (MASS)

In the recent development of MASS, it has been discussed at MSC on an international instrument of MASS (MASS Code). Non-mandatory MASS Code mainly on goal and functional requirements for items such as safety, operation, security, etc. is currently under consideration.
At this session, based on the report by the intersessional working group (ISWG) meeting held in September 2024, chapters of Risk Assessment (Chapter 7), Connectivity (Chapter 12), and Remote Operations (Chapter 18) were finalized. In addition, the future work plan was reviewed, and it was agreed that an intersessional working group meeting will be held in the second half of 2025, and that the non-mandatory MASS Code will be finalized at MSC 111, scheduled for 2026. There will be no changes regarding the schedule for mandatory MASS Code, i.e. it will be considered after the development of the non-mandatory MASS Code, with a view to adoption by 2030.

At this time, the structure of the non-mandatory MASS Code will be as follows.

Part 1: Introduction (purpose and application of the code)

Part 2: Main principles for MASS and MASS functions (certificate and survey, approval process, risk assessment, operational context, human element, etc.)

Part 3: Goals, functional requirements and expected performance (stipulating for each item such as safety of navigation and remote operations)

(To be continued)

6. A safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels

   At MSC 107, identification and updating a list of new technologies and alternative fuels to reduce greenhouse gas (GHG) emissions and their technical assessment, as well as a review of safety obstacles and gaps in the current IMO instruments that may impede the use of the alternative fuel or new technology, were initiated. The correspondence group is working to update the list and is supposed to report to MSC 110.

   In addition, it was proposed that the IGF Code should also apply to gaseous fuels irrespective of flashpoint by the Sub-Committee on Carriage of Cargoes and Containers held in September 2024 (CCC 10). At this session, amendments to SOLAS II-1/56 to apply the IGF code to all gaseous fuels, not just low-flashpoint fuels, was approved. It is expected to be adopted at MSC 110.

7. Cyber risk management

   In view of the growing importance of cyber security on board ships and the need for security risk countermeasures, Resolution MSC.428(98) on maritime cyber risk management and the non-mandatory guidelines (MSC-FAL.1/Circ.3/Rev.2) for reference in the implementation of this resolution have been developed.

   At the previous session, a draft amendment to the guidelines in light of the increased use of cyber-connected systems in recent years were agreed. The draft amendment to the guidelines were further approved by subsequent 49th session of the Facilitation Committee (FAL 49) and published as an MSC-FAL Circular (MSC-FAL.1/Circ.3/Rev.3).

   At this session, it was agreed to the need to further develop cybersecurity standards for ships and port facilities as next steps to enhance maritime cybersecurity and also agreed to extend the target completion of the output on this agenda item to year 2026 to further discussion.

For any questions about the above, please contact:

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(To be continued)

Attachment:

1. RESOLUTION MSC.566(109)
2. MSC.1/Circ.1681 Voluntary early implementation of the amendments to chapter 16 of the IGC Code
3. RESOLUTION MSC.567(109)
4. DRAFT AMENDMENTS TO THE HSC CODE
5. DRAFT AMENDMENTS TO THE IGC CODE
6. DRAFT AMENDMENTS TO SOLAS CHAPTER II-1
7. MSC.1/Circ.1682 Unified interpretations of SOLAS regulations III/20.8.4 and 20.11, and resolution MSC.402(96)
8. MSC.1/Circ.1683 Unified interpretations of SOLAS regulation II-2/4.5.6.1, and paragraphs 3.1.2, 3.1.4 and 3.5.3 of the IBC Code
9. MSC.1/Circ.1684 Unified Interpretations of SOLAS chapter II-2
10. MSC.1/Circ.1685 Unified interpretation of SOLAS chapter II-1
11. MSC.1/Circ.677/Rev.1 Revised standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks in tankers
12. MSC.1/Circ.1687 Interim guidelines for the safety of ships using ammonia as fuel

# ANNEX 1

## RESOLUTION MSC.566(109)
## (adopted on 6 December 2024)

## AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (IGC CODE)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

NOTING resolution MSC.5(48), by which it adopted the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk ("the IGC Code"), which has become mandatory under chapter VII of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"), and subsequent amendments adopted to the IGC Code,

NOTING ALSO article VIII(b) and regulation VII/11.1 of the Convention concerning the procedure for amending the IGC Code,

HAVING CONSIDERED, at its 109th session, amendments to the IGC Code proposed and circulated in accordance with article VIII(b)(i) of the Convention,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the IGC Code, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on 1 January 2026, unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have notified their objections to the amendments;

3 INVITES Contracting Governments to the Convention to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 July 2026 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Contracting Governments to the Convention;

5 ALSO REQUESTS the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (IGC CODE)**

**CHAPTER 16**
**USE OF CARGO AS FUEL**

1 Paragraph 16.9.2 is replaced by the following:

"16.9.2 The use of cargoes requiring carriage in type 1G ships, as identified in column "c" in the table of chapter 19, shall not be permitted. If acceptable to the Administration, cargoes identified as toxic products in column "f" which are required to be carried in type 2G/2PG ships in column "c" in the table of chapter 19 may be used as fuel, provided that the same level of safety as natural gas (methane) is ensured in accordance with the relevant provisions of this Code, including those in 1.3, and taking into account the guidelines developed by the Organization*, after special consideration has been given by the Administration."

* Refer to the guidelines to be developed by the Organization.

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MSC.1/Circ.1681
26 February 2025

**VOLUNTARY EARLY IMPLEMENTATION OF THE AMENDMENTS TO CHAPTER 16 OF THE IGC CODE, ADOPTED BY RESOLUTION MSC.566(109)**

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), adopted amendments to the IGC Code by resolution MSC.566(109).

2 The entry-into-force date of the aforementioned amendments is 1 July 2026, applicable to ships subject to the Code, the keels of which are laid, or which are at a similar stage of construction, on or after 1 July 2016, in accordance with paragraph 1.1.2.1 of the IGC Code.

3 In adopting the amendments to chapter 16 of the IGC Code, the Committee, having considered the need for their voluntary early implementation, in accordance with the *Guidelines on the voluntary early implementation of amendments to the 1974 SOLAS Convention and related mandatory instruments* (MSC.1/Circ.1565), agreed to invite the Contracting Governments to the International Convention for the Safety of Life at Sea, 1974, to implement them prior to the entry-into-force date.

4 Voluntary early implementation should be communicated by a Contracting Government to the Organization for dissemination through GISIS (Module on Survey and Certification).

5 In addition to the aforementioned communication, a Contracting Government may also consider the use of the existing provisions for equivalent arrangements under SOLAS regulation I/5 to cover the interim period between the date of the voluntary early implementation and the entry-into-force date of the amendments.

6 A Contracting Government, in line with paragraph 1.2.4 of the *Procedures for port State control, 2023* (resolution A.1185(33)), as may be amended, when acting as a port State, should refrain from enforcing its decision on the voluntary early implementation of amendments to chapter 16 of the IGC Code to ships entitled to fly the flag of other Contracting Governments, calling at its ports.

7 The Contracting Governments, when undertaking port State control activities, should take into account the present invitation and any subsequent notifications communicated by other Contracting Governments through GISIS.

8 Contracting Governments are invited to be guided accordingly and to bring the contents of this circular to the attention of all concerned, especially port State control authorities and recognized organizations.

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## ANNEX 2

## RESOLUTION MSC.567(109)
**((adopted on 6 December 2024)**

## AMENDMENTS TO THE INTERNATIONAL CODE OF SAFETY FOR SHIPS USING GASES OR OTHER LOW-FLASHPOINT FUELS (IGF CODE)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

NOTING resolution MSC.391(95), by which it adopted the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code), which has become mandatory under chapter II-1 of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"), and subsequent amendments adopted to the IGF Code,

NOTING ALSO article VIII(b) and regulation II-1/2.28 of the Convention concerning the procedure for amending the IGF Code,

HAVING CONSIDERED, at its 109th session, amendments to the IGF Code proposed and circulated in accordance with article VIII(b)(i) of the Convention:

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the IGF Code, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on 1 July 2027, unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have notified the Secretary-General of their objections to the amendments;

3 INVITES Contracting Governments to the Convention to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on 1 January 2028 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Contracting Governments to the Convention;

5 ALSO REQUESTS the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CODE OF SAFETY FOR SHIPS USING GASES OR OTHER LOW-FLASHPOINT FUELS (IGF CODE)**

## PART A

### 2 General

### 2.2 Definitions

1 The following new paragraph 2.2.44 is added after paragraph 2.2.43:

"2.2.44 *Ship constructed on or after 1 January 2028* means:

.1 for which the building contract is placed on or after 1 January 2028; or

.2 in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 July 2028; or

.3 the delivery of which is on or after 1 January 2032."

## PART A-1
## Specific requirements for ships using natural gas as fuel

### 5 Ship design and arrangement

### 5.3 Regulations – General

2 The following new paragraph 5.3.3.5.1 is inserted after paragraph 5.3.3.5 and before paragraph 5.3.3.6:

"5.3.3.5.1 For ships with suction wells installed in fuel tanks, the bottom of the suction well may protrude into the vertical extent of the minimum distance specified in 5.3.3.5, provided that such wells are as small as practicable and the protrusion below the inner bottom plating does not exceed 25% of the depth of the double bottom or 350 mm, whichever is less."

3 In sub-paragraph 5.3.4.2, the definition of "*H*" is replaced by the following:

"*H* is the distance from baseline, in metres, to the lowermost boundary of the fuel tank excluding the suction well, if installed; and"

## 7 Material and general pipe design

### 7.3 Regulations for general pipe design

4 The following new paragraph 7.3.1.4 is inserted after paragraph 7.3.1.3 and the subsequent paragraphs 7.3.1.4 and 7.3.1.5 are renumbered as 7.3.1.5 and 7.3.1.6 accordingly:

"7.3.1.4 For ships constructed on or after 1 January 2028, pressure relief valves discharging liquid or gas from the piping system shall discharge into the fuel tanks whenever the tank MARVS pressure is lower than the setting of the pressure relief valves in accordance with the arrangements in 9.4.2, and shall be designed to ensure that the required discharge capacity is met. Alternatively, they may discharge to the vent mast, if means are provided to detect and dispose of any liquid that may flow into the vent system."

## 9 Fuel supply to consumers

### 9.4 Regulations on safety functions of gas supply system

5 The following new paragraph 9.4.2 is inserted after paragraph 9.4.1 and the subsequent paragraphs 9.4.2 to 9.4.10 are renumbered as 9.4.3 to 9.4.11 accordingly:

"9.4.2 For ships constructed on or after 1 January 2028, fuel tank inlets from pressure relief valve discharge lines, protecting the piping system according to 7.3.1.4, shall be provided with non-return valves in lieu of valves that are automatically operated when the safety system required in 15.2.2 is activated. Safe means for tank isolation during maintenance shall be available according to 18.3 without affecting the proper operation of pressure relief valves."

## 11 Fire safety

### 11.3 Regulations for fire protection

6 Paragraph 11.3.2 is replaced by the following:

"11.3.2.1 Any boundary of accommodation spaces, service spaces, control stations, escape routes and machinery spaces, facing fuel tanks on open deck, shall be shielded by A-60 class divisions. The A-60 class divisions shall extend up to the underside of the deck of the navigation bridge. For ships constructed on or after 1 January 2028, any such boundary facing the fuel tank on the open deck which is separated by a minimum distance, as determined to the satisfaction of the Administration through a heat analysis to provide protection equivalent to an A-60 class division, shall be considered acceptable, and intermediate structures providing heat protection to the above spaces may also be considered acceptable. Notwithstanding the above-mentioned requirements:

.1 for oil tankers and chemical tankers constructed on or after 1 January 2028, A-60 insulation, required by SOLAS regulation II-2/9.2.4.2.5, shall be considered to meet the above-mentioned requirements provided that the fuel tank is located in the cargo area forward of accommodation spaces, service spaces, control stations, escape routes and machinery spaces. Consideration for the protection of accommodation block sides may be necessary; and

.2 for ships constructed on or after 1 January 2028, where no source of gas release from the fuel containment system is considered possible, e.g. a type C tank in which tank connections are in a tank connection space, A-60 class shielding is not required.

11.3.2.2 Fuel tanks shall be segregated from cargo in accordance with the requirements of the International Maritime Dangerous Goods (IMDG) Code where fuel tanks are regarded as bulk packaging. For the purposes of stowage and segregation requirements of the IMDG Code, a fuel tank on the open deck shall be considered as a class 2.1 package."

7 Paragraph 11.3.3.1 is replaced by the following:

"11.3.3.1 Notwithstanding the last sentence in paragraph 11.3.3, for ships constructed on or after 1 January 2028, the fuel storage hold space may be considered as a cofferdam provided that:

.1 the type C tank is not located directly above machinery spaces of category A or other rooms with high fire risk; and

.2 the minimum distance to the A-60 boundary from the outer surface of the insulation system of a type C tank or the boundary of the tank connection space, if any, is not less than 900 mm. For the vacuum insulated type C tank, outer surface of the insulation system means outer surface of the outer shell."

**12 Explosion prevention**

**12.5 Hazardous area zones**

12.5.2 Hazardous area zone 1

8 Sub-paragraph 12.5.2.3 is replaced by the following:

".3 For ships constructed on or after 1 January 2028, areas on open deck, or semi-enclosed spaces on deck, within 3 m of any fuel tank outlet, gas or vapour outlet,* bunker manifold valve, other fuel valve, fuel pipe flange, ventilation outlets from zone 1 spaces and fuel tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation;

* Such areas are, for example, all areas within 3 m of fuel tank hatches, ullage openings or sounding pipes for fuel tanks located on open deck and gas vapour outlets."

9 The following new sub-paragraph 12.5.2.4 is inserted after sub-paragraph 12.5.2.3 and the subsequent sub-paragraphs 12.5.2.4 to 12.5.2.9 are renumbered as 12.5.2.5 to 12.5.2.10 accordingly:

".4 for ships constructed on or after 1 January 2028, areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of a fuel tank vent mast outlet within a vertical cylinder of unlimited height and 6 m radius centred upon the centre of the outlet, and within a hemisphere of 6 m radius below the outlet. Where it is not possible to maintain the above distances due to the size and layout of the ship, a reduced zone can be accepted based on a dispersion analysis, using 50% LEL criteria. The zone dimensions shall never be less than those given in 12.5.2.3, and shall include a surrounding zone 2 hazardous area meeting the dimensions given in 12.5.3.1."

12.5.3 Hazardous area zone 2

10 The following new paragraph 12.5.3.3 is added after paragraph 12.5.3.2:

"12.5.3.3 In lieu of 12.5.3.1, for ships constructed on or after 1 January 2028, this zone includes spaces 4 m beyond the cylinder and 4 m beyond the hemisphere defined in 12.5.2.4".

**13 Ventilation**

**13.3 Regulations – General**

11 Paragraph 13.3.5 is replaced by the following:

"13.3.5 For ships constructed on or after 1 January 2028, air inlets for hazardous enclosed spaces shall be taken from areas that, except for the inlets, would be non-hazardous. Air inlets for non-hazardous enclosed spaces shall be taken from non-hazardous areas at least 1.5 m away from the boundaries of any hazardous area."

12 The following new paragraph 13.3.8 is inserted after paragraph 13.3.7 and the subsequent paragraphs 13.3.8 to 13.3.10 are renumbered as 13.3.9 to 13.3.11 accordingly:

"13.3.8 For ships constructed on or after 1 January 2028:

.1 where the ventilation ducts serving non-hazardous spaces pass through a hazardous space, the ducts shall be gastight and have overpressure relative to that hazardous space; and

.2 where the ventilation ducts serving hazardous spaces pass through less hazardous or non-hazardous spaces, the ducts shall be gastight and have underpressure relative to the less hazardous or non-hazardous spaces. Ventilation pipes serving hazardous spaces that pass through less hazardous or non-hazardous spaces are acceptable without the need for underpressure, provided that they are fully welded and designed in accordance with chapter 7."

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# ANNEX 7

## DRAFT AMENDMENTS TO THE INTERNATIONAL CODE OF SAFETY FOR HIGH-SPEED CRAFT, 1994 (1994 HSC CODE)

## CHAPTER 8
## LIFE-SAVING APPLIANCES AND ARRANGEMENTS

### 8.3 Personal life-saving appliances

1 Paragraph 8.3.5 is replaced by the following:

"8.3.5 A lifejacket complying with the requirements of regulation III/32.1 or regulation III/32.2 of the Convention should be provided for every person on board the craft and, in addition:

.1 a number of lifejackets suitable for children equal to at least 10% of the number of passengers on board should be provided or such greater number as may be required to provide a lifejacket for each child;

.2 every passenger craft should carry lifejackets for not less than 5% of the total number of persons on board. These lifejackets should be stowed in conspicuous places on deck or at muster stations;

.3 a sufficient number of lifejackets should be carried for persons on watch and for use at remotely located survival craft and rescue boat stations;

.4 all lifejackets should be fitted with a light, which complies with the requirements of regulation III/32.3 of the Convention; and

.5 in addition, on all craft, the following should be provided no later than the date of the first renewal survey on or after 1 January 2028:

  .1 for passenger craft on voyages less than 24 h, a number of infant lifejackets equal to at least 2.5% of the number of passengers on board should be provided;

  .2 for passenger craft on voyages 24 h or greater, infant lifejackets should be provided for each infant on board; and

  .3 if the adult lifejackets provided are not designed to fit persons weighing up to 140 kg and with a chest girth of up to 1,750 mm, a sufficient number of suitable accessories should be available on board to allow them to be secured to such persons."

ANNEX 1

**FORM OF SAFETY CERTIFICATE FOR HIGH-SPEED CRAFT**

**Record of Equipment for High-Speed Craft Safety Certificate**

## 2 Details of life-saving appliances

1 In the table for "Details of life-saving appliances, a new entry 8.3 is inserted under entry 8.2, as follows:

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| | | |
|---|---|---|
| 8.3 | Number suitable for infants | ……………….. |

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# ANNEX 24

## DRAFT AMENDMENTS TO THE IGC CODE

*(Refer to document CCC 10/WP.4, annex 1, for track changes)*

## DRAFT MSC RESOLUTION

## AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (IGC CODE)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

NOTING resolution MSC.5(48), by which it adopted the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk ("the IGC Code"), which has become mandatory under chapter VII of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"),

NOTING ALSO article VIII(b) and regulation VII/11.1 of the Convention concerning the procedure for amending the IGC Code,

HAVING CONSIDERED, at its [110th] session, amendments to the IGC Code proposed and circulated in accordance with article VIII(b)(i) of the Convention,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the IGC Code, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on [1 July 2027], unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have notified their objections to the amendments;

3 INVITES Contracting Governments to the Convention to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on [1 January 2028] upon their acceptance in accordance with paragraph 2 above;

4 DETERMINES that MSC.1/Circ.1543, MSC.1/Circ.1559, MSC.1/Circ.1590, MSC.1/Circ.1606, MSC.1/Circ.1617, MSC.1/Circ.1625, MSC.1/Circ.1651, MSC.1/Circ.1669 and MSC.1/Circ.1679 are superseded, taking effect when the said amendments enter into force; however, they remain in effect for existing ships constructed prior to the entry into force of this resolution;

5 REQUESTS the Secretary-General, for the purposes of article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Contracting Governments to the Convention;

6 ALSO REQUESTS the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

**AMENDMENTS TO THE INTERNATIONAL CODE FOR THE CONSTRUCTION AND EQUIPMENT OF SHIPS CARRYING LIQUEFIED GASES IN BULK (IGC CODE)**

**CHAPTER 1**
**GENERAL**

**1.1 Application and implementation**

1 Paragraphs 1.1.1.1 and 1.1.1.2 are inserted as follows:

"1.1.1.1 Ships subject to this Code may use products listed in chapter 19 as fuel, subject to the requirements of chapter 16. If the product is not carried as cargo and only used as fuel, the ship shall comply with the most stringent requirements for the cargo or fuel, as applicable."

"1.1.1.2 The products used as fuel shall be listed on the ship's International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk and identified as fuel."

**1.2 Definitions**

2 The following new definitions are inserted in the respective alphabetical order, together with the associated footnote, and subsequent paragraphs are renumbered accordingly:

"1.2.18 *Essential safety functions* are safety functions required by the Code, which include a system that initiates required actions to prevent escalation of potential hazards."

"1.2.24 *Gastight* means a physical barrier which prevents any significant quantity of flammable gas from entering into an adjoining area in accordance with standards acceptable to the Organization.*"

"* Refer to the recommendations published by the International Electrotechnical Commission, IEC 60092:502."

"1.2.30 *Integrated system* is a combination of computer-based systems which are interconnected in order to allow centralized access to sensor information and/or command and control. Integration of systems shall ensure that no failure of any component of the system will result in an unacceptable loss of control, alarm or safety functions."

"1.2.46 *Reversionary control* is an alternative means of control that may be local manual or local automatic."

## CHAPTER 2

## SHIP SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

### 2.1 General

3 Paragraph 2.1.4 is amended to read as follows:

"2.1.4 If a ship is intended to carry more than one of the products listed in chapter 19, the standard of damage shall correspond to the product having the most stringent ship type requirements. If a product listed in chapter 19 is only used as fuel, not carried as a cargo, and bunkered in dedicated deck tanks, the standard of damage shall correspond to the ship type requirements of the ship's cargo. The requirements for the location of individual cargo and gas fuel tanks, however, are those for ship types related to the respective products intended to be carried."

### 2.7.1 Survival requirements

4 In paragraph 2.7.2.1, at the end, the following sentence is added:

", except for those ventilators (in compliance with regulation 19(4) of the International Convention on Load Lines, 1966/88) which have to remain open to supply air to the engine-room or emergency generator room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship and;"

## CHAPTER 3
## SHIP ARRANGEMENTS

### 3.2 Accommodation, service and machinery spaces and control stations

5 In paragraph 3.2.6, the following sub-paragraphs are added, and the existing paragraph 3.2.6 is renumbered to 3.2.6.1:

".2 Engine-room casings, cargo machinery spaces, electric motor rooms and steering gear compartments are generally considered as spaces not covered by paragraph 3.2.6.1 and, therefore, the requirement for closing devices need not be applied to these spaces.

.3 The closing devices shall be gastight. Ordinary steel fire-flaps without gaskets/seals are not considered to be satisfactory.

.4 Regardless of paragraphs 3.2.6.2 and 3.2.6.3, the closing devices for main inlets and outlets of all ventilation systems shall be operable from outside of the protected space in accordance with SOLAS regulation II-2/5.2.1.1."

**3.5 Access to spaces in the cargo area**

6 In paragraph 3.5.3.1.2, at the end, the following sentence is added:

"For ships constructed on or after 1 January 2028, 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."

7 In paragraph 3.5.3.1.3, at the end, the following sentences and figures are added, and the following figures in this chapter are renumbered accordingly:

"For ships constructed on or after 1 January 2028, the minimum clear opening of not less than 600 mm x 800 mm may also include an opening with corner radii of 300 mm (see figure 3.1). 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.

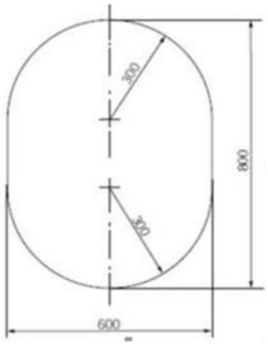


Figure 3.1

Subject to verification of easy evacuation of an 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 acceptable alternative to the traditional opening of 600 mm x 800 mm with corner radii of 300 mm (see figure 3.2).

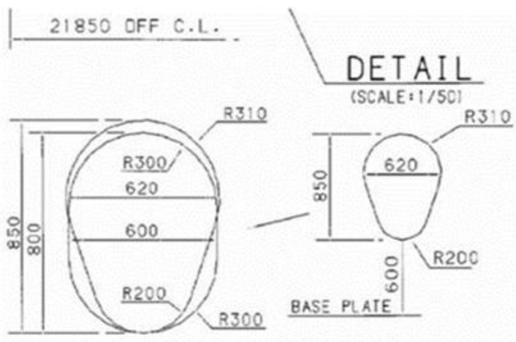


Figure 3.2

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".

**3.7 Bilge, ballast and fuel oil arrangements**

8 In paragraph 3.7.5, at the end, the following sentence is added:

"The requirements of "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."

## CHAPTER 4
## CARGO CONTAINMENT

**4.19.1 Materials forming ship structure**

9 In paragraph 4.19.1.6.2, the existing text is amended to read as follows:

"the heating system shall be considered as an essential auxiliary. All electrical components of at least one of the systems provided in accordance with paragraph 4.19.1.6.1 shall be supplied from the emergency source of electrical power; and"

10 In paragraph 4.19.1, a new paragraph is added as follows:

"4.19.1.7 For ships constructed on or after 1 January 2028, heating system referred to in paragraph 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. 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. 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 to satisfy the requirements of paragraph 4.19.1.6.1, provided a suitable risk assessment is conducted to the satisfaction of the Administration. In all cases, essential electrical components shall be supplied from the emergency source of electrical power."

11 In paragraph 4.20.1.1, the existing paragraph is amended to read as follows:

"4.20.1.1 For ships constructed on or after 1 January 2028, ~~All~~ welded joints of the shells of type A independent tanks and type B independent tanks, primarily constructed of plane surfaces, shall be of the in-plane butt weld full penetration type. This includes the tank corners which are constructed using bent plating which is aligned with the tank surfaces and connected with in-plane welds. 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 and in accordance with the following:

.1 except for small penetrations on domes, nozzle welds shall also be designed with full penetration;

.2 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; and

.3 tee welds can be accepted for other localized constructions of the shell, such as suction well, sump, dome, etc., where tee welds of full penetration type shall also be used."

12 In paragraph 4.20.1.2 and sub-paragraph .1, the existing text is amended to read as follows, and the following figures in this chapter are renumbered accordingly:

"4.20.1.2 For ships constructed on or after 1 January 2028, welding joint details for type C independent tanks. including bi-lobe tanks, primarily constructed of curved surfaces fitted with a centreline bulkhead, 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. 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 recognized organization acting on its behalf, depending on the results of the tests carried out at the approval of the welding procedure (see figure 4.1). Other edge preparations may be permitted, depending on the results of the tests carried out at the approval of the welding procedure; and

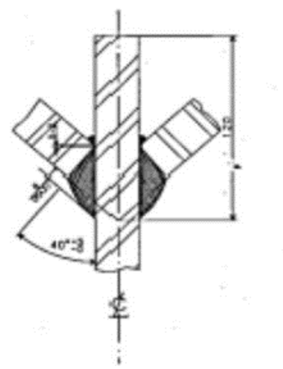

Figure 4.1"

**4.23 Type C independent tanks**

13 Paragraph 4.23.1.1 is replaced by the following:

"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 vapour pressure defined in 4.23.1.2 is intended to ensure that ~~and~~ the dynamic stress range shall be sufficiently small so that an initial surface flaw will not have significant propagation."

14 The following new paragraph 4.23.3.3 is inserted after paragraph 4.23.3.2:

"4.23.3.3 For ships constructed on or after 1 January 2028, guidance is given in 4.28.4 and 4.28.5 for finite element analysis and buckling assessment respectively."

15 The existing paragraph 4.23.4 is renumbered and replaced to read as follows:

"4.23.4.1 For large type C independent tanks, the Administration or recognized organization acting on its behalf may require additional fatigue verification as follows:

.1 $C_w$ shall be less than or equal to 0.1; or

.2 predicted failure development time, from the assumed initial defect until reaching a critical state, shall not be less than three times the lifetime of the tank."

**4.28 Guidance notes for chapter 4**

16 The following new paragraphs 4.28.4 and 4.28.5 are inserted after paragraph 4.28.3:

"4.28.4 **Guidance to finite element analysis of type C tanks for ships constructed on or after 1 January 2028**

4.28.4.1 ***General***

4.28.4.1.1 The allowable stresses described in 4.23.3.1 are applicable for the finite element analysis of the type C tanks.

4.28.4.1.2 As a supplement to the prescriptive requirements, the finite element analysis of the type C cargo tanks may be carried out for the following cases:

.1 Locations where a structural strength cannot be assessed by the prescriptive requirements, e.g. structural discontinuities in way of tank support, Y connection of bi-lobe and multi-lobe tank, etc.

.2 Tanks of novel design or configuration.

4.28.4.1.3 The procedure for finite element analysis should be in accordance with the recognized standards, such as ASME Boiler and Pressure Vessel Code, section VIII, Division 2, or other equivalent which is acceptable to the Administration, provided the maximum strength utilizations in 4.23.3.1 are complied with.

4.28.4.1.4 The scantling defined by the prescriptive requirements on the type C tank of the Code is not to be reduced by any form of alternative calculations using finite element analysis.

4.28.4.1.5 For calculation of reaction forces at the tank supports the following factors shall be taken into account:

.1 elasticity of support material (intermediate layer of wood or similar material); and

.2 change in contact surface between tank and support, and of the relevant reactions, due to thermal shrinkage of tank and elastic deformations of tank and support material.

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

4.28.4.2 Allowable stresses for finite element analysis

4.28.4.2.1 In general, finite element models composed of 2D shell element or solid 3D element are considered acceptable for stress calculation. The mesh size of the finite element model shall be to the satisfaction of the Administration or recognized organization acting on its behalf.

4.28.4.2.2 The application of allowable stresses for linear finite element analysis of the type C tank body using 2D shell element or solid 3D element is given in the following table.

4.28.4.2.3 The strength of stiffening rings of type C tanks are to be checked. The calculated stresses of the stiffening ring of type C tanks using finite element method are to be performed according to 4.28.4, and the permissible stresses of the stiffening rings shall not exceed that of the tank body defined in 4.28.4.

**Application of allowable stresses for finite element analysis of the type C tank body using the finite element analysis of 2D shell element or 3D solid element for ships constructed on or after 1 January 2028**

| Code criterion given in 4.23.3.1 | Application for FE 2D shell element or 3D element | |
|---|---|---|
| | **Finite element results check** | **Locations where check should be applied** |
| $\sigma_m \leq f$ | $\sigma_{e\_membrane} \leq f$ 1) | (A) Areas remote from structural discontinuities |
| $\sigma_L \leq 1.5f$ | $\sigma_{e\_membrane} \leq 1.5f$ 1) | (B) Area in way of structural discontinuities |
| $\sigma_b \leq 1.5f$ | $\sigma_{e\_surface} \leq 1.5f$ 1) | (C) Any area (A) or (B) where bending stresses exist |
| $\sigma_L + \sigma_b \leq 1.5f$ | $\sigma_{e\_surface} \leq 1.5f$ 1) | See (B) and (C) |
| $\sigma_m + \sigma_b \leq 1.5f$ | $\sigma_{e\_surface} \leq 1.5f$ 1) | See (A) and (C) |
| $\sigma_m + \sigma_b + \sigma_g \leq 3.0f$ | $\sigma_{e\_surface} \leq 3.0f$ 1), 2) | See (A) and (C) |
| $\sigma_L + \sigma_b + \sigma_g \leq 3.0f$ | $\sigma_{e\_surface} \leq 3.0f$ 1), 2) | See (B) and (C) |

where:

$\sigma_{e\_membrane}$ is element equivalent stress derived from the stress components at the mid layer/thickness of the element.

$\sigma_{e\_surface}$ is element equivalent stress derived from the stress components at the top and bottom layer/surface of the element, whichever is greater.

Note:

1) For accident and testing load conditions, the allowable stresses can be modified according to 4.23.5.2 and 4.23.6.1 of the IGC Code

2) The factor $f$ is defined in 4.23.3 of the IGC Code.

3) For the criterion $\leq 3.0f$, it should be carefully evaluated especially for materials with under matched weld properties. In such cases, the transverse weld tensile strength shall not be less than the actual yield strength of the parent metal, the respective $R_e$ and $R_m$ of the weld, after any applied heat treatment, shall be used.

4.28.5 **Buckling assessment of type C cargo tanks for ships constructed on or after 1 January 2028**

4.28.5.1 ***General***

4.28.5.1.1 The buckling assessment of type C cargo tanks should be carried out in accordance with a recognized pressure vessel standard acceptable to the Administration or recognized organization acting on its behalf. The selected standard should be used for design and fabrication. The scantlings of a type C tank subject to external pressure is not to be less than the value required by the formulas in 4.28.5.2.

4.28.5.1.2 Regarding the lateral buckling of stiffening ring, it should be considered additionally in accordance with international standards (e.g. PD5500) or equivalent regulations.

4.28.5.1.3 For novel configurations where the requirements given in this subsection or recognized standards are not applicable, more advanced buckling assessment methods may be used, as deemed appropriate by the Administration.

4.28.5.1.4 Non-linear finite element analysis, considering geometrical and material non-linearity, may be accepted as an advanced method, provided that the buckling capacity reflects the plate edge misalignment, ovality and deviation from true circular form over a specified arc or chord length.

4.28.5.2 ***Scantling of shells and stiffening rings under external pressure***

4.28.5.2.1 For cylindrical shell, the critical buckling pressure $P_c$, in MPa, can be taken as:

$$P_c = \frac{1}{3}\left[n^2 - 1 + \frac{2n^2 - 1 - \nu}{n^2\left(\frac{2L}{\pi D}\right)^2 - 1}\right]\frac{2E}{(1-\nu^2)}\left(\frac{t}{D}\right)^3 + \frac{2E\,\frac{t}{D}}{(n^2-1)\left[n^2\left(\frac{2L}{\pi D}\right)^2 + 1\right]^2}$$

where:
D=outside diameter of the cylindrical shell, in mm, based on gross scantling
t=net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance
E=Young's modulus, in N/mm$^2$
v=Poisson's ratio
n= number of circumferential buckling waves. It is to be taken as the integral value to minimize the critical pressure $P_c$ with $n \geq Max\left(2, \frac{\pi D}{2L}\right)$.
L=effective distance between stiffening rings, in mm

4.28.5.2.2 For spherical shells, such as hemispherical, torispherical and ellipsoidal ends, the critical buckling pressure $P_c$, in MPa, can be taken as:

$$P_c = 1.21\mathrm{E}\left(\frac{t}{R}\right)^2$$

where:
R=outside radius of the sphere shell, in mm, based on gross scantling
E=Young's modulus, in N/mm$^2$
t=net thickness of the spherical shell, in mm, exclusive of corrosion allowance

The critical buckling pressure formula for the spherical shell above is to be used for hemispherical, torispherical and ellipsoidal tank ends, where R is taken as the outside radius of the corresponding spherical shell for hemispherical and tori spherical tank ends, and the maximum outside radius of the crown for an ellipsoidal tank end, i.e. D2/(4h), where h is the external height of the tank end measured based on gross scantling from the connection plane between the cylindrical shell and tank end.

4.28.5.2.3 For stiffening ring, the moment of inertia I, in $mm^4$, shall not be less than

$$I = \frac{0.18D^3LP_e}{E}$$

where:
D = outside diameter of the cylindrical shell, in mm, based on gross scantling
E=Young's modulus, in $N/mm^2$
L=effective distance between stiffening rings, in mm
Pe=external design pressure, in MPa
The width of shell, in mm, contributing to the moment of inertia shall not be greater than $0.75\sqrt{Dt}$, where t=net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance.

4.28.5.2.4 Cylindrical and spherical shells are to satisfy the following criteria:

$$\frac{P_c}{P_e} \geq 4 \text{ for cylindrical shell}$$

$\frac{P_c}{P_e} \geq 15$ for spherical shell
where:
Pc=critical buckling pressure, in MPa
Pe=external design pressure, in MPa".

## CHAPTER 5
## PROCESS PRESSURE VESSELS AND LIQUID, VAPOUR AND PRESSURE PIPING SYSTEMS

### 5.2 System requirements

17 Paragraph 5.2.2.1 and sub-paragraph .1 are amended to read as follows:

**"**5.2.2.1 Any piping system addressed in 5.1.1 that may contain cargo liquid or vapour shall:

.1 be segregated from other piping systems, except where interconnections are required for cargo related operations such as purging, gas freeing or inerting. The requirements of 9.4.4 and 16.4.1.3 shall be taken into account with regard to preventing back-flow of cargo. In such cases, precautions shall be taken to ensure that cargo or cargo vapour cannot enter other piping systems through the interconnections;"

18 The following new paragraph 5.2.2.1.2 is added after paragraph 5.2.2.1.1 and subsequent paragraphs 5.2.2.1.2 to 5.2.2.1.5 are renumbered as paragraphs 5.2.2.1.3 to 5.2.2.1.6.

"5.2.2.1.2 Notwithstanding that, ships operating in fixed locations, in a re-gasification and gas discharge mode or a gas receiving, processing, liquefaction and storage mode are not considered as vessels "at sea" with regard to sub-paragraph .6 of this paragraph. Cargo piping only operated in fixed locations (example: re-gasification systems and its piping) and kept depressurized inerted and isolated at sea, other than athwartship shore connection piping or emergency cargo jettisoning piping systems, may also be located outboard of the transverse tank location requirements of 2.4.1, but not closer than a minimum distance of 0.8 metre from the ship outer shell;"

**5.4 Design pressure**

19 In paragraph 5.4.4, the text is replaced to read as follows:

"5.4.4 The design pressure of the outer pipe or duct of gas fuel systems 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 a suitable pressure relief system shall be considered in the design:

.1 for gas fuel systems with inner pipe working pressures not greater than 1 MPa, the maximum built-up pressure arising in the annular space, after the inner pipe rupture shall not be less than the maximum working pressure of inner gas pipe; and

.2 for ships constructed on or after 1 January 2028, for gas fuel systems with inner pipe having a 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 paragraph 5.11.4.2. "

**5.5 Cargo system valve requirements**

20 Paragraph 5.5.1.2*bis* is added after paragraph 5.5.1.2 as follows:

"5.5.1.2*bis* For ships constructed on or after 1 January 2028, in addition, remotely operated valves shall also be fitted, as appropriate, as part of the emergency shutdown (ESD) system (see paragraph 18.10)."

21 Paragraphs 5.5.2.1 and 5.5.2.2 are amended to read as follows:

"5.5.2.1 All liquid and vapour connections, except for safety relief valve inlet and discharge lines, and liquid level gauging devices, shall have shut-off valves located as close to the tank as practicable. These valves shall provide full closure and shall be capable of local manual operation."

"5.5.2.2 For ships constructed on or after 1 January 2028, all liquid and vapour connections, except for safety relief valve inlet and discharge lines and liquid level gauging devices, shall be equipped with remotely controlled ESD valves, located as close to the tank as practicable. Such ESD valves shall comply with the requirements of 18.10.2 and provide full closure of the line. A single valve may be substituted for the two separate valves, provided the valve complies with the requirements of 18.10.2 and provides full closure of the line."

22 Paragraphs 5.5.3.1 and 5.5.3.2 are amended to read as follows:

"5.5.3.1 One remotely controlled ESD valve shall be provided at each cargo transfer connection to stop liquid and vapour transfer to or from the ship. Transfer connections not in use shall be isolated with suitable blank flanges."

"5.5.3.2 In addition to the ESD valve, a manual valve shall be provided for each liquid connection. A manual valve shall also be provided for vapour connections where cargo tank MARVS exceeds 0.07MPa. The manual valves may be inboard or outboard of the ESD valve to suit the ship's design."

**5.6 Cargo transfer arrangements**

23 In paragraph 5.6.5.1, at the end, the following sentence is added:

"However, the aforementioned 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."

24 In paragraph 5.6.6, the existing paragraph is renumbered as 5.6.6.1 and a new paragraph is added as follows:

"5.6.6.2 Means to indicate that filters are becoming blocked and filter maintenance is required is to 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."

**5.11 Piping system component requirements**

25 Paragraph 5.11.2.2 is amended to read as follows:

"5.11.2.2 The minimum wall thickness shall be calculated as follows:

$t = (t_0 + b + c) / (1 - |a|\cancel{\mathrm{a}}/100)$ (mm) where:
$t_0$ = theoretical thickness, determined by the following formula
$t_0 = PD / (2K \times e + P)$ (mm)
with:
P = design pressure (MPa) referred to in 5.4;
D = outside diameter (mm);
K = allowable stress ($N/mm^2$) referred to in 5.11.3; and
e = efficiency factor equal to 1.0 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 1.0, in accordance with recognized standards, may be required depending on the manufacturing process;

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

$b = D \cdot t_0 / 2.5r$ (mm) with:

r = mean radius of the bend (mm)

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

a = negative manufacturing tolerance for thickness (%). If $a$ is -5%, i.e. $|a|$ is equal to 5, the denominator of the formula of the minimum wall thickness of pipes shall be 1- (5/100)."

**5.11.4 High-pressure gas fuel outer pipes or ducting scantlings**

26 Paragraph 5.11.4 is amended and 5.11.4.2 added as follows:

5.11.4.1 For ships constructed on or after 1 January 2028, in fuel gas piping systems of design pressure greater than the peak pressure specified in 5.11.4.2, the tangential membrane stress of a straight section of pipe or ducting shall not exceed the tensile strength divided by 1.5 ($R_m$ /1.5) when subjected to the design pressure specified in 5.4. The pressure ratings of all other piping components shall reflect the same level of strength as straight pipes.

"5.11.4.2 For ships constructed on or after 1 January 2028, for inner pipes having a working pressure greater than 1 MPa, the design pressure of the outer pipe or the duct shall be taken as the higher of the following:

.1 the maximum built-up pressure: static pressure in way of the rupture resulting from the gas flowing in the annular space;

.2 the local instantaneous peak pressure in way of the rupture is given by the following expression:

$$p = p_0 \left(\frac{2}{k+1}\right)^{\frac{k}{k-1}}$$

Where:

$p_0$ = maximum working pressure of the inner pipe (absolute pressure)

$k = C_p/C_v$ constant pressure specific heat divided by the constant volume specific heat

As an alternative to the above formula, the peak pressure found from representative tests can be used. Tests reports shall then be submitted."

27 Paragraph 5.11.6.1 is amended as follows:

5.11.6.1 Flanges, valves, bellows expansion joints and other fittings shall comply with recognized standards, taking into account the material selected and the design pressure defined in 5.4. For ships constructed before 1 January 2028, bellows expansion joints used in vapour service, a lower minimum design pressure may be accepted, except for any new installation or replacement.

## 5.12 Materials

28 Paragraph 5.12.4 is renumbered and amended to read as follows:

"5.12.3 Where the cargo piping system is located in a salt-laden atmosphere, including on the exposed deck, adequate measures to avoid corrosion and stress corrosion cracking occurring shall be taken by material selection and protection against exposure to salt water. For ships constructed on or after 1 January 2028, the following apply:

.1 use of stainless steel having a pitting resistance equivalent number (PREN = 1 • %Cr + 3.3 (%Mo + 0.5 • %W ) + 16 • %N) more than 22, such as 316/316L; or

.2 use of stainless steel not meeting the above requirements, such as 304/304L provided the piping is protected by a coating system suitable for the intended service conditions, including cryogenic temperature—ultraviolet solar radiation; or

.3 use of other materials permitted by table 6.4 of the IGC Code, protected by a coating system suitable for the intended service conditions, including cryogenic temperature—ultraviolet solar radiation."

### 5.12.4 Cargo piping insulation system

29 Paragraphs 5.12.3.1 and 5.12.3.2 are renumbered and amended to read as follows:

"5.12.4.1 For ships constructed on or after 1 January 2028, cargo piping systems shall be provided with a thermal insulation system as necessary to minimize heat leak into the cargo during transfer operations and to protect personnel from direct contact with cold or hot surfaces as follows:

.1 The properties of the piping insulation shall be considered when calculating the heat balance of the containment system and capacity of the pressure/temperature control system.

.2 Surfaces of cargo piping, process pressure vessels, and equipment with which personnel are likely to contact under normal conditions shall be protected by thermal insulation, except for the following:

.1 surfaces which are protected by physical screening measures to prevent direct contact;

.2 surfaces of manual valves having extended spindles that protect the operator from the cargo temperature;

.3 surfaces whose design temperature, based on inner fluid temperature, is above minus 10°C or below 60°C; and

.4 surfaces located where contact by personnel is unlikely under normal conditions based on recognized standards, preferably more than 2.0 m vertically and/or 0.6 m horizontally away from walkways or floors of working areas."

"5.12.4.2 Where applicable, owing 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."

**5.13 Testing requirements**

30 In paragraph 5.13.1.1, the existing paragraph is amended to read as follows:

"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;

.2 the flow or capacity shall be certified to a recognized standard for each size and type of valve, which annotates that;

.1 for pressure relief valves (PRVs) that are subject to paragraph 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 contributing to shell or seat tightness of the valve having melting temperatures lower than 925°C, the type testing shall include a fire test to a standard acceptable to the Administration."

31 In paragraph 5.13.2.1, the existing paragraph is amended to read as follows:

"5.13.2.1 The requirements of this section shall apply to piping inside and outside the cargo tanks. However, the Administration may accept relaxations from these requirements for open-ended piping and piping inside cargo tanks, except pumps discharge lines."

32 In paragraph 5.13.2.4, at the end, the following sentence is added:

"The maximum pressure at gas pipe rupture 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 paragraph 5.4.4.1."

## CHAPTER 8
## VENT SYSTEMS FOR CARGO CONTAINMENT

### 8.1 General

33 In paragraph 8.1, the existing paragraph is renumbered as 8.1.1 to read as follows:

"8.1.1 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 chapter 7 shall be independent of the pressure relief systems."

34 In paragraph 8.1, a new paragraph is added as follows:

"8.1.2 For ships constructed on or after 1 January 2028, interbarrier spaces, which may be subject to pressures beyond their design capabilities, shall also be provided with a suitable pressure relief system, as defined below:

.1 The formula for determining the relieving capacity given in 8.2.3 is for interbarrier spaces surrounding independent type A cargo tanks, where the thermal insulation is fitted to the cargo tanks.

.2 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 8.2.3. However, the leakage rate is to be determined in accordance with paragraph 4.7.2.

.3 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.

.4 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."

### 8.2 Pressure relief systems

35 In paragraph 8.2, a new paragraph is added after paragraph 8.2.4:

"8.2.4*bis* For ships constructed on or after 1 January 2028, 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:

$$Q_{sa} = 3{,}4.\, A_c \frac{\rho}{\rho_V} \sqrt{h} \quad (m^3/s)$$

where:

$Q_{sa}$ = minimum required discharge rate of air at standard conditions of 273 K and 1.013 bar

$A_c$ = design crack opening area ($m^2$)

$$A_c = \pi/4 \cdot \delta \cdot l(m^2)$$

$\delta$ = max, crack opening width (m)

$\delta$ = 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 figure 8.1.

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

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

$\rho_V$ = 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 (bar).

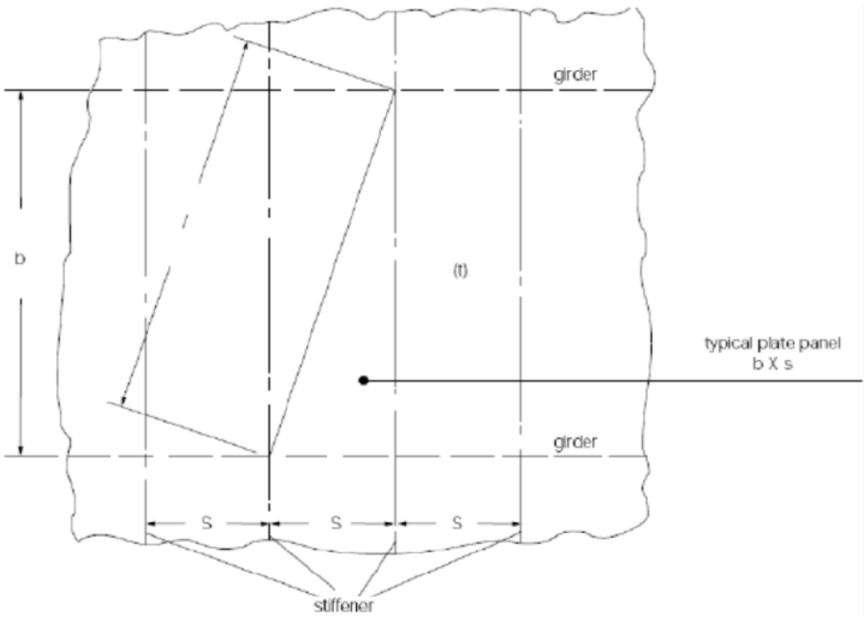


**Figure 8.1**"

With the insertion of the figure above, the other figures are renumbered and cross references to those figures in this chapter revised accordingly.

36 Paragraph 8.2.9 is amended as follows:

8.2.9 In the event of a failure of a cargo tank installed PRV, a safe means of emergency isolation shall be available:

.1 Procedures shall be provided and included in the cargo operations manual (see 18.2).

.2 For ships constructed on or after 1 January 2028, if an isolation valve is installed, a mechanical locking system shall be used to prevent full or partial isolation so that only one of the cargo tank installed PRVs can be isolated. If the PRVs are fitted with a remotely sensed pilot line, an isolation valve shall also be fitted with a locking system synchronized with the locking system of the isolation of the main PRV.

.3 For ships constructed on or after 1 January 2028, if an isolation valve is installed, safe means to depressurize the trapped cargo between that isolation valve and PRV shall be provided.

.4 Isolation of the PRV shall be carried out under the supervision of the master. This action shall be recorded in the ship's log and a sign posted in the cargo control room, if provided, and at the PRV.

.5 The tank shall not be loaded until the full relieving capacity is restored.

37 Paragraph 8.2.18 is replaced to read as follows:

"8.2.18 The adequacy of the vent system designed for two phase flow for tanks having a MARVS above 0.07 MPa shall be demonstrated, taking into account the recommendations developed by the Organization.* A relevant certificate shall be permanently kept on the ship. For the purpose of this paragraph, vent system means:

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

.2 the PRV; and

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

This section need not apply when the reference temperature is defined as per 15.1.3.1."

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

**8.4.1 Sizing of pressure relieving system**

38 In paragraph 8.4.1, a new paragraph is added after paragraph 8.4.1.3 as follows:

"8.4.1.4 For ships constructed on or after 1 January 2028, for prismatic tanks, vapours generated under fire exposure computed using the formula given in paragraph 8.4.1.2 and the following formula variable:

.1 $L_{min}$, 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, $\underline{L_{min}}$ is the smaller of the length and the average width.

.2 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.

.3 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. "

39 Paragraphs 8.4.2, 8.4.3 and 8.4.5 are amended to read as follows:

"8.4.2 ***Sizing of vent system***

8.4.2.1 Pressure losses upstream and downstream of the PRVs shall be taken into account when determining the pipe size and routeing to ensure the flow capacity required by 8.4.1.

8.4.2.2 For ships constructed on or after 1 January 2028, the inclusion of isolation valves in which the flow area of the valve is equal to or larger than the inlet flow area of the pressure relief device and do not affect the PRV flow, capacity and stability are acceptable."

**"**8.4.3 ***Upstream pressure losses***

8.4.3.1 The pressure losses in the vent line from the tank to the PRV inlet shall be supported by flow calculations. These losses shall not exceed 3% of the valve set pressure at the calculated flow rate, in accordance with 8.4.1.

8.4.3.2 Pilot-operated PRV sensing lines shall be sized to avoid pressure losses which affect the function of the PRV. The sensing line shall be self-draining and without liquid pockets."

"8.4.5 To ensure stable PRV operation, the blow-down shall not be less than the sum of the inlet pressure loss and 0.02 MARVS at the rated capacity. This limitation does not apply to pilot-operated PRV fitted with a remote sensing line if confirmed by the PRV manufacturer."

## CHAPTER 9
## CARGO CONTAINMENT SYSTEM ATMOSPHERE CONTROL

40 Paragraph 9.4.6 is amended to read as follows:

"9.4.6 Where insulation spaces are continually supplied with an inert gas as part of a leak detection system, effective means shall be provided to monitor the quantity of gas being supplied to each individual space."

41 The following new paragraph 9.4.7 is added after paragraph 9.4.6:

"9.4.7 For ships constructed on or after 1 January 2028, abnormal flow of inert gas in leak detection system shall trigger audible and visible alarms at the locations specified in 13.6.13. The alarm(s) set points shall be defined by the designer and accepted by the Administration or recognized organization acting on its behalf with due consideration of the operational pressure which shall be maintained in the space and flow rate(s) necessary for reliable gas leak detection."

## CHAPTER 10
## ELECTRICAL INSTALLATIONS

42 Paragraph 10.2.6 is amended to read as follows:

"10.2.6 Electrical generation and distribution systems, including their control systems, shall be designed such that a single fault will not result in the loss of ability to maintain cargo tank pressures, as required by 7.8.1, and hull structure temperature, as required by 4.19.1.6, within normal operating limits. Failure modes and effects shall be analysed and documented to a standard not inferior to those acceptable to the Administration.*

* IEC 60812, Edition 2.0 200601 "Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)"

43 Paragraph 10.2.8 is amended to read as follows:

"10.2.8 Electronic devices which are not intrinsically safe, including depth sounding or log devices, radar and impressed current cathodic protection system anodes, if located in the hazardous areas, shall be housed in gastight enclosures."

## CHAPTER 11
## FIRE PROTECTION AND EXTINCTION

### 11.1 Fire safety requirements

44 In paragraph 11.1.4, at the end, the following sentence is added:

"For ships constructed on or after 1 January 2028, 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 paragraphs 3.1.2 and 3.1.3 of the IGC Code, the weather deck area above these tanks shall be regarded as a 'cargo area' for the purpose of applying paragraph 11.3.6 of this Code."

### 11.2 Fire mains and hydrants

45 In paragraph 11.2, new paragraphs are added as follows:

"11.2.6 For ships constructed on or after 1 January 2028, the maximum capacity calculation for emergency fire pump is as follows:

11.2.6.1 If all the fire pumps (required in accordance with SOLAS regulation II-2/10.2.2.2.2) mentioned in paragraph 11.3.4, supplying the water-spray system (for covering the superstructures and deckhouses) are disabled owing to a fire in any one compartment, then the emergency fire pump shall be sized to cover:

.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 two fire hydrants (as per paragraph 11.2).

11.2.6.2 When the ship is also fitted with a total flooding high expansion foam system or a fixed pressure water-spraying fire- extinguishing system protecting the engine-room (to comply with SOLAS regulation II-2/10.4.1.1.2 or SOLAS regulations II-2/10.4.1.1.3 and 10.5.1.1) and the emergency fire pump is intended to supply seawater to this system, then, the emergency fire pump shall also be sized to cover the foam system for dealing with an engine-room fire, when the main fire pumps are disabled.

11.2.6.3 On the basis of 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 paragraph 11.2.6.1 and paragraph 11.2.6.2 above (i.e. water-spray, hydrants and foam) at the same time and shall need only be sized to cover the most demanding area and required systems, as follows:

.1 the foam system + two hydrants; or

.2 the water-spray system + two hydrants;

whichever is greater."

**11.3 Water-spray system**

46 In paragraph 11.3.1, a new sub-paragraph is added as follows and the subsequent sub-paragraph .8 is renumbered as .9:

".8 remote survival crafts facing cargo area, taking into consideration cargo area extension for fire-fighting purposes as stated in paragraph 11.1.4. Remote liferafts located in areas covered by water-spray protection as required in .6 shall be considered as adequately protected; and"

47 Paragraph 11.3.2.2 is amended to read as follows:

"11.3.2.2 On vertical surfaces and for structures having not clearly defined horizontal or vertical surface, 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."

48 In paragraph 11.3.3, the existing text is amended to read as follows:

"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 tank groupings, where one group is defined as tanks located in transverse direction from ship side to ship side, representing an area equal to the combined area of the largest tank groupings, including any gas process units within these areas. 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 of above requirement; or

.2 for ships intended for operation as listed in 1.1.10, necessary protection subject to special consideration under 11.3.1 of any added fire hazard and the adjacent athwartship tank grouping.

in addition to the surfaces specified in 11.3.1.4 to 11.3.1.9. 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."

49 In paragraph 11.3.4, the existing text is amended to read as follows:

"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 (required in accordance with SOLAS regulation II-2/10.2.2.2.2) or the emergency fire pump, if a fire in one compartment could disable both fire pumps (required in accordance with SOLAS regulation II-2/10.2.2.2.2)."

and the following new paragraphs are added:

"11.3.4.1 For ships constructed on or after 1 January 2028, in cases where the emergency fire pump is used to meet paragraph 11.3.4, its capacity, in addition to being capable of maintaining two jets of water as required by paragraph 12.2.2.1.1 of the FSS Code, shall be increased taking into account the spray application rates stated in paragraph 11.3.2.1, but limiting coverage to boundaries of normally manned superstructures and deckhouses, survival crafts and their muster areas. Also, see paragraph 11.2.6 for requirements regarding maximum capacity calculation for emergency fire pump."

"11.3.4.2 For ships constructed on or after 1 January 2028, fire pumps and emergency fire pumps in paragraph 11.3.4 are fire pumps required by SOLAS regulation II-2/10.2.2 installed outside the space where spray pump(s) are located."

"11.3.4.3 For ships constructed on or after 1 January 2028, compartment in paragraph 11.3.4 is 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."

50 Paragraph 11.3.6 is amended to read as follows:

"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 flush or back-flush the system with fresh water to prevent any blockages."

51 The following new paragraph 11.3.8 is added after paragraph 11.3.7 and subsequent paragraph 11.3.8 is renumbered as paragraph 11.3.9:

"11.3.8 For ships constructed on or after 1 January 2028, when isolating valves are fitted in the water-spray system to maintain the required water supply in the case that the system is fed from the emergency fire pump as indicated by 11.3.4, the operating position of the isolating valves shall be located outside the cargo area, so that they are readily accessible and, for valves that are normally closed, located in accordance with 11.3.7."

### 11.4 Dry chemical powder fire-extinguishing systems

52 In paragraph 11.4.8, the following new paragraph is added:

"11.4.8.1 Testing arrangements are to involve discharge using dry chemical powder from all monitors and hand hose lines on board, but a full discharge of the installed quantity of dry powder is not required. This testing can 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 completion of this testing, the system, including all monitors and hand hose lines, are to be blown through with dry air; but only for the purpose of the system subsequently being clear from any residues of dry chemical powder."

## CHAPTER 12
## ARTIFICIAL VENTILATION IN THE CARGO AREA

### 12.1 Spaces required to be entered during normal cargo handling operations

53 The following new paragraph is added after paragraph 12.1.1, together with the associated footnote:

"12.1.1.1 For ships constructed on or after 1 January 2028, electric motor rooms located outside cargo area defined by 1.2.7 shall comply with requirements for separation of gas-safe and gas hazardous areas, including 12.1.10 and be designed in accordance with standards acceptable to the Organization.*

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* Refer to the recommendations published by the International Electrotechnical Commission (IEC 60092:502:1999)."

54 Paragraph 12.1.8 is amended to read as follows:

"12.1.8 Where fans are required by this chapter, full required ventilation capacity for each space shall be available after failure of any single fan, or spare parts shall be provided for at least one entire fan comprising a motor, starter spares and complete rotating element including shaft and bearings of each type. Full ventilation capacity shall be restored before use of the space for operational purposes."

55 Paragraph 12.2.2 is amended to read as follows:

"12.2.2 For permanent installations, the capacity of 8 air changes per hour shall be provided and for portable systems, the capacity of 16 air changes per hour shall be provided. Hold spaces and cofferdams accessed shall be provided with ventilation not less than the capacity of 2 air changes per hour, subject to meeting the requirements of 18.8."

## CHAPTER 13
## INSTRUMENTATION AND AUTOMATION SYSTEMS

### 13.2 Level indicators for cargo tanks

56 Paragraph 13.2.2 is amended to read as follows:

"Where only one liquid level gauge is fitted, it shall be arranged so that it can be maintained in an operational condition without the need to empty or gas free the tank. Any part of this level gauge, other than components not subject to failure under normal service, shall be capable of being repaired with the tank in service."

### 13.3 Overflow control

57 Paragraph 13.3.1 is amended to read as follows:

"13.3.1 Each cargo tank shall be fitted with an independent high liquid level alarm giving an audible and visual warning when activated."

58 Paragraph 13.3.2 is amended to read as follows:

"13.3.2 An additional independent sensor shall automatically actuate a shut-off valve in a manner that will both avoid excessive liquid pressure in the loading line and prevent the tank from becoming liquid full."

59 The following new paragraph 13.3.3 is added after paragraph 13.3.2 and the subsequent paragraph 13.3.3 is renumbered as 13.3.4:

"13.3.3 For ships constructed on or after 1 January 2028, the sensors in 13.3.1 and 13.3.2 shall be independent from other liquid level indicators."

60 Renumbered paragraph 13.3.4 is amended to read as follows:

"13.3.4 The emergency shutdown valve referred to in 5.5.2 and 18.10 may be used for this purpose."

61 Paragraph 13.3.4 starting with "A high liquid level alarm …" is deleted and paragraph 13.3.5 is amended to read as follows:

"13.3.5 The position of the sensors required by 13.3.1 and 13.3.2 shall be verified at each of the following occasions:

.1 at the first full cargo loading, or after the initial survey required in 1.4.2.1; and

.2 after each renewal survey as required in 1.4.2.2.

Function testing of high-level alarms shall be conducted by raising the cargo liquid level in the cargo tank to the alarm point. Alternative equivalent function testing arrangements may be considered, subject to the satisfaction of the Administration or recognized organization acting on its behalf."

62 The following new paragraph 13.3.8 is inserted after paragraph 13.3.7:

"13.3.8 The override system permitted by 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 13.3.5 (see 18.10.3.4)."

### 13.6 Gas detection

63 In paragraph 13.6.4, the following new paragraph is added:

"13.6.4.1 For ships constructed on or after 1 January 2028, 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 chapter 19 of the Code."

64 Paragraph 13.6.17 is amended to read as follows:

"13.6.17 For other spaces described by 13.6.2, alarms shall be activated when the vapour concentration reaches 30% LFL and safety functions required by chapter 16 shall be activated before the vapour concentration reaches 60% LFL. Where required by 16.7.3.3, the crankcases of internal combustion engines that can run on gas shall be arranged to alarm before 100% LFL."

65 In paragraph 13.9.3, the existing text is amended to read as follows:

"13.9.3 Key hazards of the integrated system based on combination and of computer-based technologies and interconnection of computer systems used for control, monitoring/alarm and safety systems for carriage, handling and conditioning of cargo liquid and vapours shall be identified using appropriate risk-based techniques. Such integrated systems shall ensure reliable communication between computer-based system components* and allow centralized access to monitoring/alarm and safety information and/or command/control.

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* Refer to *Guidelines for the onboard use and application of computers* (MSC/Circ.891)."

## CHAPTER 15
## FILLING LIMITS FOR CARGO TANKS

### 15.1 Definitions

66 In paragraph 15.1.3, sub-paragraph .1 is amended to read as follows:

".1 when no cargo vapour pressure/temperature control, as referred to in chapter 7, is provided, or for products requiring a type 1G ship, the temperature corresponding to the vapour pressure of the cargo at the set pressure of the PRVs; and"

67 Paragraph 15.2 is amended to read as follows:

"**15.2 General requirements**

15.2.1 The default value for the filling limit (FL) of cargo tanks is 98% at the reference temperature. Exceptions to this value shall meet the requirements of 15.3. The maximum filling limit of cargo tanks shall be so determined that the vapour space has a minimum volume at reference temperature allowing for:

.1 tolerance of instruments such as level and temperature gauges; and

.2 volumetric expansion of the cargo between the PRV set pressure and the maximum allowable rise stated in 8.4.

15.2.2 The ship shall be designed and operated in a manner to ensure the liquid level in the cargo tank shall not exceed the filling limit under all design conditions."

68 Paragraph 15.3 is amended to read as follows:

"**15.3 Determination of increased filling limit**

15.3.1 This section does not apply to type C tanks or tanks with MARVS greater than 0.07 MPa except where it is verified and accepted by the Administration or recognized organization acting on its behalf that the risks associated with the higher design pressure of these tanks are properly mitigated taking into account the specific design features, including venting systems requirement in paragraph 8.2.18, of the individual tank.

15.3.2 A filling limit greater than the limit of 98% specified in 15.2.1 may be permitted under the trim and list conditions specified in 8.2.17, providing:

.1 the PRV inlet arrangement shall remain in the vapour space; and

.2 allowances shall be provided for:

.1 volumetric expansion of the liquid cargo due to the pressure increase from the MARVS to full flow relieving pressure in accordance with 8.4.1;

.2 an operational margin of minimum 0.1% of tank volume; and

.3 tolerances of instrumentation such as level and temperature gauges.

15.3.3 In no case shall a filling limit exceeding 99.5% at reference temperature be permitted."

69 Paragraph 15.4 is amended to read as follows:

"**15.4 Maximum loading limit**

15.4.1 The maximum loading limit (LL) to which cargo tank may be loaded shall be determined by the following formula:

$$LL = FL \, \rho_R / \rho_L$$

where:

LL = loading limit as defined in 15.1.2, expressed in percentage;

FL = filling limit as specified in 15.1.1 expressed in percentage;

$\rho_L$ = relative density of cargo at the loading temperature;

$\rho_R$ = relative density of cargo at the reference temperature

15.4.2 The Administration or recognized organization acting on its behalf may allow type C tanks to be loaded according to the formula in 15.4.1 with the relative density $\rho_R$ as defined below, provided that the tank vent system has been approved in accordance with 8.2.18:

$\rho_R$ = relative density of cargo at the highest temperature that the cargo may reach upon termination of loading, during transport, or at unloading, under the ambient design temperature conditions described in 15.1.4.

This paragraph does not apply to product requiring a type 1G ship."

70 Paragraph 15.5 is deleted and paragraph 15.6 renumbered as paragraph 15.5.

**CHAPTER 16**
**USE OF CARGO AS FUEL**

**16.1 General**

71 Paragraph 16.1 is amended to read as follows and paragraph 16.1.2 added:

"16.1.1 Except as provided for in 16.9, methane (LNG) ($CH_4$), ethane ($C_2H_6$) and LPG are the only hydrocarbon fuels that may be utilized in machinery spaces of category A, and, in these spaces, they may only be utilized in systems such as boilers, inert gas generators, internal combustion engines, gas combustion units and gas turbines."

"16.1.2 LPG, for the purpose of chapter 16, is composed of propane ($C_3H_8$), butane ($C_4H_{10}$), or a propane-butane mixture as listed in chapter 19 and may contain small amounts of other hydrocarbons. It can be in either a liquefied or gaseous state. LPG in the liquefied state is referred to as LPG liquid, and LPG in the gaseous state is referred to as LPG vapour."

72 Paragraph 16.2 is retitled to read as follows:

"**16.2 General requirements for gas consumers and fuel systems**"

73 Paragraph 16.2.1 is amended to read as follows:

"16.2.1 For all fuels covered by 16.1**,** the fuel supply system shall comply with the requirements of 16.4.1, 16.4.2 and 16.4.3".

74 Paragraphs 16.2.3. 16.2.4 and 16.2.5 are added as follows:

"16.2.3 LPG or ethane fuel consumers and associated systems shall be designed for operation within the possible range of composition of the intended fuel. Information about the range of acceptable compositions shall be provided on board."

"16.2.4 The LPG or ethane fuel consumers shall exhibit no external visible flame and shall maintain the uptake exhaust temperature or, if impractical, sufficiently below the auto-ignition temperature of the fuel. In a mixture of gases, the component with the lowest auto-ignition temperature shall be the appropriate reference. The LPG or ethane fuel consumer exhaust gas temperature shall be continuously monitored. In case of consumer with a turbocharger, the temperature shall be measured after the turbocharger."

"16.2.5 A risk assessment using acceptable and recognized risk analysis techniques shall be conducted for LPG or ethane fuel supply arrangements including associated systems demonstrating an equivalent level of safety to utilizing LNG vapour as fuel and the results documented. The scope of the risk assessment shall include aspects of the cargo-handling system that are part of the fuel supply, including consumers. Consideration shall be given to the hazards associated with the arrangement, operation and maintenance of the fuel system, considering reasonably foreseeable failures. The risk assessment shall address the consequences of fuel leakage, considering the properties of LPG or ethane vapour and its accumulation or escape into another space."

75 Paragraph 16.3 is retitled to read as follows:

"16.3 Arrangement of spaces containing gas consumers or gas equipment"

76 Paragraphs 16.3.5 and 16.3.6 are added after paragraph 16.3.4 as follows:

"16.3.5 For spaces outside the cargo area containing LPG or ethane fuel systems, special consideration shall be given to the density and lower flammability limit (LFL) of LPG or ethane vapour. Ventilation capacity, including ventilation inlet and outlet location, shall be supported by numerical calculations performed in accordance with a recognized standard, such as a computational fluid dynamics (CFD), gas dispersion analysis, or approval by the Administration or recognized organization. Notwithstanding, for enclosed spaces within the cargo area, on the open deck and containing LPG or ethane fuel conditioning equipment, the requirements of paragraph 12.1.3 shall apply."

"16.3.6 For spaces outside the cargo area containing LPG or ethane fuel systems, in addition to the requirements of paragraph 13.6.12, gas detection heads shall be fitted in spaces where LPG or ethane vapour may accumulate particularly where air circulation is reduced or near the bottom of the space. The suitability of their location shall be supported by numerical calculations performed in accordance with a recognized standard, such as a CFD, gas dispersion analysis, a physical smoke test or approval by the Administration or recognized organization. The numerical calculations shall include the possible range of composition of the intended fuel."

77 Paragraph 16.3.4 is amended to read as follows:

"16.3.4 All vents and bleed lines that may contain or be contaminated by gas fuel shall be routed to ~~a~~ safe location external to the machinery space and be fitted with flame screen. For ships constructed on or after 1 January 2028, these vent and bleed lines shall be independent from cargo and cargo vent piping systems."

## 16.4 Gas fuel supply

78 Paragraph 16.4.1.1*bis* and paragraph 16.4.1.1*ter* are added after 16.4.1.1 as follows:

"16.4.1.1*bis* LPG or ethane fuel piping outside the cargo area shall be of double wall design or ducted and the outer boundary shall be continuous in the space. In spaces outside the cargo area, non-continuous double barriers shall not be used under the circumstances described in paragraph 16.4.6.2."

"16.4.1.1*ter* For LPG fuel supply systems, liquid, vent and purging shall lead to a fuel collection tank, gas-liquid separator or similar device located in the cargo area. Heating of the gas-liquid separator may be necessary for ships operating in cold areas. Fuel supply vent piping systems shall be designed to safely handle any fuel condensate which may occur without restricting the function of the system. Any liquids formed shall be safely disposed. Vent piping associated with the fuel supply system shall be fitted with an inert gas purging interface and shall include a means for preventing condensation of vapour in the system."

79 The following new paragraphs 16.4.1.3, 16.4.1.4, 16.4.1.4.1 and 16.4.1.4.2 are added after paragraph 16.4.1.2:

"16.4.1.3 For permanent installations, the inert gas piping connected to the fuel piping shall be fitted with double block and bleed valves. In addition, a non-return valve shall be installed in the inert gas piping upstream of the double block and bleed valves. For LPG liquid fuel supply systems, the piping shall have a means of being drained without release of liquid to the atmosphere. LPG liquid trapped in double block and bleed valves or the inert gas system piping shall have a means of being drained without release of liquid to the atmosphere."

"16.4.1.4. All safety functions related to gas burning form the Gas Burning Safety System. This system may be a part of the cargo automation and safety system as described in chapter 13.8.1 or a stand-alone system interfacing with the same and built to the same requirements."

"16.4.1.4.1 Main functions as described in the subsequent paragraphs as well as in other parts of this Code with reference to table 18.1 as guidance."

"16.4.1.4.2 A full cargo ESD shall initiate the closure of the Master Valves described in 16.4.6.1."

80 Paragraph 16.4.3 is renumbered as 16.4.3.1 and paragraph 16.4.3.2 is added as follows:

"16.4.3.2 For LPG or ethane fuel systems, the air inlet of the pipe or duct shall not be in a machinery space. In addition, the air inlet of the pipe or duct shall be in a location which would be safe in the absence of the air inlet. Consideration shall be given to the risk of liquid carry-over resulting from a liquid leak. Ventilation outlets of the pipe or duct shall be in the cargo area."

81 Paragraph 16.4.5 is amended to read as follows:

"16.4.5 The supply and return piping of each gas consumer unit shall be provided with fuel isolation by automatic double block and bleed, vented to a safe location, under both normal and emergency operation. The automatic valves shall be arranged to fail to the closed position on loss of actuating power. In a space containing multiple consumers, the shutdown of one shall not affect the gas fuel supply to the others. For LPG or ethane liquid fuel supply systems, the piping shall be able to be drained and bleed valves opened without release of liquid to the atmosphere."

## 16.5 Gas fuel plant and related storage tanks

82 Paragraph 16.5.2.2 is amended to read as follows:

"16.5.2.2 Fuel supply equipment is to be included into all safety actions/shutdowns required by any of the cargo system related safety systems insofar as fuel supply is not safe while the respective action is ongoing."

## 16.7 Special requirements for gas-fired internal combustion engines

83 In paragraph 16.7.1.4, the existing text is amended to read as follows:

"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, as follows:

.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.

.2 The case of crankcases, the explosion relief valves, as required by SOLAS regulation II-1/27.4, are to be considered suitable for the gas operation of the engine. For engines not covered by the said SOLAS regulation, a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase is to be carried out."

84 The following new paragraphs 16.7.3.3.1 to 16.7.3.3.3 are added after paragraph 16.7.3.3 and before paragraph 16.7.3.4:

"16.7.3.3.1 For ships constructed on or after 1 January 2028, for Otto combustion process gas and dual fuel engines where the space below the piston is in direct communication with the crankcase, gas detection shall be provided to the crankcase, sumps (vent space) and charge air manifolds unless otherwise justified by the safety concept of the engine."

"16.7.3.3.2 For ships constructed on or after 1 January 2028, for Otto combustion crosshead engine designs, gas detection shall be provided to the piston underspace side unless otherwise justified by the safety concept of the engine."

"16.7.3.3.3 For ships constructed on or after 1 January 2028, for all engine types (e.g.4-stroke, 2-stroke, trunk piston, crosshead, Otto or Diesel combustion process), a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase, sumps, scavenge spaces/charge air manifolds and cooling system vents shall be carried out and reflected in the safety concept of the engine. This may identify alternative means to detect and/or mitigate gas operation fault conditions."

## 16.8 Special requirements for gas turbines

85 Paragraph 16.8.1.1*bis* is added after 16.8.1.1 as follows:

"16.8.1.1*bis* Each turbine using LPG fuel shall be fitted with a gastight enclosure unless fuel supply piping meets the requirements of paragraph 16.4.3. The consequences of gas leakage shall be evaluated in the risk assessment required by 16.2.5."

## CHAPTER 17
## SPECIAL REQUIREMENTS

86 Paragraph 17.4 is amended as follows by adding a new unnumbered paragraph under the heading:

**17.4 Refrigeration systems**

"The special requirements in this paragraph listed under column "i" in the table in chapter 19 are applicable only when a refrigeration system is required or used to maintain the cargo tank pressure and temperature within design limits of the containment system and/or within the conditions of carriage of the cargo indicated on the Certificate of Fitness."

87 In paragraph 17.21, the existing text is amended to read as follows:

"**17.21 Carbon dioxide**

17.21.1 Uncontrolled pressure loss from the cargo can cause solidification and the cargo will change from the liquid to the solid state. The precise triple point temperature of a particular carbon dioxide cargo shall be supplied before loading the cargo, and will depend on the purity of that cargo. The set pressure for the alarms and automatic actions described in this section shall be set to at least 0.05 MPa above the highest triple point pressure of the cargo being carried under all expected conditions. The triple point for pure carbon dioxide occurs at 0.417 MPa gauge and -56.6°C."

88 Paragraph 17.21.4 is amended to read as follows:

"17.21.4 Cargo tanks shall be continuously monitored for low pressure when carbon dioxide cargo is carried. An audible and visual alarm shall be given at the cargo control position and on the bridge. If the cargo tank pressure falls to the set pressure for alarms and automatic actions specified in 17.21.1, the monitoring system shall automatically close all cargo manifold liquid and vapour valves and stop all cargo compressors and cargo pumps. The emergency shutdown system required by 18.10 may be used for this purpose."

89 Paragraph 17.21.6 is amended to read as follows:

"17.21.6 Cargo hold spaces, cargo compressor rooms and other enclosed spaces where carbon dioxide could accumulate shall be fitted with continuous monitoring for carbon dioxide build-up. The alarms shall be set to 5,000 ppm."

90 The following new paragraphs 17.21.7 and 17.21.8 are added after paragraph 17.21.6:

"17.21.7 The materials of construction used in the cargo system shall also take into account the possibility of corrosion, in case carbon dioxide cargo contains impurities such as water or sulphur dioxide, which can cause acidic corrosion or other problems."

"17.21.8 Other requirements

17.21.8.1 The requirements for flammable products may be waived.

17.21.8.2 Carbon dioxide is considered a toxic product for the purpose of the Code.

The IGC Code requirements for toxic products are limited to the requirements indicated in the following paragraphs and as shown in table in chapter 19 for carbon dioxide.

17.21.8.3 The requirements of 3.2.5, 3.3.4, 3.6, 5.7.4, 12.1.7, 12.1.9, 13.6.11, 13.6.14, 13.6.15, 13.6.17 and 18.10.3.4, as well as chapters 10 (except for 10.2.6) and 11 do not apply to ships that exclusively carry this cargo.

17.21.8.4 In the application of 3.1.2 and 3.1.3, a single A-0 bulkhead shall be considered sufficient for this cargo.

17.21.8.5 In the application of 3.3.1, the requirement of SOLAS regulation II-2/9.2.3 for cargo spaces shall be applied instead of SOLAS regulation II-2/9.2.4 for cargo pump-rooms.

17.21.8.6 In the application of 3.8, bow or stern loading and unloading shall be allowed subject to the approval by the Administration.

17.21.8.7 When flammable or other toxic products are used for fuel or reliquefication systems, due consideration shall be applied to the additional risk.

17.21.8.8 In the application of chapter 9, inert gas may be not required based on the specific design. Dry air may be required to prevent condensation in hold space, cargo tanks and piping to gas free tanks.

17.21.8.9 In the application of chapter 13, all requirements (except those exclusively related to flammability) shall be applied except for 13.6.5 ."

91 Paragraph 17.22 is deleted.

## CHAPTER 18
## OPERATING REQUIREMENTS

### 18.9 Cargo sampling

92 In paragraph 18.9, the following new paragraph is added:

"18.9.6 The requirements as required from paragraphs 18.9.1 to 18.9.5 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."

### 18.10 Cargo emergency shutdown (ESD) system

93 Paragraph 18.10.1.1 is amended to read as follows:

"18.10.1.1 A cargo emergency shutdown system shall be fitted to stop cargo flow in the event of an emergency, either internally within the ship, or during cargo transfer to ship or shore. The ESD system is intended to return the cargo system to a safe static condition so that any remedial action can be taken. The design of the ESD system shall avoid the potential generation of surge pressures within cargo transfer pipe work."

94 Paragraph 18.10.1.3 is amended to read as follows:

"18.10.1.3 The ESD system shall be activated by the manual and automatic initiations listed in table 18.1, which is a summary of ESD shutdown-related system functions taking into account those required by the relevant sections of the IGC Code, including chapter 16 and may not describe all requirements. The actual enforceable requirements are found in the text of the Code. 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. A failure of any part of the system shall activate an ESD. Failure of the system includes loss of motive power for ESD valves and main electric power failure."

95 Paragraph 18.10.2.1.3 is amended to read as follows, and paragraphs 18.10.2.1.4, 18.10.2.2 and 18.10.2.3 are deleted:

"18.10.2.1.3 ESD valves in liquid piping systems shall close fully and smoothly within 30 seconds of initiation of the emergency shutdown. Information about the closure time of the valves and their operating characteristics shall be available on board, and the closing time shall be verifiable and repeatable.

96 The following paragraphs 18.10.3.1 and 18.10.3.2 are added after the heading "18.10.3 ESD system controls", and the subsequent paragraphs 18.10.3.1 to 18.10.3.4 are renumbered as 18.10.3.3 to 18.10.3.6 accordingly:

"18.10.3.1 The ESD system shall be designed to be activated by the manual and automatic initiations as specified in the Code. 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."

"18.10.3.2 The ESD system shall be fail-safe. If any single part of the system fails, ESD shall be initiated."

97 Paragraph 18.10.3.3 is amended to read as follows:

"18.10.3.3 Cargo machinery that is running shall be stopped by activation of the ESD system by causes in the relevant sections of the Code with reference to table 18.1 as guidance."

98 Table 18.1 is replaced by the following table, together with the associated notes:

**"Table 18.1 – Shutdown-related system cause and effect functions**

| Initiation | | Shutdown action (See 8.10.1.1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Emergency shutdown system (ESD) | | | | | | Gas Burning Safety System (GBSS) | | |
| | | Cargo Pumps | Compressor used for cargo handling | ESD valves on manifold | Cargo tank ESD valves | ESD link (to terminal) | Reliquefication plant including relevant aux systems and compressor | Pumps used for gas fuel | Compressors used for gas fuel | Master valve |
| **1** | ESD System failure (see 18.10.1.3) | V | V | V | V | V | V | V | V | V |
| **2** | ESD Push-button (see 18.10.3.3) | V | V | V | V | V | V | V | V | V |
| **3** | Fire detection in cargo area. (see 18.10.3.4) | V | V | V | V | V | V | V | V | V |
| **4** | ESD link from terminal① (see 18.10.1.4) | V | V | V | V① | V | N/A | N/A | N/A | N/A |
| **5** | Overflow protection (See 13.3.2) ② | V | V | V | V | V | V | V | V | V |
| **6** | Low pressure protection in cargo tanks ④ (see 8.3.1.1, 18.10.4) | V | V | V | V | V | V | V | V | V |
| **7** | Master valve receives shut signal ③ (see 16.4.2, 16.4.3, 16.4.6.2.1, 16.4.6.3.1, 16.4.8) | N/A | N/A | N/A | N/A | N/A | N/A | V | V | V |
| **8** | Fuel gas push-button (see 16.4.6.2.2, 16.4.6.3.2, 16.5.2.1) | N/A | N/A | N/A | N/A | N/A | N/A | V | V | V |
| **9** | Low suction pressure in gas fuel (see 16.5.2.2) ④ | N/A | N/A | N/A | N/A | N/A | N/A | V | V | V |
| **10** | Fire detection outside cargo area (see 16.5.2.2) | N/A | N/A | N/A | N/A | N/A | N/A | V | V | ~~ü~~ |

Note:
① ESD link (from terminal) does not trip the gas fuel supply or cargo reliquefication as the emergency is on the terminal, tripping of necessary tank valves is optional.

② The sensors referred to in 13.3.2 may be used to automatically close the individual tank filling valve if this can be done in a manner that will avoid excessive liquid pressure in the loading line. Alternatively full ESD can be initiated as given in the table.

③ Master valve receive shut signal refers to main valve required by 16.4.6.1 and not individual consumers. In case several consumers are served by different supply systems, only common equipment needs to be shut down.

④ Vacuum protection of cargo tanks and low suction pressure in gas fuel can be the same protection.

99 In paragraph 18.10.4, the heading is amended to read as follows:

"18.10.4 *Associated safety systems*"

## CHAPTER 19
## SUMMARY OF MINIMUM REQUIREMENTS

100 In explanatory notes to the summary of minimum requirements, the existing entries in the table are amended, and a new entry is added, as follows:

| ***Product name*** | | ***Ship type*** | ***Independent tank type C required*** | ***Control of vapour space within cargo tanks*** | ***Vapour detection*** | ***Gauging*** | | ***Special requirements*** |
|---|---|---|---|---|---|---|---|---|
| Carbon Dioxide | | 3G | ' | ' | T | C | | 17.21 |
| | | | ' | ' | | | | |
| VOC Condensate | | 2G/2PG | - | - | F + T* | C | | 14.4.2, 14.4.3, 17.9, 17.11 |

## APPENDIX 2

## MODEL FORM OF INTERNATIONAL CERTIFICATE OF FITNESS FOR THE CARRIAGE OF LIQUEFIED GASES IN BULK

101 The table in paragraph 3.3 is amended to read as follows, paragraph 3.5 is added, paragraph 4 is amended to read as follows, and a new paragraph 5 is added as follows. The existing paragraphs 5 to 7 are renumbered as 6 to 8:

".3

| Tank type and number | Stress factors[5] | | | | Materials[5] | MARVS[6] | Cargo/fuel |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | | | |
| | | | | | | | |
| Cargo piping | | | | | | | |
| Fuel vapour or liquid piping | | | | | | | |

.4 Mechanical properties of the cargo tank materials were determined at ….°C[7].

.5 Mechanical properties of the fuel tank materials were determined at ….°C.[7]"

"4 That the ship is suitable for the carriage in bulk of the following products as cargo provided that all the relevant operational provisions of the Code are observed.[8]

| **Products** | **Conditions of carriage (tank numbers, etc.)** | **Minimum temperature** |
|---|---|---|
| | | |
| | | |
| | | |
| Continued on attachment 1, additional signed and dated sheets. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan. | | |

"

"5 That the ship is suitable for the carriage and use of the following products as fuel provided that all the relevant operational provisions of the Code are observed.[8]

| **Products** | **Conditions of carriage and use (tank numbers, etc.)** | **Minimum temperature** |
|---|---|---|
| | | |
| | | |
| | | |
| Continued on attachment 1, additional signed and dated sheets. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan. | | |

"

APPENDIX

**CHECK/MONITORING SHEET FOR THE PROCESS OF AMENDING THE CONVENTION AND RELATED MANDATORY INSTRUMENTS (PROPOSAL/DEVELOPMENT)**

**Part III –** Process monitoring to be completed during the work process at the Sub-Committee and checked as part of the final approval process by the Committee (refer to paragraph 3.2.1.3)

| | | |
|---|---|---|
| 1 | The Sub-Committee, at an initial engagement, has allocated sufficient time for technical research and discussion before the target completion date, especially on issues needing to be addressed by more than one Sub-Committee and for which the timing of relevant sub-committees meetings and exchanges of the result of consideration needed to be carefully examined. | Yes |
| 2 | The scope of application agreed at the proposal stage was not changed without the approval of the Committee. | Yes |
| 3 | The technical base document/draft amendment addresses the proposal's issue(s) through the suggested instrument(s); where it does not, the Sub-Committee offers the Committee an alternative method of addressing the problem raised by the proposal. | N/A |
| 4 | Due attention is to be paid to the *Interim Guidelines for the systematic application of the grandfather clause* (MSC/Circ.765). | N/A |
| 5 | All references have been examined against the text that will be valid if the proposed amendment enters into force. | Yes |
| 6 | The location of the insertion or modified text is correct for the text that will be valid when the proposed text enters into force on a four-year cycle of entry into force, as other relevant amendments adopted might enter into force on the same date. | Yes |
| 7 | There are no inconsistencies in respect of scope of application between the technical regulation and the application statement contained in regulation 1 or 2 of the relevant chapter, and application is specifically addressed for existing and/or new ships, as necessary. | Yes |
| 8 | Where a new term has been introduced into a regulation and a clear definition is necessary, the definition is given in the article of the Convention or at the beginning of the chapter. | Yes |
| 9 | Where any of the terms "fitted", "provided", "installed" or "installation" are used, consideration has been given to clarifying the intended meaning of the term. | Yes |

| | | |
|---|---|---|
| 10 | All necessary related and consequential amendments to other existing instruments, including non-mandatory instruments, in particular to the forms of certificates and records of equipment required in the instrument being amended, have been examined and included as part of the proposed amendment(s). | Yes |
| 11 | The forms of certificates and records of equipment have been harmonized, where appropriate, between the Convention and its Protocols. | N/A |
| 12 | It is confirmed that the amendment is being made to a currently valid text and that no other bodies are concurrently proposing changes to the same text. | Yes |
| 13 | All entry-into-force criteria (building contract, keel laying and delivery) have been considered and addressed. | Yes |
| 14 | Other impacts of the implementation of the proposed/approved amendment have been fully analysed, including consequential amendments to the "application" and "definition" regulations of the chapter. | Yes |
| 15 | The amendments presented for adoption clearly indicate changes made with respect to the original text, so as to facilitate their consideration. | Yes |
| 16 | For amendments to mandatory instruments, the relationship between the Convention and the related instrument has been observed and addressed, as appropriate. | Yes |
| 17 | The related record format has been completed or updated, as appropriate. | Yes |

## RECORD FORMAT

The following records should be created and kept updated for each regulatory development.

The records can be completed by providing references to paragraphs of related documents containing the relevant information, proposals, discussions and decisions.

| |
|---|
| **1 Title (number and title of regulation(s))** |
| IGC Code chapters 1,2,4,5,8,9,10,11,12,13,15,16,17,18, and the Model Form of the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk |
| **2 Origin of the requirement (original proposal document)** |
| The output was proposed by MSC 102/21/1. The large number of UIs submitted to the CCC Sub-Committee since the entry into force of the IGC Code in 2016 indicates there is a clear need to update the IGC Code, taking account of the experience gained. Additional outputs were added by MSC 103/21 paragraph 18, Completion of agenda item 1.17 has been extended to 2024. Refer to biennial status report for 2022-23. See section 5 (history of discussion) for more information. |
| **3 Main reason for the development (extract from the proposal document)** |
| "Review of the IGC Code" has been extended to 2024, and those draft amendments that could not be completed at CCC 9, were finalized at CCC 10. The amendments include a variety of issues, including application of finite element analysis to type C tanks, carriage of $CO_2$ cargoes, the use of LPG and toxic cargoes as fuel, the causes and effects of an ESD and cargo tank filling limits. |
| **4 Related output** |
| Amendments to the IGC Code and development of guidelines for ammonia cargo as fuel |

**5 History of the discussion (approval of work programmes, sessions of sub-committees, including CG/DG/WG arrangements)**

**CCC 6** endorsed the work plan for the next phase of the development of the IGC Code and endorsed the output on "Review of the IGC Code".

**CCC 9** developed amendments, for approval at MSC 109 and adoption at MSC 110.

**CCC 10** Continued development of additional amendments which had not been agreed upon at CCC 9, with a view to entry into force on 1 January 2028.

**6 Impact on other instruments (codes, performance standards, guidance circulars, certificates/records format, etc.)**

Model Form of the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk ~~[~~and Interim Guidelines on the use of Ammonia as Fuel~~]~~

**7 Technical background**

***7.1 Scope and objective (to cross-check with items 4 and 5 in part II of the checklist)***

The amendments include a variety of issues including application of finite element analysis to type C tanks; carriage of $CO_2$ cargoes; the use of LPG and toxic cargoes as fuel; the causes and effects of an ESD; and cargo tank filling limits.

***7.2 Technical/operational background and rationale (e.g. summary of FSA study, if available, or engineering challenge posed)***

Not applicable

***7.3 Source/derivation of requirement (non-mandatory instrument, industry standard, national/regional requirement)***

Not applicable

***7.4 Short summary of requirement (what is the new requirement – in short and lay terms)***

The amendments will enhance safety by regulating a variety of issues including application of finite element analysis to type C tanks; carriage of $CO_2$ cargoes; the use of LPG and toxic cargoes as fuel; the causes and effects of an ESD; and cargo tank filling limits.

***7.5 Points of discussions (controversial points and conclusion)***

Not applicable

***

# ANNEX 4

## DRAFT MSC RESOLUTION

## AMENDMENTS TO CHAPTER II-1 OF THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO article VIII(b) of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"), concerning the amendment procedure applicable to the annex to the Convention, other than to the provisions of chapter I,

HAVING CONSIDERED, at its [110th] session, amendments to the Convention proposed and circulated in accordance with article VIII(b)(i) of the Convention,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention, amendments to the Convention, the text of which is set out in the annex to the present resolution;

2 DETERMINES, in accordance with article VIII(b)(vi)(2)(bb) of the Convention, that the said amendments shall be deemed to have been accepted on [1 July 2026], unless, prior to that date, more than one third of the Contracting Governments to the Convention or Contracting Governments the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet have notified the Secretary-General of their objections to the amendments;

3 INVITES Contracting Governments to the Convention to note that, in accordance with article VIII(b)(vii)(2) of the Convention, the amendments shall enter into force on [1 January 2027] upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article VIII(b)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Contracting Governments to the Convention;

5 ALSO REQUESTS the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Contracting Governments to the Convention.

ANNEX

**DRAFT AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974**

**CHAPTER II-1**

**CONSTRUCTION - STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS**

**PART A**
**General**

**Regulation 2 – Definitions**

1 The following new sub-paragraph is added after existing sub-paragraph 29:

".30 *Gaseous fuel* means any fluid used as fuel which:

.1 has a vapour pressure exceeding 0.28 MPa absolute at a temperature of 37.8°C; or

.2 is completely gaseous at 20°C at a standard pressure of 101.3 kPa."

**PART G**
**Ships using low-flashpoint fuels**

2 The existing title of part G is replaced by the following:

"**PART G**
**Ships using gaseous fuels or low-flashpoint fuels**"

**Regulation 56 – Application**

3 Paragraphs 1 to 4 are replaced by the following:

"1 Except as provided for in paragraphs 4 and 5, this part shall apply to ships using gaseous fuels or low-flashpoint fuels:

.1 for which the building contract is placed on or after 1 January 2017;

.2 in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 July 2017; or

.3 the delivery of which is on or after 1 January 2021.

Such ships using low-flashpoint fuels shall comply with the requirements of this part in addition to any other applicable requirements of the present regulations.

2 Except as provided for in paragraphs 4 and 5, a ship, irrespective of the date of construction, including one constructed before 1 January 2009, which converts to using gaseous fuels or low-flashpoint fuels on or after 1 January 2017 shall be treated as a ship using gaseous fuels or low-flashpoint fuels on the date on which such conversion commenced.

3 Except as provided for in paragraphs 4 and 5, a ship using gaseous fuels or low-flashpoint fuel, irrespective of the date of construction, including one constructed before 1 January 2009, which, on or after 1 January 2017, undertakes to use gaseous fuels or low-flashpoint fuels different from those which it was originally approved to use before 1 January 2017 shall be treated as a ship using gaseous fuels or low-flashpoint fuels on the date on which such undertaking commenced.

4 This part shall not apply to gas carriers, as defined in regulation VII/11.2:

.1 using their cargoes as fuel and complying with the requirements of the IGC Code, as defined in regulation VII/11.1; or

.2 using other gaseous fuels provided that the fuel storage and distribution systems design and arrangements for such gaseous fuels comply with the requirements of the IGC Code for gas as a cargo."

**Regulation 57 – Requirements for ships using low-flashpoint fuels**

4 The existing title of regulation 57 is replaced by the following:

"**Regulation 57 Requirements for ships using gaseous fuels or low-flashpoint fuels**"

5 The paragraph is replaced by the following:

"Except as provided in regulations 56.4 and 56.5, ships using gaseous fuels or low-flashpoint fuels shall comply with the requirements of the IGF Code."

APPENDIX

## CHECK/MONITORING SHEET FOR THE PROCESS OF AMENDING THE CONVENTION AND RELATED MANDATORY INSTRUMENTS (PROPOSAL/DEVELOPMENT)

**Part III –** Process monitoring to be completed during the work process at the Sub-Committee and checked as part of the final approval process by the Committee (refer to paragraph 3.2.1.3)

| | | |
|---|---|---|
| 1 | The Sub-Committee, at an initial engagement, has allocated sufficient time for technical research and discussion before the target completion date, especially on issues needing to be addressed by more than one Sub-Committee and for which the timing of relevant sub-committees meetings and exchanges of the result of consideration needed to be carefully examined. | Yes |
| 2 | The scope of application agreed at the proposal stage was not changed without the approval of the Committee. | Yes |
| 3 | The technical base document/draft amendment addresses the proposal's issue(s) through the suggested instrument(s); where it does not, the Sub-Committee offers the Committee an alternative method of addressing the problem raised by the proposal. | N/A |
| 4 | Due attention is to be paid to the *Interim Guidelines for the systematic application of the grandfather clause* (MSC/Circ.765). | N/A |
| 5 | All references have been examined against the text that will be valid if the proposed amendment enters into force. | Yes |
| 6 | The location of the insertion or modified text is correct for the text that will be valid when the proposed text enters into force on a four-year cycle of entry into force, as other relevant amendments adopted might enter into force on the same date. | Yes |
| 7 | There are no inconsistencies in respect of scope of application between the technical regulation and the application statement contained in regulation 1 or 2 of the relevant chapter, and application is specifically addressed for existing and/or new ships, as necessary. | Yes |
| 8 | Where a new term has been introduced into a regulation and a clear definition is necessary, the definition is given in the article of the Convention or at the beginning of the chapter. | Yes |
| 9 | Where any of the terms "fitted", "provided", "installed" or "installation" are used, consideration has been given to clarifying the intended meaning of the term. | N/A |
| 10 | All necessary related and consequential amendments to other existing instruments, including non-mandatory instruments, in particular to the forms of certificates and records of equipment required in the instrument being amended, have been examined and included as part of the proposed amendment(s). | Yes |
| 11 | The forms of certificates and records of equipment have been harmonized, where appropriate, between the Convention and its Protocols. | N/A |
| 12 | It is confirmed that the amendment is being made to a currently valid text and that no other bodies are concurrently proposing changes to the same text. | Yes |
| 13 | All entry-into-force criteria (building contract, keel laying and delivery) have been considered and addressed. | Yes |
| 14 | Other impacts of the implementation of the proposed/approved amendment have been fully analysed, including consequential amendments to the "application" and "definition" regulations of the chapter. | Yes |
| 15 | The amendments presented for adoption clearly indicate changes made with respect to the original text, so as to facilitate their consideration. | Yes |
| 16 | For amendments to mandatory instruments, the relationship between the Convention and the related instrument has been observed and addressed, as appropriate. | Yes |
| 17 | The related record format has been completed or updated, as appropriate. | Yes |

**RECORD FORMAT**

The following records should be created and kept updated for each regulatory development.

The records can be completed by providing references to paragraphs of related documents containing the relevant information, proposals, discussions and decisions.

| |
|---|
| **1 Title (number and title of regulation(s))** |
| Draft amendments to the International Convention for the Safety of Life at Sea, 1974. Chapter II-1 on Construction - Structure, Subdivision and Stability, Machinery and Electrical Installations, Part A Definitions, Regulation 56 Application and Regulation 57 Requirements for ships using low-flashpoint fuels. |
| **2 Origin of the requirement (original proposal document)** |
| MSC 108 noted (MSC 108/20, paragraphs 5.30 to 5.33) that the title of the IGF Code stated that it should apply to fuels that were gases or had a low-flash point, while, in SOLAS chapter II-1, Part G, the IGF Code applies to ships using low-flashpoint fuels regardless of whether they are in liquid or gaseous form.<br><br>The Committee also noted that the definition of low-flashpoint fuel in SOLAS regulation II-1/2 was *"Low-flashpoint fuel means gaseous or liquid fuel having a flashpoint lower than otherwise permitted under regulation II-2/4.2.1.1"*.<br><br>The Committee further noted the need to clarify whether or not the IGF Code applied to ships using gas as fuel irrespective of flashpoint and referred this issue as an urgent matter to CCC 10 for consideration and advice to MSC 109 accordingly.<br><br>In September 2024, CCC 10 endorsed the principle that IGC Code ships using liquefied gases as fuel, including liquefied gases not carried as cargo, are subject to the requirements of the IGC Code in lieu of the IGF Code (CCC 10/4, paragraph 19). |
| **3 Main reason for the development (extract from the proposal document)** |
| Clarification needed considering that the title of the IGF Code stated that it should apply to fuels that were gases or had a low-flash point, while, in SOLAS chapter II-1, Part G, the IGF Code applies to ships using low-flashpoint fuels regardless of whether they are in liquid or gaseous form. |
| **4 Related output** |
| "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels" |
| **5 History of the discussion (approval of work programmes, sessions of sub-committees, including CG/DG/WG arrangements)** |
| MSC 109 in December 2024 note the discussions of the Sub-Committee concerning unified interpretations, and that concerning document CCC 10/10/3 (IACS), the Sub-Committee recommended that SOLAS chapter II-1 would require an amendment in line with paragraph 20 of that document; and that concerning document CCC 10/10/4 (Republic of Korea), the Sub-Committee recommended that the issues raised in that document could be further considered under the output on "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels".<br><br>MSC 109 also considered the proposal by the UK (MSC 1098/6) to amend SOLAS to clarify the application of the IGF Code to gas fuels. The WG noted that the current applicability of the IGF Code covered slow-flashpoint fuels, as defined in SOLAS regulation II-1/2.29, and ammonia did not present flammable vapour during the phase change from liquid to gas. Therefore, ammonia seemed to fall outside the scope of the IGF Code. The document stated that, consequently, this could create uncertainty within the industry looking to invest in ammonia fuelled ships, compliant with the Guidelines, as developed by CCC 10 |

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|---|
| MSC 109, approved the draft amendments to the SOLAS Convention as prepared by the WG in relation to the application of the IGF Code and agree to the recommendation of the Group that these amendments be approved at this session with a view to adoption at MSC 110 in June 2025 and that the four-year amendment cycle in MSC.1/Circ.1481, should be relaxed, with a view for the entry into force in 2027.<br><br>The mentioned draft amendments to be circulated after the issuance of MSC 109 Report. |
| **6 Impact on other instruments (codes, performance standards, guidance circulars, certificates/records format, etc.)** |
| IGC Code |
| **7 Technical background** |
| ***7.1 Scope and objective (to cross-check with items 4 and 5 in part II of the checklist)*** |
| The WG noted that the current applicability of the IGF Code covered slow-flashpoint fuels, as defined in SOLAS regulation II-1/2.29, and ammonia did not present flammable vapour during the phase change from liquid to gas. |
| ***7.2 Technical/operational background and rationale (e.g. summary of FSA study, if available, or engineering challenge posed)*** |
| Not applicable |
| ***7.3 Source/derivation of requirement (non-mandatory instrument, industry standard, national/regional requirement)*** |
| Not applicable |
| ***7.4 Short summary of requirement (what is the new requirement – in short and lay terms)*** |
| Before these amendments, ammonia seemed to fall outside the scope of the IGF Code, consequently, this could create uncertainty within the industry looking to invest in ammonia fuelled ships, compliant with the Guidelines, as developed by CCC 10. |
| ***7.5 Points of discussions (controversial points and conclusion)*** |
| Not applicable |

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MSC.1/Circ.1682
22 January 2025

**UNIFIED INTERPRETATIONS OF SOLAS REGULATIONS III/20.8.4 AND 20.11, AND RESOLUTION MSC.402(96)**

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), approved, with a view to providing more specific guidance on the applicability of SOLAS regulation III/20.11 and resolution MSC.402(96) to inflated rescue boats, unified interpretations (UIs) of SOLAS regulations III/20.8.4 and 20.11, and resolution MSC.402(96), prepared by the Sub-Committee on Ship Systems and Equipment, at its tenth session (4 to 8 March 2024), as set out in the annex.

2 Member States are invited to use the annexed UIs as guidance when applying SOLAS regulations III/20.8.4 and 20.11, and resolution MSC.402(96), and to bring the UIs to the attention of all parties concerned.

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## ANNEX

## UNIFIED INTERPRETATIONS OF SOLAS REGULATIONS III/20.8.4 AND 20.11, AND RESOLUTION MSC.402(96)

## RESOLUTION MSC.402(96)

## SOLAS CHAPTER III

## Life-saving appliances and arrangements

**Regulations III/20.8.4 and 20.11 – Operational readiness, maintenance and inspections**

SOLAS regulation III/20.11 and resolution MSC.402(96) should also be applicable to inflated rescue boats.

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MSC.1/Circ.1683
22 January 2025

**UNIFIED INTERPRETATIONS OF SOLAS REGULATION II-2/4.5.6.1, AND PARAGRAPHS 3.1.2, 3.1.4 AND 3.5.3 OF THE IBC CODE**

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), approved, with a view to providing more specific guidance for the application of the relevant requirements of chapter II-2 of the SOLAS Convention and the IBC Code, regarding cargo/vapour piping and related gas-freeing piping/ducts on tankers, unified interpretations (UIs) of SOLAS chapter II-2 and the IBC Code, prepared by the Sub-Committee on Ship Systems and Equipment at its tenth session (4 to 8 March 2024), as set out in the annex.

2 Member Governments are invited to use the annexed (UIs) as guidance when applying relevant provisions of SOLAS chapter II-2 and the IBC Code, and to bring them to the attention of all parties concerned.

3 This circular applies to the systems installed on or after 1 January 2026.

4 The expression *installed on or after 1 January 2026* means:

.1 for ships for which the building contract is placed on or after 1 January 2026, or in the absence of the contract, constructed on or after 1 January 2026, any installation date on the ship; or

.2 for ships other than those ships prescribed in .1 above, a contractual delivery date for the equipment or, in the absence of a contractual delivery date, the actual delivery date of the equipment to the ship on or after 1 January 2026.

***

# ANNEX

## UNIFIED INTERPRETATIONS OF SOLAS REGULATION II-2/4.5.6.1 AND PARAGRAPHS 3.1.2, 3.1.4 AND 3.5.3 OF THE IBC CODE

All cargo piping (including cargo tank venting piping, relief valve discharge piping, cargo tank purging and gas-freeing piping/ducts), except those serving for inerting gas supply and for bow or stern loading and unloading arrangement, should be arranged within the cargo areas, as defined in SOLAS regulation II-2/3.6 and in paragraph 1.3.6 of the IBC Code. However, gasfreeing air-supply fan(s)/blower(s) and related air-supply piping/ducts may be located in- the forecastle area, outside of the cargo area, subject to the following paragraphs:

.1 the air-supply piping/ducts should not be permanently connected to cargo piping or cargo tank venting piping/ducts and additionally the following conditions in sub-paragraphs .1 to .5 should also be met:

.1 the connection should be made with detachable connections (e.g. spool pieces, detachable ducts/hoses, etc.) and two shut-off valves fitted as specified in sub-paragraph .2 below. Such detachable connections should be located within the cargo area;

.2 a non-return valve should be provided within the cargo area at the cargo side (i.e. between the said detachable connection and cargo tank(s)). A shut-off valve should be fitted at the fan/blower side (i.e. between the said detachable connection and the fan(s)/blower(s)), and another shut-off valve should be fitted at the cargo side (i.e. between the said detachable connection and cargo tank(s)). The shut-off valve at the cargo side may or may not be located after the non-return valve and therefore, a single non-return valve with a positive means of closure can be located between the said detachable connection and cargo tank(s) in lieu of the combination of the said non-return valve and shut-off valve at the cargo side;

.3 the shut-off valve at the fan/blower side should open after the air-supply fan(s)/blower(s) is/are started; this should be triggered/activated by the fan discharge pressure;

.4 the shut-off valve at the fan/blower side should automatically close when the air-supply fan(s)/blower(s) is/are stopped or in the event of- loss of gas freeing air pressure; and

.5 when the air-supply duct is arranged penetrating through the bulkhead facing the cargo area, the shut-off valve at the fan/blower side should be fitted directly on the bulkhead. This shut-off valve may or may not be located inside the fan/blower room. Alternatively, the shut-off valve at the fan/blower side may be fitted on the open deck apart from the bulkhead. In all cases, electrical parts (if any) of this shut-off valve should, if fitted in a hazardous area, be of certified safe type* for use in the concerned hazardous area (Zone 1 or Zone 2);

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* Refer to IEC 60092-502:1999 Electrical Installations in Ships – Tankers.

.2 the part of the air-supply piping/duct from air intakes of the fan(s)/blower(s) till the shut-off valve at the fan/blower side, except the part necessary to extend into a hazardous area (depending on the location of this shut-off valve), should be arranged in a non-hazardous area. The air intakes for the gas-freeing fans/blowers should be located on the open deck and in a non-hazardous area;

.3 when not being used in gas-freeing operation, the said detachable connection should be dismantled, with all the openings closed with blank flanges; and a warning plate should be provided in the vicinity of each opening, stating "This opening is to be closed with a blank flange when not in gas-freeing operation";

.4 the air-supply fan(s)/blower(s), as well as the associated piping/ducts, should not be used for any other purpose;

.5 the air-supply fan(s)/blower(s) should be of the non-sparking type (see IACS unified requirement UR F29);

.6 electrical motor(s) driving the air-supply fan(s)/blower(s) should be of the explosionproof type when fitted in the duct or located- in the cargo area; and

.7 suitable and clear operational procedures should be provided stating, inter alia:

.1 the flexible hose, detachable duct or spool piece can only be connected and fixed to the piping/duct just or within 10 minutes before the gas-freeing operation; and

.2 the shut-off valves can only be opened after the air-supply fan(s)/blower(s) are put into operation and this action should be interlocked with the fan discharge pressure.

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MSC.1/Circ.1684
22 January 2025

**UNIFIED INTERPRETATIONS OF SOLAS CHAPTER II-2**

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), approved, in order to provide specific guidance on the consistent application of SOLAS regulation II-2/11.4.1 on the crown of a machinery space of category A, as well as SOLAS regulations II-2/4.5.3.2.2 and 11.6.3.2 on the secondary means of venting cargo tanks, the unified interpretations (UIs) of SOLAS chapter II-2, prepared by the Sub-Committee on Ship Systems and Equipment, at its tenth session (4 to 8 March 2024), as set out in the annex.

2 Member States are invited to use the annexed UIs as guidance when applying SOLAS regulations II-2/11.4.1, 4.5.3.2.2 and 11.6.3.2, respectively, and to bring them to the attention of all parties concerned.

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## ANNEX

## UNIFIED INTERPRETATIONS OF SOLAS CHAPTER II-2

**SOLAS regulation II-2/11.4.1 – Machinery spaces of category A, crowns and casings**

1 The crown of a machinery space of category A should be understood to mean the underside of the deck and the uppermost horizontal part of the main space of the machinery space. If the upper side bulkheads are sloping, the sloping parts of the bulkheads should be included in the crown.

**SOLAS regulations II-2/4.5.3.2.2 and 11.6.3.2 – Cargo areas of tankers; Protection of cargo tank structure against pressure or vacuum in tankers**

2 For ships that apply pressure sensors in each tank as an alternative to having the secondary means of venting as per SOLAS regulation II-2/11.6.3.2, the setting of the over-pressure alarm should be above the pressure setting of the P/V valve and the setting of the under-pressure alarm should be below the vacuum setting of the P/V valve. The alarm settings should be within the design pressures of the cargo tanks. The settings should be fixed and should not be arranged for blocking or adjustment in operation.

3 An exception should be permitted for ships that carry different types of cargo and use P/V valves with different settings, one setting for each type of cargo. The settings may be adjusted to account for the different types of cargo.

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MSC.1/Circ.1685
22 January 2024

# UNIFIED INTERPRETATION OF SOLAS CHAPTER II-1

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), with a view to providing more specific guidance on SOLAS regulation II-1/26, approved the unified interpretation of SOLAS chapter II-1, prepared by the Sub-Committee on Ship Systems and Equipment, at its tenth session (4 to 8 March 2024), as set out in the annex.

2 Member States are invited to use the annexed unified interpretation as guidance when applying SOLAS regulation II-1/26, and to bring the unified interpretation to the attention of all parties concerned.

3 This circular applies to the systems installed on passenger ships, on or after 1 January 2026.

4 The expression *installed on or after 1 January 2026* means:

(a) for passenger ships for which the building contract is placed on or after 1 January 2026, or in the absence of the contract, constructed on or after 1 January 2026, any installation date on the ship; or

(b) for passenger ships other than those ships prescribed in (a) above, a contractual delivery date for the equipment or, in the absence of a contractual delivery date, the actual delivery date of the equipment to the ship on or after 1 January 2026.

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# ANNEX

## UNIFIED INTERPRETATION OF SOLAS CHAPTER II-1

## CHAPTER II-1

## Construction – Structure, subdivision and stability, machinery and electrical installations

### Regulation II-1/26.2 – General

1 The possibility of failures in electric machines should be considered. Sufficient propulsion capacity should be maintained or restored within due time for the following failure modes of electric machines, as a minimum:

.1 winding insulation failures; and

.2 excitation failures.

2 Single electric propulsion motors (both single and dual winding with a single rotor) for main propulsion should not be considered to provide the reliability required for a single essential propulsion component. A separate propulsion unit sufficient to give the ship a navigable speed should be required for such arrangements.

3 Propulsion arrangements with two independent rotors on a single shaft should be considered to provide the required reliability, provided it is possible to de-excite or de-flux each of the rotors individually and to supply the stators independently.

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MSC.1/Circ.677/Rev.1
22 January 2025

# REVISED STANDARDS FOR THE DESIGN, TESTING AND LOCATING OF DEVICES TO PREVENT THE PASSAGE OF FLAME INTO CARGO TANKS IN TANKERS

1 The Committee, at its forty-ninth session (2 to 6 April 1984), adopted the standards so developed, which were attached to MSC/Circ.373.

2 The Committee agreed that the inert gas system was to be considered as equivalent to devices to prevent the passage of flame into cargo tanks only if vent outlets on ships fitted with inert gas systems were at least fitted with devices to prevent the passage of flame into cargo tanks, but that these devices need not comply with the test requirement for endurance burning. The Committee noted that, in the standards, emphasis was laid on compliance with test specifications rather than on construction. It was then understood that, in the case of a tanker fitted with an inert gas system, the provision of flashback would suffice and a well-designed and fitted flame screen could meet this criterion. In summary, if a flame screen met the standards, it would be accepted.

3 The Committee, at its fifty-fifth session (11 to 22 April 1988), adopted amendments to the standards contained in MSC/Circ.373 and disseminated them as MSC/Circ.373/Rev.1.

4 The Committee, at its sixty-fourth session (5 to 9 December 1994), recognizing the necessity to clarify some provisions in the revised standards, adopted further amendments thereto, which are incorporated in the *Revised standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks in tankers* (MSC/Circ.677).

5 The Committee, at its 109th session (2 to 6 December 2024), recalling previous amendments made to the Revised standards (MSC/Circ.677) by MSC.1/Circ.1009 and MSC.1/Circ.1324, and having noted a need to revise an ISO standard reference therein, approved *Revised standards for the design, testing and locating of devices to prevent the passage of flame into cargo tanks in tankers* for circulation as MSC.1/Circ.677/Rev.1.

6 Member Governments are invited to give effect to the revised standards in conjunction with the application of SOLAS regulation II-2/4.5.3.

7 This circular applies to the devices installed on or after 4 December 2026.

8 The present circular supersedes MSC/Circ.677, as amended by MSC.1/Circ.1009 and MSC.1/Circ.1324, as of 4 December 2026.

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# ANNEX

# REVISED STANDARDS FOR THE DESIGN, TESTING AND LOCATING OF DEVICES TO PREVENT THE PASSAGE OF FLAME INTO CARGO TANKS IN TANKERS

## CONTENTS

# 1 INTRODUCTION

## 1.1 Purpose

The 1981 and the 1983 amendments to the International Convention for the Safety of Life at Sea, 1974 (SOLAS) include revised requirements for fire safety measures for tankers, which were incorporated in the revised SOLAS chapter II-2 in the 2000 amendments. SOLAS regulation II-2/4.5.3.3 states:

> "The venting system shall be provided with devices to prevent the passage of flame into the cargo tanks. The design, testing and locating of these devices shall comply with the requirements established by the Administration which shall contain at least the Standards adopted by the Organization."

## 1.2 Application

1.2.1 These Standards are intended to cover the design, testing, locating and maintenance of "devices to prevent the passage of flame into cargo tanks" (hereafter called "devices") of tankers and combination carriers carrying crude oil and petroleum products having a flashpoint of 60°C (closed cup) or less, and a Reid vapour pressure below atmospheric pressure and other products having a similar fire hazard.

1.2.2 Oil tankers and combination carriers fitted with an inert gas system in accordance with SOLAS regulation II-2/4.5.5 should be fitted with devices which comply with these Standards, except that the tests specified in 3.2.3 and 3.3.3.2 are not required. Such devices are only to be fitted at openings unless they are tested in accordance with 3.4.

1.2.3 These Standards are intended for devices protecting cargo tanks containing crude oil, petroleum products and flammable chemicals. In the case of the carriage of chemicals, the test media referred to in section 3 can be used for products having an MESG of 0.9 mm and greater. However, devices for chemical tankers certified for the carriage of products with an MESG[1] less than 0.9 mm should be tested with the following media based on the apparatus group assigned as per column i" of the IBC Code, chapter 17:

.1 Apparatus Group II B - ethylene (MESG = 0.65 mm); and

.2 Apparatus Group II C - hydrogen (MESG = 0.28 mm).

Where no apparatus group is assigned in column i", the device should be tested in accordance with the requirements for Apparatus Group II B.

1.2.4 Devices should be tested and located in accordance with these standards. In addition to these standards, pressure/vacuum valves should comply with ISO Standard 15364:2021 "Ships and marine technology — Pressure-vacuum valves for cargo tanks and devices to prevent the passage of flame into cargo tanks".

1.2.5 Devices are installed to protect:

.1 openings designed to relieve pressure or vacuum caused by thermal variations (regulation II-2/11.6.1.1);

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1 Reference is made to IEC 60079, Electrical Apparatus for Explosive Gas Atmospheres.

.2 openings designed to relieve pressure or vacuum during cargo loading, ballasting or during discharging (regulation II-2/11.6.1.2); and

.3 outlets designed for gas freeing (regulation II-2/16.3.2.2.3).

1.2.6 Devices should not be capable of being bypassed or blocked open unless they are tested in the bypassed or blocked open position in accordance with section 3.

1.2.7 These Standards do not include consideration of sources of ignition such as lightning discharges since insufficient information is available to formulate equipment recommendations. All cargo handling, tank cleaning and ballasting operations should be suspended on the approach of an electrical storm.

1.2.8 These Standards are not intended to deal with the possibility of the passage of flame from one cargo tank to another on tankers with common venting systems.

1.2.9 When outlet openings of gas-freeing systems on tankers not fitted with inert gas systems are required to be protected with devices, they should comply with these Standards except that the tests specified in 3.2.3 and 3.3.3.2 are not required.

1.2.10 Certain of the tests prescribed in section 3 of these Standards are potentially hazardous, but no attempt is made in this circular to specify safety requirements for these tests.

### 1.3 Definitions

For the purpose of these Standards, the following definitions are applicable.

1.3.1 "Flame arrester" is a device to prevent the passage of flame in accordance with a specified performance standard. Its flame-arresting element is based on the principle of quenching.

1.3.2 "Flame screen" is a device utilizing wire mesh to prevent the passage of unconfined flames, in accordance with a specified performance standard.

1.3.3 "Flame speed" is the speed at which a flame propagates along a pipe or other system.

1.3.4 "Flashback" is the transmission of a flame through a device.

1.3.5 "High velocity vent" is a device to prevent the passage of flame, consisting of a mechanical valve which adjusts the opening available for flow in accordance with the pressure at the inlet of the valve in such a way that the efflux velocity cannot be less than 30 m/s.

1.3.6 "Pressure/vacuum valve"[2] is a device designed to maintain pressure and vacuum in a closed container within preset limits.

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2 Pressure/vacuum valves are devices to prevent the passage of flame when designed and tested in accordance with these Standards.

## 2 STANDARDS

### 2.1 Principles

2.1.1 Depending on their service and location, devices are required to protect against the propagation of:

.1 moving flames; and/or

.2 stationary flames from pre-mixed gases,

after ignition of gases resulting from any cause.

2.1.2 When flammable gases from outlets ignite, the following four situations may occur:

.1 At low gas velocities, the flame may:

.1 flashback; or

.2 stabilize itself as if the outlet were a burner.

.2 At high velocities, the flame may:

.1 burn at a distance above the outlet; or

.2 be blown out.

2.1.3 In order to prevent the passage of flame into a cargo tank, devices must be capable of performing one or more of the following functions:

.1 permitting the gas to pass through passages without flashback and without ignition of the gases on the protected side when the device is subjected to heating for a specified period;

.2 maintaining an efflux velocity in excess of the flame speed for the gas, irrespective of the geometric configuration of the device and without the ignition of gases on the protected side when the device is subjected to heating for a specified period; and

.3 preventing an influx of flame when conditions of vacuum occur within the cargo tanks.

### 2.2 Mechanical design standards

2.2.1 The casing or housing of devices should meet similar standards of strength, heat resistance and corrosion resistance as the pipe to which they are attached.

2.2.2 The design of devices should allow for ease of inspection and removal of internal elements for replacement, cleaning or repair.

2.2.3 All flat joints of the housing should be machined true and should provide for a joint having an adequate metal-to-metal contact.

2.2.4 Flame arrester elements should fit in the housing in such a way that flame cannot pass between the element and the housing.

2.2.5 Resilient seals may be installed only if their design is such that if the seals are partially or completely damaged or burned, the device is still capable of effectively preventing the passage of flame.

2.2.6 Devices should allow for efficient drainage of moisture without impairing their efficiency to prevent the passage of flame.

2.2.7 The casing and element and gasket materials should be capable of withstanding the highest pressure and temperature to which the device may be exposed under both normal and specified fire test conditions.

2.2.8 End-of-line devices should be so constructed as to direct the efflux vertically upwards.

2.2.9 Fastenings essential to the operation of the device, i.e. screws, etc., should be protected against loosening.

2.2.10 Means should be provided to check that any valve lifts easily without remaining in the open position.

2.2.11 Devices in which the flame-arresting effect is achieved by the valve function and which are not equipped with the flame arrester elements (e.g. high velocity valves) must have a width of the contact area of the valve seat of at least 5 mm.

2.2.12 Devices should be resistant to corrosion in accordance with 3.5.1

2.2.13 Elements, gaskets and seals should be of material resistant to both seawater and the cargoes carried.

2.2.14 The casing or housing should be capable of passing a hydrostatic pressure test, as required in 3.5.2.

2.2.15 In-line devices should be able to withstand, without damage or permanent deformation, the internal pressure resulting from detonation when tested in accordance with section 3.4.

2.2.16 A flame arrester element should be designed to ensure quality control of manufacture to meet the characteristics of the prototype tested, in accordance with these Standards.

**2.3 Performance Standards**

2.3.1 Devices should be tested in accordance with 3.5 and thereafter shown to meet the test requirements of 3.2 to 3.4, as appropriate.

2.3.2 Performance characteristics, such as the flow rates under both positive and negative pressure, operating sensitivity, flow resistance and velocity should be demonstrated by appropriate tests.

2.3.3 Devices should be designed and constructed to minimize the effect of fouling under normal operating conditions. Instructions on how to determine when cleaning is required and the method of cleaning should be provided for each device in the manufacturers' instruction manual.

2.3.4 Devices should be capable of operating in freezing conditions (such as may cause blockage by freezing cargo vapours or by icing in bad weather) and if any device is provided with heating arrangements so that its surface temperature exceeds 85°C, then it should be tested at the highest operating temperature.

2.3.5 Devices based upon maintaining a minimum velocity should be capable of opening in such a way that a velocity of 30 m/s is immediately initiated, maintaining an efflux velocity of at least 30 m/s at all flow rates and, when the gas flow is interrupted, be capable of closing in such a way that this minimum velocity is maintained until the valve is fully closed.

2.3.6 In the case of high velocity vents, the possibility of inadvertent detrimental hammering[3] leading to damage and/or failure should be considered, with a view to eliminating it.

## 2.4 Flame screens

2.4.1 Flame screens should be:

.1 designed in such a manner that they cannot be inserted improperly in the opening;

.2 securely fitted in openings so that flames cannot circumvent the screen;

.3 able to meet the requirements of these standards. For flame screens fitted at vacuum inlets through which vapours cannot be vented the test specified in 3.2.3 need not be complied with; and

.4 be protected against mechanical damage.

## 2.5 Sizing, location and installation of devices

2.5.1 For determining the size of devices to avoid inadmissible pressure or vacuum in cargo tanks during loading or discharging, calculations of pressure losses should be carried out. The following parameters should be taken into account:

.1 loading/discharge rates;

.2 gas evolution;

.3 pressure loss across devices, taking into account the resistance coefficient;

.4 pressure loss in the vent piping system;

.5 pressure at which the vent opens if a high velocity valve is used;

.6 density of the saturated vapour/air mixture; and

.7 to compensate for possible fouling of a flame arrester, 70% of its rated performance is to be used in the pressure drop calculation of the installation.

2.5.2 Devices should be located at the outlets to atmosphere unless tested and approved for in-line installation. Devices for in-line installation may not be fitted at the outlets to atmosphere unless they have also been tested and approved for that position.

[3] Hammering is rapid full stroke opening/closing, not intended by the manufacturer during normal operations.

2.5.3 End-of-line devices which are intended for exclusive use at openings of inerted cargo tanks need not be tested against endurance burning as specified in 3.2.3.

2.5.4 Where end-of-line devices are fitted with cowls, weather hoods and deflectors, etc. these attachments should be fitted for the tests described in 3.2.

2.5.5 Where detonation flame arresters are installed, as in-line devices venting to atmosphere, they should be located at a sufficient distance from the open end of the pipeline so as to preclude the possibility of a stationary flame resting on the arrester.

2.5.6 When venting to atmosphere is not performed through an end-of-line device according to 2.5.4, or a detonation flame arrester according to 2.5.5, the in-line device has to be specifically tested with the inclusion of all pipes, tees, bends, cowls, weather hoods, etc., which may be fitted between the device and atmosphere. The testing should consist of the flashback test of 3 2.2 and, if for the given installation it is possible for a stationary flame to rest on the device, the testing should also include the endurance burning test of 3.2.3.

2.5.7 Means should be provided to enable personnel to reach devices situated more than 2 m above deck to facilitate maintenance, repair and inspection.

## 3 TYPE TEST PROCEDURES

### 3.1 Principles

3.1.1 Tests should be conducted by a laboratory acceptable to the Administration.

3.1.2 Each size of each model should be submitted for type testing. However, for flame arresters testing may be limited to the smallest and the largest sizes and one additional size in between to be chosen by the Administration. Devices should have the same dimensions and most unfavourable clearances expected in the production model. If a test device is modified during the test programme, the testing should be started over again.

3.1.3 Tests described in this section using gasoline vapours (a non-leaded petroleum distillate consisting essentially of aliphatic hydrocarbon compounds with a boiling range approximating 65°C/75°C), technical hexane vapours, or technical propane, as appropriate, and referred to in this section, are suitable for all devices protecting tanks containing a flammable atmosphere of the cargoes referred to in 1.2.1. This does not preclude the use of gasoline vapours or technical hexane vapours for all tests referred to in this section.

3.1.4 After the relevant tests, the device should not show mechanical damage that affects its original performance.

3.1.5 Before the tests the following equipment as appropriate should be properly calibrated:

.1 gas concentration meters;

.2 thermometers:

.3 flow meters;

.4 pressure meters; and

.5 time recording devices.

3.1.6 The following characteristics should be recorded, as appropriate, throughout the tests:

.1 concentration of fuel in the gas mixture,

.2 temperature of the test gas mixture at inflow of the device; and

.3 flow rates of the test gas mixtures when applicable.

3.1.7 Flame passage should be observed by recording, e.g. temperature, pressure, or light emission by suitable sensors on the protected side of the device; alternatively, flame passage may be recorded on video tape.

**3.2 Test procedures for flame arresters located at openings to the atmosphere**

3.2.1 The test rig should consist of an apparatus producing an explosive mixture, a small tank with a diaphragm, a flanged prototype of the flame arrester, a plastic bag[4] and a firing source in three positions (see appendix 1).[5] Other test rigs may be used, provided the tests referred to in this section are achieved to the satisfaction of the Administration.

3.2.2 A flashback test should be carried out as follows:

.1 The tank, flame arrester assembly and the plastic bag[4] enveloping the prototype flame arrester should be filled so that this volume contains the most easily ignitable propane/air mixture[6]. The concentration of the mixture should be verified by appropriate testing of the gas composition in the plastic bag. Where devices referred to in 2.5.6 are tested, the plastic bag should be fitted at the outlet to atmosphere. Three ignition sources should be installed along the axis of the bag, one close to the flame arrester, another as far away as possible therefrom, and the third at the midpoint between these two. These three sources should be fired in succession, twice in each of the three positions. The temperature of the test gas should be within the range of 15°C to 40°C.

.2 If a flashback occurs, the tank diaphragm will burst and this will be audible and visible to the operator by the emission of a flame. Flame, heat and pressure sensors may be used as an alternative to a bursting diaphragm.

3.2.3 An endurance burning test should be carried out, in addition to the flashback test, for flame arresters at outlets where flows of explosive vapour are foreseeable:

.1 The test rig as referred to in 3.2.1 may be used, without the plastic bag. The flame arrester should be so installed that the mixture emission is vertical. In this position the mixture should be ignited. Where devices referred to in 2.5.6 are tested, the flame arrester should be so installed as to reflect its final orientation.

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4 The dimensions of the plastic bag are dependent on those of the flame arrester, but for the flame arresters normally used on tankers, the plastic bag may have a circumference of 2 m, a length of 2.5 m and a wall thickness of 0.05 m.

5 In order to avoid remnants of the plastic bag from falling back on to the device being tested after ignition of the fuel/air mixture, it may be useful to mount a coarse wire frame across the device within the plastic bag. The frame should be so constructed as not to interfere with the test result.

6 Reference is made to IEC 60079, Electrical Apparatus for Explosive Gas Atmospheres.

.2 Endurance burning should be achieved by using the most easily ignitable gasoline vapour/air mixture or the most easily ignitable technical hexane vapour/air mixture with the aid of a continuously operated pilot flame or a continuously operated spark igniter at the outlet. The test gas should be introduced upstream of the tank shown in appendix 2. Maintaining the concentration of the mixture as specified above, by varying the flow rate, the flame arrester should be heated until the highest obtainable temperature on the cargo tank side of the arrester is reached. Temperatures should be measured, for example, at the protected side of the flame quenching matrix of the arrester (or at the seat of the valve in case of testing high velocity vents according to 3.3). The highest obtainable temperature may be considered to have been reached when the rate of rise of temperature does not exceed 0.5°C per minute over a ten-minute period. This temperature should be maintained for a period of 10 minutes, after which the flow should be stopped and the conditions observed. The temperature of the test gas should be within the range of 15°C to 40°C.

If no temperature rise occurs at all: inspect the arrester for a more adequate position of the temperature sensor, taking account of the visually registered position of the stabilized flame during the first test sequence. Positions which require the drilling of small holes into fixed parts of the arrester have to be taken into account. If all this is not successful, affix the temperature sensor at the unprotected side of the arrester in a position near to the stabilized flame.

If difficulties arise in establishing stationary temperature conditions (at elevated temperatures), the following criteria should apply: using the flow rate which produced the maximum temperature during the foregoing test sequence, endurance burning should be continued for a period of two hours from the time the above-mentioned flow rate has been established. After that period the flow should be stopped and the conditions observed. Flashback should not occur during this test.

3.2.4 When a pressure or/and vacuum valve is integrated to a flame-arresting device, the flashback test has to be performed with the pressure or/and vacuum valve blocked open If there are no additional flame quenching elements integrated in a pressure valve, this valve has to be considered and tested as a high velocity vent valve according to paragraph 3.3.

**3.3 Test procedures for high velocity vents**

3.3.1 The test rig should be capable of producing the required volume flow rate. In appendices 2 and 3, drawings of suitable test rigs are shown. Other test rigs may be used, provided the tests are achieved to the satisfaction of the Administration.

3.3.2 A flow condition test should be carried out with high velocity vents using compressed air or gas at agreed flow rates. The following should be recorded:

.1 The flow rate. Where air or a gas other than vapours of cargoes with which the vent is to be used is employed in the test, the flow rates achieved should be corrected to reflect the vapour density of such cargoes.

.2 The pressure before the vent opens. The pressure in the test tank on which the device is located should not rise at a rate greater than 0.01 $N/mm^2/min$.

.3 The pressure at which the vent opens.

.4 The pressure at which the vent closes.

.5 The efflux velocity at the outlet which should not be less than 30 m/s at any time when the valve is open.

3.3.3 The following fire safety tests should be conducted while adhering to 2.3.6 using a mixture of gasoline vapour and air or technical hexane vapour and air, which produces the most easily ignitable mixture at the point of ignition. This mixture should be ignited with the aid of a permanent pilot flame or a spark igniter at the outlet:

.1 Flashback tests in which propane may be used instead of gasoline or hexane should be carried out with the vent in the upright position and then inclined at 10° from the vertical. For some vent designs further tests with the vent inclined in more than one direction may be necessary. In each of these tests the flow should be reduced until the vent closes and the flame is extinguished, and each should be carried out at least 50 times. The vacuum side of combined valves should be tested in accordance with 3.2.2 with the vacuum valve maintained in the open position for the duration of this test, in order to test the efficiency of the device which must be fitted.

.2 An endurance burning test, as described in 3.2.3, should be carried out. Following this test, the main flame should be extinguished and then, with the pilot flame burning or the spark igniter discharging, small quantities of the most easily ignitable mixture should be allowed to escape for a period of 10 minutes maintaining a pressure below the valve of 90% of the valves opening setting, during which time flashback should not occur. For the purposes of this test the soft seals or seats should be removed.

### 3.4 Test rig and test procedures for detonation flame arresters located in-line

3.4.1 A flame arrester should be installed at one end of a pipe of suitable length and of the same diameter as the flange of the flame arrester. On the opposed flange a pipe of a length corresponding to 10 pipe diameters should be affixed and be closed by a plastic bag[7] or diaphragm. The pipe should be filled with the most easily ignitable mixture of propane and air, which should then be ignited. The velocity of the flame near the flame arrester should be measured and should have a value of that for stable detonations.

3.4.2 Three detonation tests should be conducted and no flashback should occur through the device and no part of the flame arrester should be damaged or show permanent deformation.

3.4.3 A drawing of the test rig is shown in appendix 4. Other test rigs may be used provided the tests are achieved to the satisfaction of the Administration.

### 3.5 Operational test procedures

3.5.1 A corrosion test should be carried out. In this test a complete device, including a section of the pipe to which it is fitted, should be exposed to a 5% sodium chloride solution spray at a temperature of 25°C for a period of 240 hours, and allowed to dry for 48 hours. An equivalent test may be used to the satisfaction of the Administration. Following this test, all movable parts should operate properly and there should be no corrosion deposits which cannot be washed off.

3.5.2 A hydraulic pressure test should be carried out in the casing or housing of a sample device, in accordance with 2.2.1.

[7] The dimensions should be at least 4 m circumference, 4 m length and a material wall thickness of 0.05 mm.

## 4 MISCELLANEOUS

### 4.1 Marking of device

Each device should be permanently marked, or have a permanently fixed tag made of stainless steel or other corrosion-resistant material, to indicate:

.1 manufacturer's name or trade mark;

.2 style, type, model or other manufacturer's designation for the device;

.3 size of the outlet for which the device is approved;

.4 approved location for installation, including maximum or minimum length of pipe, if any, between the device and the atmosphere and the apparatus group assigned to the tested device;

.5 direction of flow through the device;

.6 indication of the test laboratory and report number; and

.7 compliance with the requirements of MSC.1/Circ.677/Rev.1.

### 4.2 Laboratory report

4.2.1 The laboratory report should include:

.1 detailed drawings of the device;

.2 types of tests conducted. Where in-line devices are tested, this information should include the maximum pressures and velocities observed in the test;

.3 specific advice on approved attachments;

.4 types of cargo for which the device is approved;

.5 drawings of the test rig;

.6 in the case of high velocity vent, the pressures at which the device opens and closes in the efflux velocity; and

7 all the information marked on the device in 4.1.

### 4.3 Manufacturer's instruction manual

4.3.1 The manufacturer should supply a copy of the instruction manual, which should be kept on board the tanker and which should include:

.1 installation instructions;

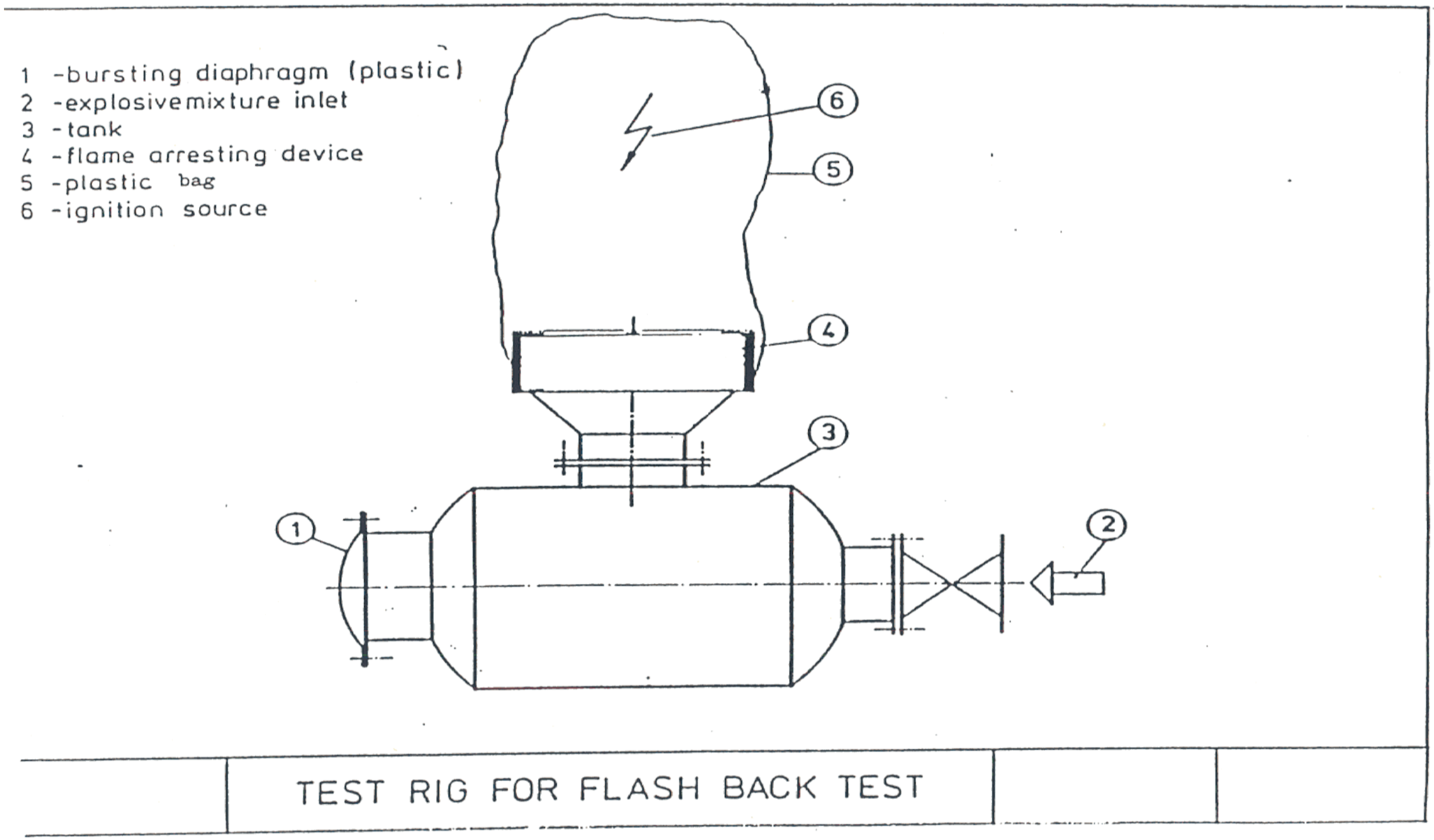
.2 operating instructions;

.3 maintenance requirements, including cleaning (see 2.3.3);

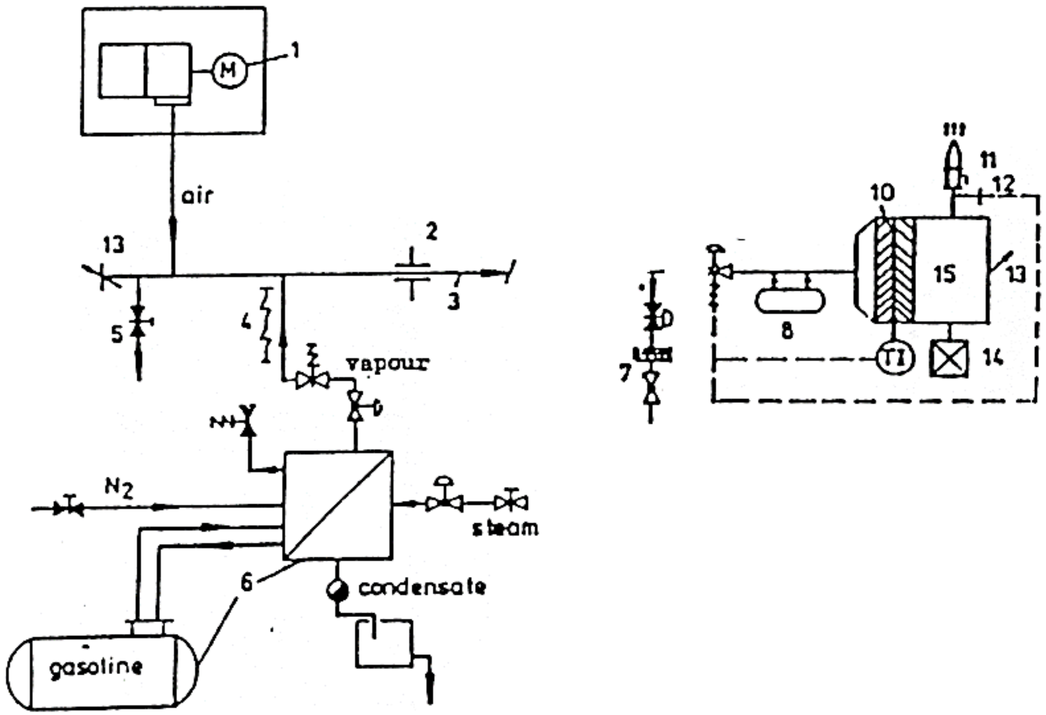
.4 copy of the laboratory report referred to in 4.2; and

.5 flow test data, including flow rates under both positive and negative pressures, operating sensitivity, flow resistance and velocity, should be provided.

**APPENDIX 1**


1 -bursting diaphragm (plastic)
2 -explosivemixture inlet
3 -tank
4 -flame arresting device
5 -plastic bag
6 -ignition source
1
2
3
4
5
6
TEST RIG FOR FLASH BACK TEST

## APPENDIX 2




fan with variable speed

volume rate indicator

pipe (500 mm diameter), length ~ 30 m

heated vapour pipe

air bypass

evaporator and liquid storage tank

vapour/air-mixture bypass

extinguishing agents

control and quick action stop valve

10 explosion arresting crimped ribbon with temperature control for the safety of the test plant

11 high velocity valve to be tested

12 flame detector

13 bursting diaphragm

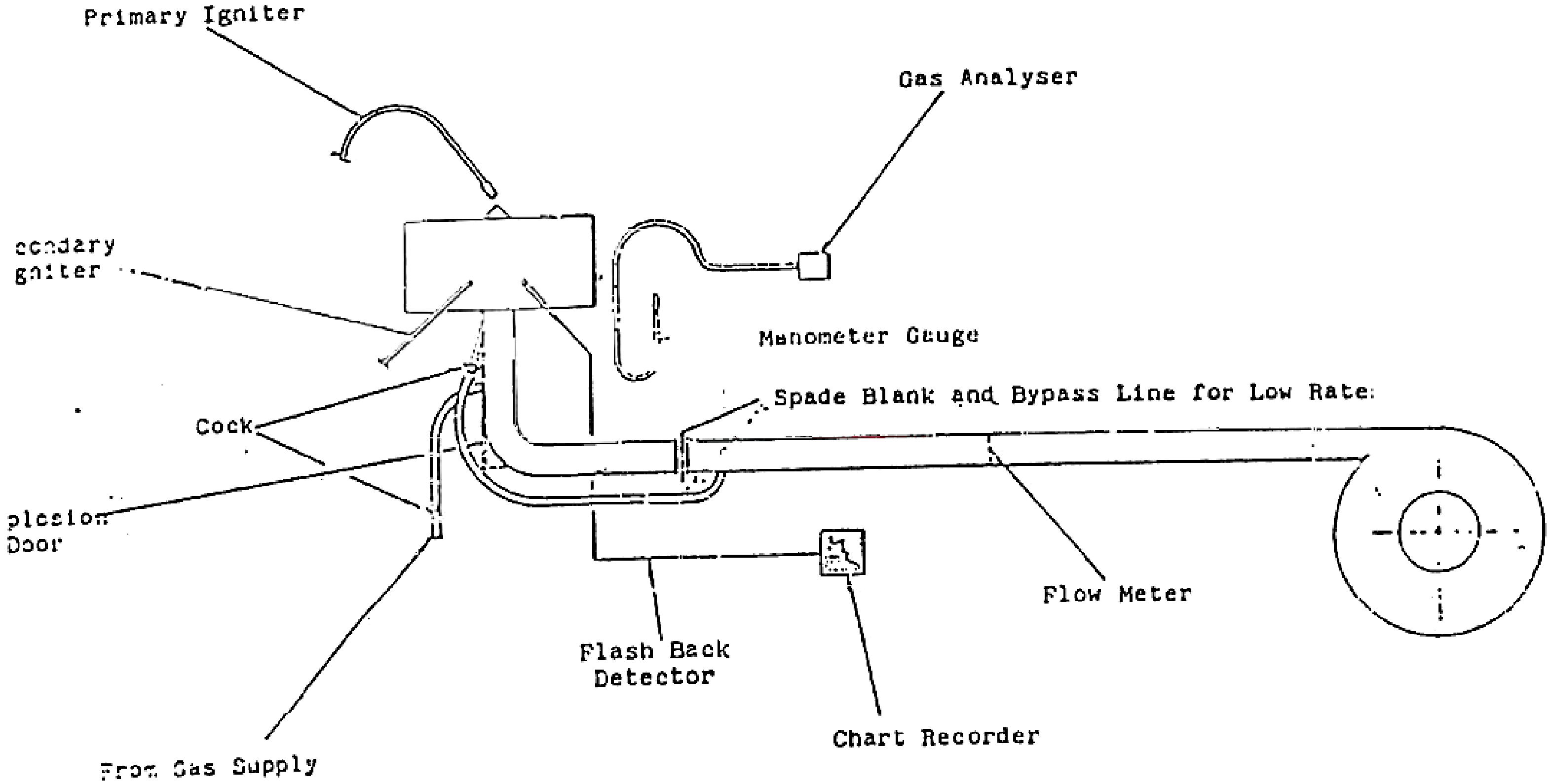
14 concentration indicator

15 tank

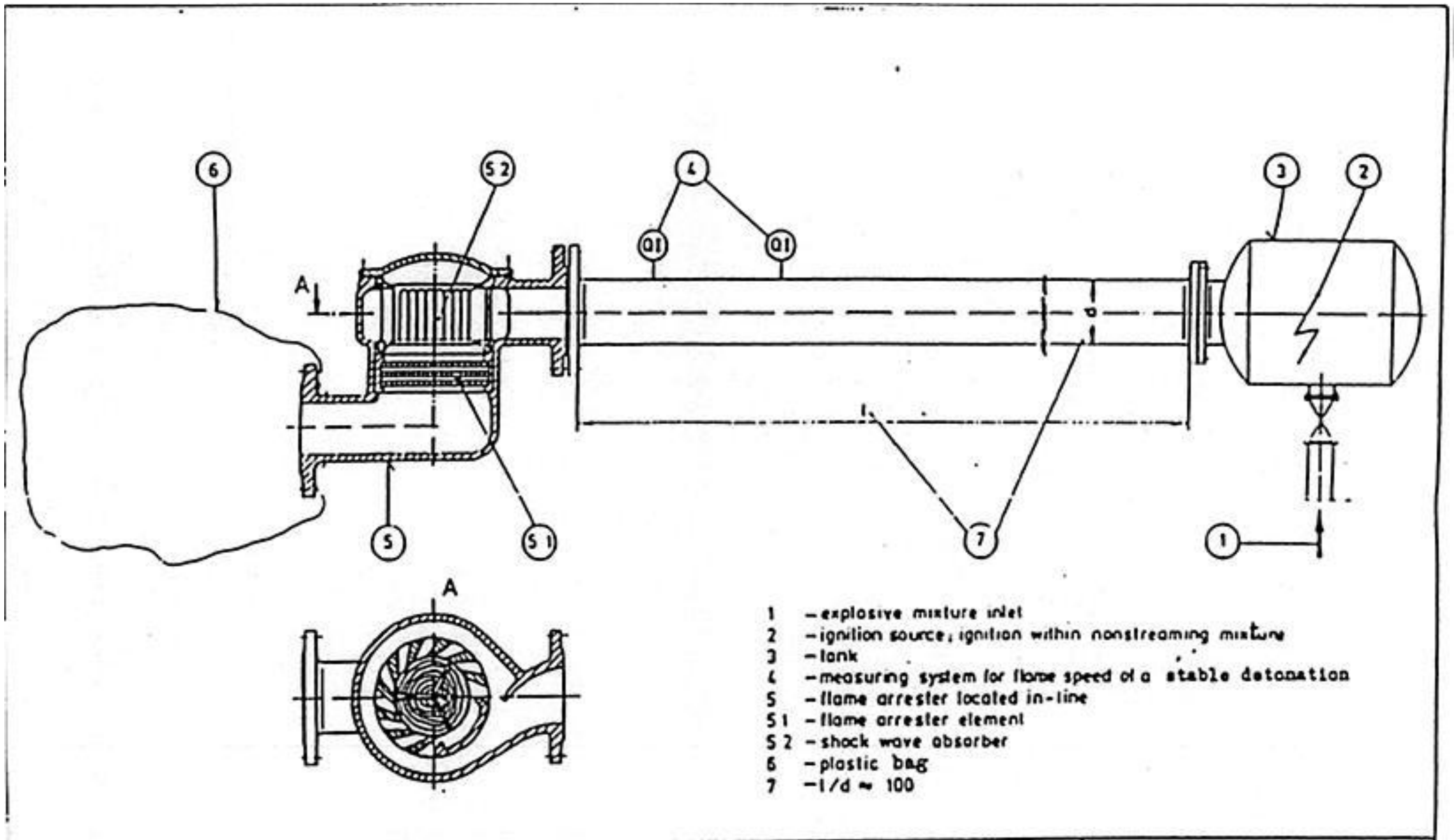
Schematic Plan of the Test Plant for High Velocity Valves
(endurance burning test only)

## APPENDIX 3

TEST RIG FOR HIGH VELOCITY VENTS



**APPENDIX 4**




Test Rig for Flame Arresters located In-Line

E

4 ALBERT EMBANKMENT
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MSC.1/Circ.1687
26 February 2025

**INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL**

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), having considered a proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its tenth session, approved the *Interim guidelines for the safety of ships using ammonia as fuel*, as set out in the annex.

2 In doing so, the Committee recognized the importance of providing guidance for the safe use of ammonia as fuel on board ships, so as to provide, at least, the same level of safety and reliability as new and comparable conventional oil-fuelled main and auxiliary machinery installations.

3 The Committee also noted the provisional nature of the Interim Guidelines, as well as the approach to provide high-level goal-based guidance for the use of ammonia as fuel, not addressing all provisions in detail, recognizing the need for future revision once relevant experience is available.

4 Member States are invited to bring the Interim Guidelines to the attention of shipbuilders, manufacturers, shipowners, ship managers, masters and ship crews, bareboat charterers and all other parties concerned.

5 Member States are also invited to recount their experience gained through the use of these Interim Guidelines to the Organization for the Committee to keep the Interim Guidelines under review.

***

## ANNEX

## INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL

## 1 INTRODUCTION

1.1 The purpose of these *Interim guidelines for the safety of ships using ammonia as fuel* (Interim Guidelines) is to provide an international standard for ships using ammonia as fuel, other than ships covered by the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

1.2 The basic philosophy of these Interim Guidelines is to present provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using ammonia as fuel to minimize the risk to the ship, its crew and the environment, having regard to the nature of the fuels involved.

1.3 Throughout the development of these Interim Guidelines, it was recognized that the provisions therein must be based on sound naval architectural and engineering principles and the best understanding available of current operational experience, field data and research and development. These Interim Guidelines address all areas that need special consideration for the use of ammonia as fuel.

1.4 These Interim Guidelines follow the *Generic guidelines for developing IMO goal-based standards* (MSC.1/Circ.1394/Rev.2) by specifying goals and functional requirements for each section forming the basis for the design, construction and operation of ships using ammonia as fuel.

1.5 The current version of these Interim Guidelines includes provisions to meet the functional requirements for ammonia as fuel.

1.6 Chapters 5 to 20 contain goals and functional requirements but may not include specific provisions with details on how to achieve these functional requirements in all cases. In applying the goals and functional requirements in these chapters to a specific ship design, Administrations and the industry should take into account, and apply where relevant, the corresponding regulations of the International Code of Safety for Ships using Gases or Other Low-flashpoint Fuels (IGF Code). Where such regulations are determined not to be fit for purpose, the principles set out in SOLAS regulation II-1/55 should be used to determine appropriate alternative performance criteria that align with the goals and functional requirements provided in these Interim Guidelines.

1.7 These Interim Guidelines have been closely aligned with the IGF Code, adopted by resolution MSC.391(95), as amended, in particular chapter 3, which is mainly text taken from chapter 3 of the IGF Code, albeit modified to reflect the recommendatory nature of these Interim Guidelines.

1.8 Wherever in these Interim Guidelines reference is made to "gas supply" as contained in the IGF Code, it should be read as "ammonia supply".

# 2 GENERAL

## 2.1 Application

Unless expressly provided otherwise, these Interim Guidelines apply to ships using ammonia as fuel. These Interim Guidelines do not address ships using ammonia cargo as fuel.

## 2.2 Definitions

For the purpose of these Interim Guidelines, the terms used have the meanings defined in the following paragraphs. Terms not defined have the same meaning as in SOLAS chapter II-2 and the IGF Code.

2.2.1 *Ammonia* means an inorganic compound represented by the chemical formula $NH_3$. In these Interim Guidelines, ammonia either in its liquefied or gaseous state is referred to as ammonia.

2.2.2 *Fuel* means ammonia, either in its liquefied or gaseous state.

2.2.3 *Fuel consumer* means any unit within the ship using ammonia as a fuel.

2.2.4 *Source of release* means a point or location from which a gas, vapour, mist or liquid may be released into the atmosphere so that an explosive and/or toxic atmosphere could be formed.

2.2.5 *Toxic area* means an area in which ammonia is or may be expected to be present.

2.2.6 *Toxic space* means an enclosed or semi-enclosed space in which ammonia is or may be expected to be present. A gas-safe machinery space is not considered to be a toxic space.

2.2.7 *Enclosed space* means any space within which, in the absence of artificial ventilation, the ventilation will be limited, and any explosive and/or toxic atmosphere will not be dispersed naturally

## 2.3 Alternative design

2.3.1 These Interim Guidelines contain functional requirements for all appliances and arrangements related to the usage of ammonia as fuel.

2.3.2 Appliances and arrangements of ammonia fuel systems may deviate from those set out in these Interim Guidelines, provided such appliances and arrangements meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety to the relevant sections.

2.3.3 The equivalence of the alternative design should be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration should not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment or type thereof which is prescribed by these Interim Guidelines.

## 3 GOAL AND FUNCTIONAL REQUIREMENTS

### 3.1 Goal

The goal of these Interim Guidelines is to provide for safe and environmentally friendly design, construction and operation of ships and in particular their installations of systems for propulsion machinery, auxiliary power generation machinery and/or other purpose machinery using ammonia as fuel.

### 3.2 Functional requirements

3.2.1 The safety, reliability and dependability of the systems should be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.

3.2.2 The probability and consequences of ammonia-related hazards should be limited to a minimum through arrangement and system design, such as ventilation, detection, containment and safety actions. In the event of ammonia leakage or failure of the risk-reducing measures, necessary safety actions should be initiated.

3.2.3 The design philosophy should ensure that risk-reducing measures and safety actions for the fuel installation do not lead to an unacceptable loss of power.

3.2.4 Hazardous areas, toxic areas and toxic spaces should be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the ship, persons on board, and equipment.

3.2.5 Equipment installed in hazardous areas should be minimized to that required for operational purposes and should be suitably and appropriately certified.

3.2.6 Unintended accumulation of explosive, flammable or toxic gas concentrations should be prevented.

3.2.7 System components should be protected against external damage.

3.2.8 Sources of ignition in hazardous areas should be minimized to reduce the probability of explosions.

3.2.9 Sources of ammonia release should be minimized to reduce the probability of ammonia exposure to humans and the environment.

3.2.10 Measures to minimize the health hazards associated with exposure to ammonia should be provided.

3.2.11 Direct release of ammonia into the atmosphere during normal operation and during any foreseeable and controllable abnormal scenario should be avoided.

3.2.12 Safe and suitable fuel supply, storage and bunkering arrangements should be made, capable of receiving and containing the fuel in the required state without leakage. Other than when necessary for safety reasons, fuel supply, storage and bunkering arrangements should be designed to prevent venting under all normal operating conditions, including idle periods.

3.2.13 Piping systems, containment and overpressure relief arrangements that are of suitable design, construction and installation for their intended application should be provided.

3.2.14 Machinery, systems and components should be designed, constructed, installed, operated, maintained and protected to ensure safe and reliable operation.

3.2.15 Suitable control, alarm, monitoring and shutdown systems should be provided to ensure safe and reliable operation.

3.2.16 Fixed fuel vapour and/or leakage detection suitable for all spaces and areas concerned should be arranged.

3.2.17 Fire detection, protection and extinction measures appropriate to the hazards concerned should be provided.

3.2.18 Commissioning, trials and maintenance of fuel systems and gas utilization machinery should satisfy the goal in terms of safety, availability and reliability.

3.2.19 The technical documentation should permit an assessment of the compliance of the system and its components with the applicable rules, guidelines, design standards used and the principles related to safety, availability, maintainability and reliability.

3.2.20 A single failure in a technical system or component should not lead to an unsafe or unreliable situation.

## 4 GENERAL PROVISIONS

### 4.1 Goal

The goal of this chapter is to ensure that the necessary assessments of the risks involved are carried out in order to eliminate or mitigate any adverse effect on the persons on board, the environment or the ship.

### 4.2 Risk assessment

4.2.1 A holistic risk assessment should be conducted to ensure that risks arising from the use of ammonia as fuel affecting persons on board, the environment, the structural strength, or the integrity of the ship and its sub-systems are addressed. Consideration should be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

4.2.2 The risk assessment should specifically consider the ammonia system integrity with a focus on its ability to prevent and isolate leakages and also evaluate potential toxicity hazards, ignition mechanisms and consequences of ignition. Special consideration should be given, but not limited to, the following specific ammonia-related hazards and topics:

.1 loss of function;

.2 component damage;

.3 fire;

.4 explosion;

.5 toxicity; and

.6 electric shock.

4.2.3 Risks, which cannot be eliminated, should be mitigated as necessary. Details of risks, and the means by which they are mitigated, should be documented to the satisfaction of the Administration.

**4.3 Limitation of explosion consequences**

4.3.1 An explosion in any space containing any potential sources of release and potential ignition sources should not:

.1 cause damage to or disrupt the proper functioning of equipment/systems located in any space other than that in which the incident occurs;

.2 damage the ship in such a way that flooding of water below the main deck or any progressive flooding occurs;

.3 damage work areas or accommodation in such a way that persons who stay in such areas under normal operating conditions are injured;

.4 damage ship personnel normally present in work or accommodation spaces under normal operating conditions;

.5 disrupt the proper functioning of control stations and switchboard rooms necessary for power distribution;

.6 damage life-saving equipment or associated launching arrangements;

.7 disrupt the proper functioning of fire-fighting equipment located outside the explosion-damaged space;

.8 affect other areas of the ship in such a way that chain reactions involving, inter alia, cargo, ammonia and bunker oil may arise; or

.9 prevent persons' access to life-saving appliances or impede escape routes.

**5 SHIP DESIGN AND ARRANGEMENT**

**5.1 Goal**

The goal of this chapter is to provide for safe location, space arrangements and mechanical protection of power generation equipment, fuel storage systems, fuel supply equipment and refuelling systems.

**5.2 Functional requirements**

5.2.1 This chapter is related to functional requirements in 3.2.1 to 3.2.3, 3.2.5 to 3.2.9, 3.2.13 to 3.2.16, 3.2.18 and 3.2.20. In particular, the following apply:

.1 the fuel tank(s) should be located in such a way that the probability for the tank(s) to be damaged following a collision or grounding is reduced to a minimum, taking into account the safe operation of the ship and other hazards that may be relevant to the ship;

.2 fuel containment systems, fuel piping and other fuel sources of release should be so located and arranged that released ammonia is led to a recovery system, treatment system or a safe location in the open air;

.3 the access or other openings to spaces containing fuel sources of release should be so arranged that flammable, asphyxiating or toxic gas cannot escape to spaces that are not designed for the presence of such gases taking into account the specific gravity and dispersion characteristics of ammonia gas;

.4 fuel piping and fuel supply system should be protected against mechanical damage;

.5 the propulsion and fuel supply system should be so designed that safety actions after any ammonia leakage do not lead to an unacceptable loss of power;

.6 the probability of an explosion in a machinery space with ammonia-fuelled machinery should be minimized; and

.7 the space where machinery and equipment fuel are installed should be designed to minimize the risk of exposure of persons on board to leaked ammonia.

**5.3 General provisions**

5.3.1 Fuel storage tanks should be protected against mechanical damage.

5.3.2 Fuel storage tanks and/or equipment located on an open deck should be located to ensure sufficient natural ventilation to prevent accumulation of ammonia.

5.3.3 Mustering stations and life-saving equipment, and access to such stations and equipment, should not be located in toxic areas as specified in 12*bis*.4.

5.3.4 Air intakes, outlets and other openings into the accommodation, service and machinery spaces, control stations and other non-toxic spaces in the ship should not be located in toxic areas as specified in 12*bis*.4.

**5.4 Provisions for protection of fuel tanks from collision and grounding**

Unless expressly provided otherwise, the requirements of 5.3.3, 5.3.4 and 5.3.5 of the IGF Code part A-1 should apply to ships using ammonia as fuel.

**5.5 Provisions for machinery space arrangement**

5.5.1 Machinery spaces containing ammonia fuel systems and/or ammonia-fuelled machinery should be arranged such that the spaces may be considered gas safe under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.

5.5.2 In a gas-safe machinery space, a single failure cannot lead to the release of fuel gas into the machinery space.

5.5.3 A gas-safe machinery space may be arranged as a conventional machinery space.

5.5.4 A single failure within the fuel system should not lead to a fuel release into the machinery space.

5.5.5 All fuel piping within machinery space boundaries should be enclosed in a gastight enclosure, taking into account paragraph 9.6 of the IGF Code part A-1.

5.5.6 Access to machinery spaces should not be arranged from toxic areas or toxic spaces.

**5.6 Provisions for location and protection of fuel piping**

5.6.1 Fuel pipes and fuel supply systems should not be located less than 800 mm from the ship's side.

5.6.2 Fuel piping should not be led directly through accommodation spaces, service spaces, electrical equipment rooms or control stations as defined in the SOLAS Convention, even though the piping is protected by secondary enclosures.

5.6.3 Fuel pipes led through ro-ro spaces, special category spaces and on open decks should be protected against mechanical damage.

**5.7 Provisions for fuel preparation room design**

***5.7.1 Provisions for fuel preparation rooms***

5.7.1.1 Fuel process equipment should be arranged in a fuel preparation room arranged in accordance with provisions in these Interim Guidelines. As an exemption to this provision, vaporizers, heat exchangers and motors for pumps submerged in tanks may also be located in tank connection spaces.

5.7.1.2 When fuel preparation rooms cannot be located on open deck, or accessed from open deck, access should be provided through an airlock in compliance with 5.11.

5.7.1.3 Fuel preparation rooms should be designed to safely contain fuel leakages. The fuel preparation room boundaries should be gastight towards other spaces in the ship.

5.7.1.4 The probable maximum leakage into the fuel preparation room should be determined based on detail design, detection and shutdown systems.

5.7.1.5 The material of the boundaries of the fuel preparation room should have a design temperature corresponding with the lowest temperature it can be subjected to in a probable maximum leakage scenario, unless the boundaries of the space, i.e. bulkheads and decks, are provided with suitable thermal protection.

5.7.1.6 The fuel preparation room should be fitted with ventilation arrangements ensuring that the space can withstand any pressure build-up caused by vaporization of the liquefied fuel.

5.7.1.7 The fuel preparation room entrance should be arranged with a sill height exceeding the liquid level resulting from a calculated maximum leakage, but should in no case be lower than 300 mm.

5.7.1.8 Fuel preparation room entrances should be arranged with water screens having constantly available water supply. The water screen should be possible to activate from a safe location outside the fuel preparation room toxic zone if an ammonia leak occurs. The water screens should be arranged on the outside of the fuel preparation room. The arrangement should include the means to safely manage any ammonia effluent produced in their operation.

5.7.1.9 A leakage in the fuel preparation room should not render necessary safety functions out of order due to low temperatures caused by the evaporation of leaking fuel.

5.7.1.10 Fuel preparation rooms should be designed to manage any ammonia release for personnel to enter safely.

### *5.7.2 Provisions for tank connection spaces*

5.7.2.1 Fuel tank connections, flanges and tank valves should be located in a tank connection space arranged in accordance with the provisions in these Interim Guidelines. Apart from fuel process equipment allowed in tank connection spaces as defined in 5.7.1.1, tank connection spaces and fuel preparation rooms should not be combined.

5.7.2.2 Tank connection spaces should be designed to safely contain fuel leakages. The tank connection space boundaries should be gastight towards other spaces in the ship.

5.7.2.3 The material of the bulkheads of the tank connection space should have a design temperature corresponding with the lowest temperature it can be subject to in a probable maximum leakage scenario.

5.7.2.4 The probable maximum leakage into the tank connection space should be determined based on detail design, detection and shutdown systems.

5.7.2.5 Tank connection spaces should be fitted with ventilation arrangements ensuring that the spaces can withstand any pressure build-up caused by vaporization of the liquefied fuel.

5.7.2.6 Tank connection space entrances should be arranged with a sill height exceeding the liquid level resulting from a calculated maximum leakage, but should in no case be lower than 300 mm.

5.7.2.7 Tank connection space entrances should be arranged with water screens having constantly available water supply. The water screen should be possible to activate from a safe location outside the tank connection space toxic zone if an ammonia leak occurs. The water screens should be arranged on the outside of the tank connection spaces. The arrangement should include the means to safely manage any ammonia effluent produced in their operation.

5.7.2.8 Unless the access to the tank connection space is independent and direct from the open deck, it should be provided through a bolted hatch. The bolted hatch should be located in a protective entry space of gastight construction with a self-closing gastight door. The access should be arranged to facilitate the evacuation of an injured person from the tank connection space by personnel wearing breathing apparatus and PPE.

5.7.2.9 A leakage in the tank connection space should not render necessary safety functions out of order due to low temperatures caused by the evaporation of leaking fuel.

### *5.7.3 Provisions for fuel bunkering stations*

5.7.3.1 The location and arrangement of the bunkering station, including whether open, enclosed, or semi-enclosed, should be subject to special consideration within the risk assessment. Depending on the arrangement this may include, but is not limited to:

.1 segregation from other areas of the ship;

.2 hazardous and toxic area plans for the ship;

.3 requirements for forced ventilation;

.4 requirements for leakage detection;

.5 safety actions related to leakage detection;

.6 access to bunkering station from non-hazardous areas through airlocks; and

.7 monitoring of bunkering station by direct line of sight or closed-circuit television (CCTV).

5.7.3.2 Mechanical spray shielding should be arranged around potential leakage sources from the ammonia system in the bunkering station.

5.7.3.3 The bunker station should be located in an area where sufficient space for efficient work and access is ensured for the personnel involved in bunkering and their equipment while wearing SCBA and PPE, and to ensure that, in an emergency, they have a clear escape route.

**5.8 Provisions for bilge systems**

5.8.1 Bilge systems installed in areas where fuel covered by these Interim Guidelines can be present should be segregated from the bilge system of spaces where fuel cannot be present.

5.8.2 Where fuel is carried in a fuel containment system requiring a secondary barrier, suitable drainage arrangements for dealing with any leakage into the hold or insulation spaces through the adjacent ship structure should be provided. The bilge system should not lead to pumps in spaces having no risks of ammonia. Means of detecting such leakage should be provided.

5.8.3 The hold or interbarrier spaces of type A independent tanks for liquid gas should be provided with a drainage system suitable for handling liquid fuel in the event of fuel tank leakage or rupture.

**5.9 Provisions for drip trays**

5.9.1 Drip trays should be fitted where leakage may occur which can cause damage to the ship structure or where limitation of the area which is affected from a spill is necessary.

5.9.2 Drip trays should be made of suitable material.

5.9.3 The drip tray should be thermally insulated from the ship's structure so that the surrounding hull or deck structures are not exposed to unacceptable cooling, in case of leakage of liquid fuel.

5.9.4 Each tray should be fitted with a drain valve to enable water to be drained over the ship's side where the tray is installed in a location where water may be retained.

5.9.5 Each tray should have a sufficient capacity to ensure that the assumed maximum amount of spill according to the risk assessment can be handled.

5.9.6 Drip trays should be provided with means to safely drain or transfer spills that contain ammonia to be contained or treated.

**5.10 Provisions for the arrangement of entrances and other openings in enclosed spaces**

5.10.1 Direct access should not be permitted from a non-hazardous area to a hazardous area. Where such openings are necessary for operational reasons, an airlock which complies with 5.11 should be provided.

5.10.2 Direct access should not be permitted from a non-toxic space to a toxic area or space. Where such openings are necessary for operational reasons, an airlock which complies with 5.11 should be provided.

5.10.3 For inerted spaces, access arrangements should be such that unintended entry by personnel should be prevented. If access to such spaces is not from an open deck, sealing arrangements should ensure that leakages of inert gas to adjacent spaces are prevented.

5.10.4 Arrangements for fuel storage hold spaces, void space, fuel tanks and other spaces classified as hazardous/toxic areas or spaces should be such as to allow entry and inspection of any such space by ship personnel wearing PPE and breathing apparatus, as well as to allow for the evacuation of injured or unconscious ship personnel. Such arrangements should comply with the following:

.1 access should be provided as follows:

.1 access to all fuel tanks. Access should be directly from open decks as far as practicable;

.2 access through horizontal openings, hatches or manholes. The size should 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 is to be not less than 600 mm X 600 mm;

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

.4 circular access openings to type C tanks are to have a diameter of not less than 600 mm.

.2 the sizes referred to in 5.10.4.1.2 and 5.10.4.1.3 may be decreased, if 5.10.4 can be met to the satisfaction of the Administration.

.3 where fuel is carried in containment systems requiring secondary barriers, 5.10.4.1.2 and 5.10.4.1.3 do not apply to spaces separated from hold spaces by a single gastight steel boundary. Such spaces are to be provided only with direct or indirect access from open decks, excluding any enclosed non-hazardous areas.

### 5.11 Provisions for airlocks

5.11.1 An airlock is a space enclosed by gastight bulkheads with two substantially gastight doors spaced at least 1.5 m and not more than 2.5 m apart. Unless subject to the requirements of the International Convention on Load Lines, the door sill should not be less than 300 mm in height. The doors should be self-closing without any holding back arrangements.

5.11.2 Airlocks should be mechanically ventilated at an overpressure relative to the adjacent hazardous/toxic area or space.

5.11.3 The airlock should be designed in a way that no gas can be released to safe spaces in case of the most critical event in the gas-dangerous space separated by the airlock. The events should be evaluated in the risk analysis according to 4.2.

5.11.4 Airlocks should have a simple geometrical form. They should provide free and easy passage and should have a deck area of not less than 1.5 $m^2$. Airlocks should not be used for other purposes, for instance as storerooms.

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

5.11.6 For non-hazardous/non-toxic spaces with access from hazardous/toxic spaces below deck where the access is protected by an airlock, upon loss of underpressure in the hazardous/toxic space, access to the space is to be restricted until the ventilation has been reinstated. Audible and visual alarms should be given at a manned location to indicate both loss of pressure and opening of the airlock doors when pressure is lost.

## 6 FUEL CONTAINMENT SYSTEM

### 6.1 Goal

The goal of this chapter is to provide that ammonia storage is adequate so as to minimize the risk to personnel, the ship and the environment to a level that is equivalent to a conventional oil-fuelled ship.

### 6.2 Functional requirements

This chapter relates to functional requirements in 3.2.1, 3.2.2, 3.2.5, 3.2.7 and 3.2.8 to 3.2.18. In particular, the following apply:

.1 the fuel containment system should be so designed that a leak from the tank or its connections does not endanger the ship, persons on board or the environment. Potential dangers to be avoided include:

  .1 exposure of ship materials to temperatures below acceptable limits;

  .2 flammable fuels spreading to locations with ignition sources;

  .3 toxicity potential and risk of oxygen deficiency due to fuels and inert gases;

  .4 restriction of access to muster stations, escape routes and life-saving appliances (LSA); and

  .5 reduction in availability of LSA;

.2 the pressure and temperature in the fuel tank should be kept within the design limits of the containment system and possible carriage requirements of the fuel; and

.3 the fuel containment arrangement should be so designed that safety actions after any ammonia leakage do not lead to an unacceptable loss of power.

**6.3 General provisions**

6.3.1 The ammonia fuel should be stored in a refrigerated state at atmospheric pressure.

6.3.2 Tank connection spaces and fuel storage hold spaces other than for tank type C should be gastight towards adjacent spaces. These spaces should not be adjacent to accommodation spaces, service spaces, electrical equipment rooms and control stations by a single bulkhead or deck. "Adjacent" means linear contact and point contact.

6.3.3 Pipe connections to the fuel storage tank should be mounted above the highest liquid level in the tanks, except for type C fuel storage tanks. Connections below the highest liquid level may however, also be accepted for other tank types after special consideration by the Administration.

6.3.4 Piping between the tank and the first valve which release liquid in case of pipe failure should have safety equivalent to a type C tank, with dynamic stress not exceeding the values given in 6.4.15.3.1.2 of the IGF Code part A-1.

6.3.5 If piping is connected below the liquid level of the tank, it has to be protected by a secondary barrier up to the first valve.

6.3.6 Means should be provided whereby liquefied gas in the storage tanks can be safely emptied.

6.3.7 It should be possible to empty, purge and vent fuel storage tanks with fuel piping systems. Instructions for carrying out these procedures must be available on board. Inerting should be performed with an inert gas prior to venting with dry air to avoid an explosion-hazardous atmosphere in tanks and fuel pipes. For further information, the provisions of the IGF Code, part A-1, paragraph 6.10, should be taken into account.

**6.4 Provisions for liquefied ammonia fuel containment**

6.4.1 Unless expressly provided otherwise, the requirements of the IGF Code, part A-1, chapter 6.4, should apply to ships using ammonia as fuel.

6.4.2 The provision of 6.4.1.3 of the IGF Code part A-1 related to portable tanks should not apply to ships using ammonia as fuel.

**6.5 Provisions for portable liquefied ammonia fuel tanks**

The provisions of 6.5 of the IGF Code should not apply to ships using ammonia as fuel.

**6.6 Provisions for compressed fuel containment**

The provisions of 6.6 of the IGF Code should not apply to ships using ammonia as fuel.

## 6.7 Provisions for pressure relief system

### *6.7.1 General*

6.7.1.1 All fuel storage tanks should be provided with a pressure relief system appropriate to the design of the fuel containment system and the fuel being carried. Fuel storage hold spaces, interbarrier spaces and tank connection spaces, which may be subject to pressures beyond their design capabilities, should also be provided with a suitable pressure relief system. Pressure control systems specified in 6.9 should be independent of the pressure relief systems.

6.7.1.2 Fuel storage tanks which may be subject to external pressures above their design pressure should be fitted with vacuum protection systems.

### *6.7.2 Pressure relief systems for liquefied ammonia fuel tanks*

6.7.2.1 Liquefied ammonia fuel tanks should be fitted with a minimum of two pressure relief valves (PRVs) allowing for disconnection of one PRV in case of malfunction or leakage.

6.7.2.2 Interbarrier spaces should be provided with pressure relief devices.[1] For membrane systems, the designer should demonstrate adequate sizing of interbarrier space PRVs.

6.7.2.3 The opening pressure of the pressure relief valves (PRVs) should not be higher than the vapour pressure that has been used in the design of the tank. Valves comprising not more than 50% of the total relieving capacity may be set at a pressure up to 5% above MARVS to allow sequential lifting, minimizing unnecessary release of vapour.

6.7.2.4 The following temperature provisions apply to PRVs fitted to pressure relief systems:

.1 PRVs on fuel tanks with a design temperature below 0°C should be designed and arranged to prevent their becoming inoperative due to ice formation;

.2 the effects of ice formation due to ambient temperatures should be considered in the construction and arrangement of PRVs;

.3 PRVs should be constructed of materials with a melting point above 925°C. Lower melting point materials for internal parts and seals may be accepted provided that fail-safe operation of the PRV is not compromised; and

.4 sensing and exhaust lines on pilot-operated relief valves should be of suitably robust construction to prevent damage.

6.7.2.5 In the event of a failure of a fuel tank PRV, a safe means of emergency isolation should be available, as follows:

.1 procedures should be provided and included in the operation manual (refer to chapter 18);

.2 the procedures should allow only one of the installed PRVs for the liquefied gas fuel tanks to be isolated, physical interlocks should be included to this effect; and

.3 isolation of the PRV should be carried out under the supervision of the master. This action should be recorded in the ship's log, and at the PRV.

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[1] Refer to IACS Unified Interpretation GC9 entitled "Guidance for sizing pressure relief systems for interbarrier spaces", 1988.

6.7.2.6 Each pressure relief valve installed on a liquefied ammonia fuel tank should be connected to a venting system, which should be:

.1 so constructed that the discharge will be unimpeded and normally be directed vertically upwards at the exit;

.2 arranged to minimize the possibility of water or snow entering the vent system; and

.3 arranged such that the height of vent exits should not be less than B/3 or 6 m, whichever is the greater, above the weather deck and 6 m above working areas and walkways. However, vent mast height could be limited to a lower value according to special consideration by the Administration.

6.7.2.7 The outlet from the pressure relief valves should normally be located at least B (greatest moulded breadth) or 25 m, whichever is less, from the nearest:

.1 air intake, air outlet or opening to accommodation, service and control spaces, or other non-hazardous area; and

.2 exhaust outlet from machinery installations.

6.7.2.8 All other fuel gas vent outlets should also be arranged in accordance with 6.7.2.6 and 6.7.2.7. Means should be provided to prevent liquid overflow from gas vent outlets, due to hydrostatic pressure from spaces to which they are connected.

6.7.2.9 In the vent piping system, means for draining liquid from places where it may accumulate should be provided. The PRVs and piping should be arranged so that liquid cannot, under any circumstances, accumulate in or near the PRVs.

6.7.2.10 Suitable protection screens of not more than 13 mm square mesh should be fitted on vent outlets to prevent the ingress of foreign objects without adversely affecting the flow.

6.7.2.11 All vent piping should be designed and arranged not to be damaged by the temperature variations to which it may be exposed, forces due to flow or the ship's motions.

6.7.2.12 PRVs should be connected to the highest part of the fuel tank. PRVs should be positioned on the fuel tank so that they will remain in the vapour phase at the filling limit (FL) as given in 6.8, under conditions of 15° list and 0.015L trim, where L is defined in 2.2.25 of the IGF Code.

### *6.7.3 Sizing of pressure relieving system*

6.7.3.1 *Sizing of pressure relief valves*

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

.1 the maximum capacity of the liquefied gas fuel tank inerting system if the maximum attainable working pressure of the liquefied gas fuel tank inerting system exceeds the MARVS of the liquefied gas fuel tanks; or

.2 vapours generated under fire exposure are computed using the following formula:

$$Q = FGA^{0.82}$$

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 liquefied gas fuel types:

$F$ = 1.0 for tanks without insulation located on deck;

$F$ = 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);

$F$ = 0.5 for uninsulated independent tanks installed in holds;

$F$ = 0.2 for insulated independent tanks in holds (or uninsulated independent tanks in insulated holds);

$F$ = 0.1 for insulated independent tanks in inerted holds (or uninsulated independent tanks in inerted, insulated holds); and

$F$ = 0.1 for membrane tanks;

$G$ = gas factor according to formula:

$$G = \frac{12.4}{LD}\sqrt{\frac{ZT}{M}}$$

where

$T$ = temperature in 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 1.0 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, $Z$ = 1.0 shall be used;

$M$ = molecular mass of the product.

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

$A$ = external surface area of the tank ($m^2$), as for different tank types, as shown in figure 6.7.3.

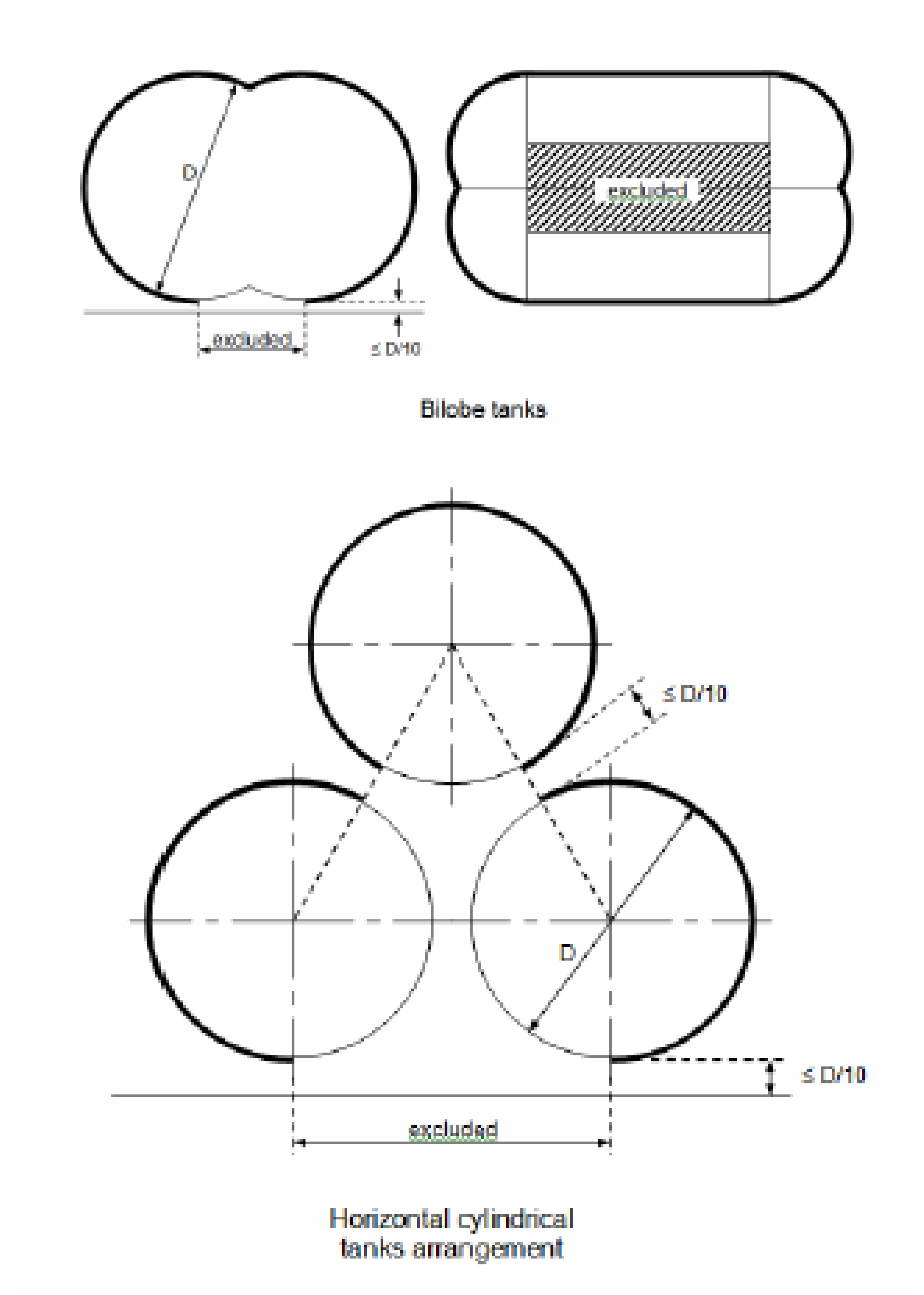


**Figure 6.7.3**

6.7.3.1.2 For tanks in fuel storage hold spaces separated from potential fire loads by cofferdams or surrounded by ship spaces with no fire load, the following should apply:

If the pressure relief valves have to be sized for fire loads, the fire factors may be reduced to the following values:

$F$ = 0.5 to $F$ = 0.25

$F$ = 0.2 to $F$ = 0.1

6.7.3.1.3 The required mass flow of air at relieving conditions is given by:

$M_{air} = Q * \rho_{air}$ (kg/s)

where density of air ($\rho_{air}$) = 1.293 kg/m$^3$ (air at 273.15 K, 0.1013 MPa).

*6.7.3.2 Sizing of vent pipe system*

6.7.3.2.1 Pressure losses upstream and downstream of the PRVs should be taken into account when determining their size to ensure the flow capacity required by 6.7.3.1.

6.7.3.2.2 With regard to upstream pressure losses:

.1 the pressure drop in the vent line from the tank to the PRV inlet should not exceed 3% of the valve set pressure at the calculated flow rate, in accordance with 6.7.3.1;

.2 pilot-operated PRVs should be unaffected by inlet pipe pressure losses when the pilot senses directly from the tank dome; and

.3 pressure losses in remotely sensed pilot lines should be considered for flowing type pilots.

6.7.3.2.3 With regard to downstream pressure losses:

.1 where common vent headers and vent masts are fitted, calculations should include flow from all attached PRVs; and

.2 the built-up back pressure in the vent piping from the PRV outlet to the location of discharge to the atmosphere, and including any vent pipe interconnections that join other tanks, should not exceed the following values:

.1 for unbalanced PRVs: 10% of MARVS;

.2 for balanced PRVs: 30% of MARVS; and

.3 for pilot-operated PRVs: 50% of MARVS.

Alternative values provided by the PRV manufacturer may be accepted.

6.7.3.2.4 To ensure stable PRV operation, the blow-down should not be less than the sum of the inlet pressure loss and 0.02 MARVS at the rated capacity.

**6.8 Provisions on loading limit for fuel tanks**

6.8.1 Storage tanks for liquefied ammonia should not be filled to more than a volume equivalent to 98% full at the reference temperature as defined in 2.2.36 of the IGF Code.

A loading limit curve for actual fuel loading temperatures should be prepared from the following formula:

$LL = FL\ \rho_R/\rho_L$

where:

$LL$ = loading limit as defined in 2.2.27 of the IGF Code, expressed in per cent;

$FL$ = filling limit as defined in 2.2.16 of the IGF Code expressed in per cent, here 98%;

$\rho_R$ = relative density of fuel at the reference temperature; and

$\rho_L$ = relative density of fuel at the loading temperature.

6.8.2 In cases where the tank insulation and tank location make the probability very small for the tank contents to be heated up due to an external fire, special considerations may be made to allow a higher loading limit than calculated using the reference temperature, but never above 95%.

## 6.9 Provisions for maintaining fuel storage condition

### *6.9.1 Control of fuel temperature and tank pressure*

6.9.1.1 The temperature of the liquefied ammonia in the fuel tanks should be maintained at a temperature of no more than -30°C at all times by means acceptable to the Administration. Systems and arrangements to be used for this purpose may include one, or a combination of, the following methods:

.1 reliquefaction of vapours;

.2 thermal oxidation of vapours; or

.3 liquefied ammonia fuel cooling.

The method chosen should be capable of maintaining the fuel temperature assuming no consumption for propulsion or power generation.

6.9.1.2 Venting of fuel vapour for control of the tank pressure is not acceptable, except in emergency situations.

### *6.9.2 Design of systems*

6.9.2.1 For worldwide service, the upper ambient design temperature should be sea 32°C and air 45°C. For service in particularly hot or cold zones, these design temperatures should be increased or decreased, to the satisfaction of the Administration.

6.9.2.2 The overall capacity of the system should be such that it can control the temperature and pressure within the design conditions without venting to atmosphere.

### *6.9.3 Reliquefaction systems*

6.9.3.1 The reliquefaction system should be arranged in one of the following ways:

.1 a direct system where evaporated fuel is compressed, condensed, and returned to the fuel tanks;

.2 an indirect system where fuel or evaporated fuel is cooled or condensed by refrigerant without being compressed;

.3 a combined system where evaporated fuel is compressed and condensed in a fuel/refrigerant heat exchanger and returned to the fuel tanks; or

.4 if the reliquefaction system produces a waste stream containing ammonia during pressure control operations within the design conditions, these waste gases should be disposed of without venting to the atmosphere.

#### *6.9.4 Thermal oxidation systems*

Thermal oxidation can be done by either consumption of the vapours according to the provisions for fuel consumers described in these Interim Guidelines or in a dedicated gas combustion unit. It should be demonstrated that the capacity of the oxidation system is sufficient to consume the required quantity of vapours.

#### *6.9.5 Compatibility*

Refrigerants or auxiliary agents used for refrigeration or cooling of fuel should be compatible with the fuel they may come in contact with (not causing any hazardous reaction or excessively corrosive products). In addition, when several refrigerants or agents are used, these should be compatible with each other.

#### *6.9.6 Availability of systems*

6.9.6.1 The availability of the system and its supporting auxiliary services should be such that in case of a single failure (of a mechanical non-static component or a component of the control systems) the fuel tank pressure and temperature can be maintained by another service/system.

6.9.6.2 Heat exchangers that are solely necessary for maintaining the pressure and temperature of the fuel tanks within their design ranges should 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 sources.

### 6.10 Reference to the IGF Code

The IGF Code chapter 6 should be taken into account, where applicable, in order to fulfil the functional requirements.

## 7 MATERIAL AND GENERAL PIPE DESIGN

### 7.1 Goal

The goal of this chapter is to ensure the safe handling of fuel, under all operating conditions, to minimize the risk to the ship, personnel and to the environment, having regard to the nature of the products involved.

### 7.2 Functional requirements

7.2.1 This chapter relates to functional requirements in 3.2.1, 3.2.5 to 3.2.10 and 3.2.13. In particular the following apply:

7.2.1.1 Fuel piping should be capable of absorbing thermal expansion or contraction caused by temperatures of the fuel without developing substantial stresses.

7.2.1.2 Provision should be made to protect the piping, piping system and components and fuel tanks from excessive stresses due to thermal movement and from movements of the fuel tank and hull structure.

7.2.1.3 If the fuel gas contains heavier constituents that may condense in the system, means for safely removing the liquid should be fitted.

7.2.1.4 Low-temperature piping should be thermally isolated from the adjacent hull structure, where necessary, to prevent the temperature of the hull from falling below the design temperature of the hull material.

7.2.1.5 Materials should be selected considering the relevant properties of ammonia. Consideration should be given to the corrosiveness of the fuel according to the relevant environment conditions, including stress corrosion cracking. System components other than piping that are likely to come into contact with and be degraded by ammonia in a leakage scenario should be compatible with ammonia.

7.2.1.6 Fuel piping should be designed to prevent fuel from unintended accumulation in piping in consideration of the characteristics of ammonia. In addition, fuel piping should be arranged for emptying, inerting and gas freeing.

### 7.3 General provisions

7.3.1 Fuel piping systems for liquid ammonia should as a minimum have a design pressure of 18 bar, corresponding to the vapour pressure of ammonia at 45°C, in order to prevent venting of ammonia in idle conditions. Fuel piping systems for gaseous ammonia should as a minimum have a design pressure of 10 bar. For fuel piping systems for liquid ammonia fitted with closed loop pressure relief arrangements routed back to the fuel storage tank, the minimum design pressure should as a minimum have a design pressure of 10 bar.

7.3.2 Expansion joints and bellows should not be used in ammonia fuel piping systems. Engine-mounted expansion bellows could be accepted based on evaluation, as reflected in the safety concept of the engine.

7.3.3 Anhydrous ammonia may cause stress corrosion cracking in containment and process systems made of carbon-manganese steel or nickel steel. To minimize the risk of this occurring, measures detailed in 17.12.2 to 17.12.7 of the IGC Code should be taken, as appropriate.

### 7.4 Reference to the IGF Code

The IGF Code chapter 7 should be taken into account, where applicable, in order to fulfil the functional requirements.

## 8 BUNKERING

### 8.1 Goal

The goal of this chapter is to provide for suitable systems on board the ship to ensure that bunkering can be conducted without causing danger to persons, the environment or the ship.

## 8.2 Functional requirements

8.2.1 This chapter relates to functional requirements in 3.2.1 to 3.2.12 and 3.2.14 to 3.2.18. In particular, the following should apply:

8.2.1.1 The piping system for transfer of fuel to the storage tanks should be designed such that any leakage from the piping system cannot cause danger to persons, the environment or the ship.

## 8.3 Provisions for bunkering station

### *8.3.1 General*

8.3.1.1 Enclosed or semi-enclosed bunkering stations should be gastight towards adjacent spaces. The term "adjacent" includes linear contact and point contact.

8.3.1.2 Air intakes and openings in accommodation spaces, service spaces, engine rooms and control stations should not be located in hazardous and toxic areas associated with bunkering stations.

8.3.1.3 Connections and piping should be so positioned and arranged that any damage to the bunkering piping does not cause damage to the ship's fuel containment system resulting in an uncontrolled fuel discharge.

8.3.1.4 Bunkering piping should not be led through accommodation spaces, service spaces, electrical equipment rooms or control stations. Where bunkering piping is arranged in other enclosed spaces, bunkering piping should pass through a secondary enclosure meeting the requirements of 9.5.1.

8.3.1.5 Arrangements should be made for safe management of any spilled fuel.

8.3.1.6 Suitable means should be provided to relieve the pressure and remove ammonia contents from pump suctions and bunker lines. Ammonia is to be discharged to the fuel tanks or other suitable location.

8.3.1.7 The surrounding hull or deck structures should not be exposed to unacceptable cooling, in case of leakage of fuel.

### *8.3.2 Ship's fuel hoses*

8.3.2.1 Liquid and vapour hoses used for fuel transfer should be compatible with the fuel and suitable for the fuel temperature.

8.3.2.2 Hoses subject to tank pressure, or the discharge pressure of pumps or vapour compressors, should be designed for a bursting pressure not less than five times the maximum pressure the hose can be subjected to during bunkering. Hoses should be regularly visually inspected, and hydrostatic pressure tested periodically at not more than a five-year interval.

8.3.2.3 Where fuel hoses are stored on the open deck or in a storage room, arrangements should be made for safe storage of the hoses.

**8.4 Provisions for manifold**

8.4.1 The bunkering manifold should be designed to withstand the external loads during bunkering. The connections at the bunkering station should be arranged in order to achieve a dry-disconnect operation in one of the followings ways:

.1 a dry-disconnect/connect coupling;

.2 a manual connect coupler or hydraulic connect coupler, used to connect the bunker system to the receiving vessel bunkering manifold presentation flange; or

.3 a bolted flange to flange assembly.

8.4.2 When intended to use either of the connections specified in paragraphs 8.4.1.2 and 8.4.1.3, these should be combined with operating procedures that ensure a dry-disconnect is achieved. The arrangement should be subject to special consideration informed by a bunkering arrangement risk assessment conducted at the design stage and considering dynamic loads at the bunkering manifold connection, the safe operation of the ship and other hazards that may be relevant to the ship during bunkering operation. The fuel handling manual required by 18.2.1.3 shall include documentation that the bunkering arrangement risk assessment was conducted, and that special consideration was granted under this requirement.

8.4.3 An emergency release coupler (ERC)/emergency release system (ERS) or equivalent means should be provided, unless installed on the bunkering supply side of the bunkering line. It should enable a quick physical disconnection "dry break-away" of the bunker system in an emergency event.

**8.5 Provisions for bunkering system**

8.5.1 An arrangement for purging fuel bunkering lines with inert gas should be provided.

8.5.2 The bunkering system should be so arranged that no gas is discharged to the atmosphere during filling of storage tanks. Vapour return line, where fitted, should be sized adequately taking into consideration the expansion ratio of the fuel during bunkering operations.

8.5.3 A manually operated stop valve and a remote operated shutdown valve in series, or a combined manually operated and remote valve should be fitted in every bunkering line close to the connecting point. It should be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

8.5.4 A bunkering-safety link (BSL), or an equivalent means for automatic and manual ESD communication to the bunkering source should be fitted.

8.5.5 Means should be provided for draining any fuel from the bunkering pipes upon completion of operation.

8.5.6 Bunkering lines should be arranged for inerting and gas freeing. Means to confirm the absence of residual liquid should be provided. When not engaged in bunkering, the bunkering pipes should be free of gas, or residual liquid, unless the consequences of not gas freeing are evaluated and approved by the Administration.

8.5.7 In case bunkering lines are arranged with a cross-over, it should be ensured by suitable isolation arrangements that no fuel is transferred inadvertently to the ship side not in use for bunkering.

8.5.8 If not demonstrated to be required at a higher value due to pressure surge considerations a default time as calculated in accordance with 16.7.3.7 of the IGF Code from the trigger of the alarm to full closure of the remote operated valve required by 8.5.3 should be adjusted.

8.5.9 Sampling valves, if fitted, should be arranged at suitable locations in the bunkering line to allow verification procedures to confirm that the bunkering line is safe before opening any flanges. A double shut-off, blank flange or plug should be installed on sampling valves in the bunkering line.

## 9 FUEL SUPPLY TO CONSUMERS

### 9.1 Goal

The goal of this chapter is to ensure the safe and reliable distribution of fuel to the fuel consumers.

### 9.2 Functional requirements

This chapter is related to functional requirements in 3.2.1 to 3.2.6, 3.2.8 to 3.2.12 and 3.2.14 to 3.2.18. In particular, the following apply:

.1 the fuel supply system should be designed so as to avoid direct release of ammonia to the atmosphere during normal operation and during any foreseeable and controllable abnormal scenario, while providing safe access for operation and inspection. The causes and consequences of ammonia gas release should be given special consideration when carrying out the risk assessment required by 4.2;

.2 the piping system for fuel transfer to the fuel consumers should be designed in a way that a failure of one barrier cannot lead to a leak from the piping system into the surrounding area causing danger to the persons on board, the environment or the ship;

.3 fuel lines outside the machinery spaces should be installed and protected so as to minimize the risk of injury to personnel and damage to the ship in case of leakage;

.4 the fuel supply system should be designed and arranged not to cause unintentional phase changes within the fuel supply system; and

.5 operational gas releases should be collected and handled by a suitable ammonia release mitigation system.

### 9.3 Provisions on redundancy of fuel supply

9.3.1 For single fuel installations, the fuel supply system should be arranged with full redundancy and segregation all the way from the fuel tanks to the fuel consumer, so that a leakage in one system does not lead to an unacceptable loss of power.

9.3.2 For single fuel installations, the fuel storage should be divided between two or more tanks. The tanks should be located in separate compartments.

9.3.3 For type C tank only, one tank may be accepted if two completely separate tank connection spaces are installed for the one tank.

**9.4 Provisions on safety functions of fuel supply system**

9.4.1 Fuel storage tank inlets and outlets should be provided with valves located as close to the tank as possible. Valves required to be operated during normal operation[2] which are not accessible should be remotely operated. Tank valves, whether accessible or not, should be automatically operated when the safety system required in 15.2.2 is activated.

9.4.2 The main fuel supply line and return lines to each fuel consumer or set of consumers should be equipped with a manually operated stop valve and an automatically operated "master fuel valve" coupled in series or a combined manually and automatically operated valve. The valves should be situated in the part of the piping that is outside the machinery space containing fuel consumers and placed as near as possible to the installation for heating the fuel, if fitted. The master fuel valve should automatically cut off the fuel supply when activated by the safety system required in 15.2.2.

9.4.3 The automatic master fuel valve should be operable from safe locations on escape routes inside a machinery space containing a fuel consumer, the engine control room, if applicable; outside the machinery space, and from the navigation bridge.

9.4.4 The fuel supply lines to fuel preparation rooms should be equipped with automatically operated shut-off valves situated at the bulkhead inside the fuel preparation room.

9.4.5 Each fuel consumer should be provided with "double block and bleed" valves arrangement. These valves should be arranged as outlined in .1 or .2 so that when the safety system required in 15.2.2 is activated, this will cause the shutoff valves that are in series to close automatically and the bleed valve to open automatically, and:

.1 the two shutoff valves should be in series in the fuel pipe to the fuel consuming equipment. The bleed valve should be in a pipe that vents to a suitable ammonia release mitigation system that portion of the fuel piping that is between the two valves in series; or

.2 the function of one of the shutoff valves in series and the bleed valve can be incorporated into one valve body, so arranged that the flow to the fuel utilization unit will be blocked and the ventilation opened.

9.4.6 The two valves should be of the fail-to-close type, while the ventilation valve should be fail-to-open.

9.4.7 The fuel supply system should include an ammonia release mitigation system capable of collecting and handling ammonia releases, including but not limited to:

.1 bleed from double block and bleed arrangements on the fuel piping systems;

.2 releases from the opening of pressure relief valves in the fuel piping system; and

.3 releases from purging and draining operations of fuel pipes.

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2 Normal operation in this context is when fuel is supplied to fuel consumers and during bunkering operations.

9.4.8 The release mitigation system should be capable of reducing the ammonia concentration to below 110 ppm. Discharges from the release mitigation system should be arranged in accordance with 6.7.2.7.

9.4.9 Where fuel supply systems supply ammonia in the liquid state, relevant bleed lines and vent lines should be led to the fuel tank or gas-liquid separator or similar device to prevent ammonia liquid from being released to the atmosphere.

9.4.10 The double block and bleed valves should also be used for normal stop of the engine.

9.4.11 In cases where the master fuel valve is automatically shut down when the safety system as required in 15.2.2 is activated, the complete fuel supply branch downstream of the double block and bleed valve should be automatically purged through the ammonia release mitigation system.

9.4.12 There should be one manually operated shutdown valve in the fuel supply line to each engine upstream of the double block and bleed valves to assure safe isolation during maintenance on the engine. Where fuel is recirculated from each engine to the fuel supply piping, one manually operated shutoff valve should also be provided downstream of the double block bleed valve in the fuel return piping for each engine.

9.4.13 For single-engine installations and multi-engine installations, where a separate master valve is provided for each engine, the master fuel valve and the double block and bleed valve functions can be combined.

9.4.14 Where gaseous ammonia fuel is supplied to a consumer, provisions should be made to prevent ammonia condensate from entering the consumer.

### 9.5 Provisions for fuel distribution outside of machinery space

9.5.1 Fuel pipes should be protected by a secondary enclosure. This enclosure can be a duct or a double wall piping system. The duct or double wall piping system should be fitted with gas detection as required in 15.8. Other solutions providing an equivalent safety level may also be accepted by the Administration.

9.5.2 The provision in 9.5.1 need not to be applied for fuel pipes located in a fuel preparation room or tank connection space.

9.5.3 Where gas detection as required in 15.8.2.2 is not fit for purpose, the secondary enclosures around liquefied fuel pipes shall be provided with leakage detection by means of pressure or temperature monitoring systems, or any combination thereof.

9.5.4 The provision in 9.5.1 also applies for fuel vent pipes, except for open-ended fully welded fuel vent pipes in open air.

### 9.6 Reference to the IGF Code

The IGF Code chapter 9 should be taken into account, where applicable, in order to fulfil the functional requirements.

# 10 POWER GENERATION INCLUDING PROPULSION AND OTHER FUEL CONSUMERS

## 10.1 Goal

The goal of this chapter is to provide safe and reliable delivery of mechanical, electrical or thermal energy.

## 10.2 Functional requirements

10.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.12, 3.2.14, 3.2.17 and 3.2.18. In particular, the following apply:

.1 the exhaust systems should be configured to prevent any accumulation of unburnt fuel;

.2 unless designed with the strength to withstand the worst-case overpressure due to ignited fuel leaks, engine components or systems containing or likely to contain an ignitable ammonia gas and air mixture should be fitted with suitable pressure relief systems. Dependent on the particular engine design this may include the air inlet manifolds and scavenge spaces;

.3 the explosion venting should be led away from where persons may normally be present;

.4 all fuel consumers should have a separate exhaust system; and

.5 the possibility of ammonia leakage from fuel consumers into the auxiliary system, such as cooling water systems and its consequences, should be minimized.

## 10.3 Reference to the IGF Code

The IGF Code chapter 10 should be taken into account, where applicable, in order to fulfil the functional requirements.

# 11 FIRE SAFETY

## 11.1 Goal

The goal of this chapter is to provide for fire protection, detection and fighting for all system components related to the storage, conditioning, transfer and use of ammonia as ship fuel.

## 11.2 Functional requirements

11.2.1 This chapter is related to functional requirements in 3.2.2, 3.2.4, 3.2.5, 3.2.6, 3.2.7, 3.2.13, 3.2.15, 3.2.16 and 3.2.18.

## 11.3 Reference to the IGF Code

The IGF Code chapter 11 should be taken into account, where applicable, in order to fulfil the functional requirements.

## 12 EXPLOSION PREVENTION

### 12.1 Goal

The goal of this chapter is to provide for the prevention of explosions and for the limitation of effects from explosion.

### 12.2 Functional requirements

12.2.1 This chapter is related to functional requirements in 3.2.2 to 3.2.5, 3.2.7, 3.2.8, 3.2.13, 3.2.15 and 3.2.18. In particular the following apply:

12.2.2 The probability of explosions should be reduced to a minimum by:

.1 reducing the number of sources of ignition; and

.2 reducing the probability of the formation of ignitable mixtures.

### 12.3 Reference to the IGF Code

The IGF Code chapter 12 should be taken into account, where applicable, in order to fulfil the functional requirements.

## *12bis* PREVENTION OF EXPOSURE TO TOXICITY

### 12*bis*.1 Goal

The goal of this chapter is to provide for the prevention of exposure to toxic gases.

### 12*bis*.2 Functional requirements

12*bis*.2.1 This chapter is related to functional requirements in 3.2.2 to 3.2.5, 3.2.7, 3.2.9, 3.2.14 and 3.2.17. In particular, the following apply:

12*bis*.2.2 The probability of exposure to toxic gases should be reduced to a minimum by considering arrangement and location of:

.1 potential sources of ammonia release, such as valves flanges and fittings;

.2 outlet from pressure relief valves;

.3 openings from spaces where ammonia leakages may occur;

.4 bunker stations;

.5 active or passive systems to prevent ammonia propagation to adjacent spaces or areas;

.6 openings to the vessel interior needing to be protected from intake of toxic gas; and

.7 safe havens, life-saving appliances and emergency escapes.

**12*bis*.3 General provisions for toxic exposure protection**

12*bis*.3.1 Toxic area and space classification is a method of analysing and classifying the areas where ammonia vapour is or may be expected to be present. The objective of the classification is to limit the risk of direct exposure to ammonia for persons on board.

12*bis*.3.2 Toxic areas and spaces are defined to allow for a safe arrangement preventing cross-contamination from ammonia releases, and to facilitate safe arrangement of life-saving appliances, emergency escapes, air intakes, outlets and other openings into the accommodation, service and machinery spaces, control stations and other non-toxic spaces.

**12*bis*.4 Provisions for toxic area and space classification**

12*bis*.4.1 Toxic areas include, but are not limited to:

.1 areas on open deck within 10 m of any flanges, valves, and other potential leakage sources in ammonia fuel systems;

.2 areas on open deck within B or 25 m, whichever is less, from outlets from the pressure relief valves installed on a liquefied fuel gas tank and all other fuel gas vent outlets;

.3. areas on open deck within B or 25 m, whichever is less, from outlets from interbarrier spaces for tanks of IMO type A;

.4 areas on open deck within 10 m from outlets from interbarrier spaces for tanks of IMO type B;

.5 areas on open deck within 10 m from outlets from secondary enclosures around ammonia piping, ventilation outlets from tank connection spaces and fuel preparation rooms and other spaces containing ammonia leakage sources;

.6 areas on open deck within 5 m from inlets to secondary enclosures around ammonia piping, ventilation inlets to tank connection spaces and fuel preparation rooms and other spaces containing ammonia leakage sources; and

.7 areas on open deck within 5 m from entrance openings to spaces containing ammonia leakage sources.

12*bis*.4.2 Toxic spaces include, but are not limited to:

.1 the interiors of fuel tanks, any pipework for pressure-relief or other venting systems for fuel tanks, pipes and equipment containing fuel;

.2 tank connection spaces, interbarrier spaces and fuel storage hold spaces for tank containment systems requiring secondary barriers;

.3 fuel preparation rooms;

.4 annular space of secondary enclosures around fuel pipes; and

.5 enclosed and semi-enclosed spaces in which potential sources of release, such as single-walled piping containing fuel, are located.

12*bis*.4.3 In addition to the toxic area requirements in this section, a dispersion analysis should be carried out in order to determine the extent of a toxic area. The gas dispersion analysis should demonstrate that ammonia concentrations exceeding 220 ppm do not reach:

.1 air intakes, outlets and other openings into the accommodation;

.2 service and machinery spaces;

.3 control stations;

.4 other non-toxic spaces in the ship; and

.5 other areas, as specified by the Administration.

12*bis*.4.4 The toxic area determined by the dispersion analysis should extend the minimum area as defined in 12*bis*.4.1, or lead to additional mitigation measures.

12*bis*.4.5 The dispersion analysis boundary conditions should be approved by the Administration. The analysis should include discharges from the pressure relief valves protecting the tank containment system, discharges from secondary barriers around fuel tanks and discharges from secondary enclosures around ammonia leakage sources.

### 12*bis*.5 Provisions for safe havens

A safe haven providing refuge in case of a release of ammonia should be arranged in one or more enclosed spaces with a cumulative total capacity to accommodate all persons on board. Safe havens should be arranged, as necessary, at essential locations for the ship's operation. The space should be designed to minimize the risk of exposure to ammonia during release of ammonia. This may be achieved by measures including, but not limited to, arrangement of ventilation systems or by arranging self-sustaining air supply for the space.

## 13 VENTILATION

### 13.1 Goal

The goal of this chapter is to provide for the ventilation required for safe operation of ammonia-fuelled machinery and equipment where ammonia is used as fuel.

### 13.2 Functional requirements

13.2.1 This chapter is related to functional requirements in 3.2.2, 3.2.5, 3.2.8, 3.2.9, 3.2.11, 3.2.13, 3.2.14 and 3.2.17.

### 13.3 Reference to the IGF Code

The IGF Code chapter 13 should be taken into account, where applicable, in order to fulfil the functional requirements.

## 14 ELECTRICAL INSTALLATIONS

### 14.1 Goal

The goal of this chapter is to provide for electrical installations that minimize the risk of ignition in the presence of a flammable atmosphere.

### 14.2 Functional requirements

14.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.4, 3.2.7, 3.2.8, 3.2.12, 3.2.13 and 3.2.16 to 3.2.18. In particular, the following apply:

14.2.2 Electrical generation and distribution systems, and associated control systems, should be designed such that a single fault will not result in the loss of ability to maintain fuel tank pressure and temperature within normal operating limits.

### 14.3 Reference to the IGF Code

The IGF Code chapter 14 should be taken into account, where applicable, in order to fulfil the functional requirements.

## 15 CONTROL, MONITORING AND SAFETY SYSTEMS

### 15.1 Goal

The goal of this chapter is to provide for the arrangement of control, monitoring and safety systems that support an efficient and safe operation of the ammonia-fuelled installation as covered in the other chapters of these Interim Guidelines.

### 15.2 Functional requirements

15.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.12, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18 of these Interim Guidelines. In particular, the following apply:

.1 the control, monitoring and safety systems of the ammonia-fuelled installation should be so arranged that the remaining power for propulsion and power generation is in accordance with 9.3.1 in the event of single failure;

.2 an ammonia safety system should be arranged to close down the fuel supply system automatically, upon failure in systems as described in table 1 and upon other fault conditions which may develop too fast for manual intervention;

.3 the safety functions should be arranged in a dedicated gas safety system that is independent of the gas control system in order to avoid possible common cause failures. This includes power supplies and input and output signal;

.4 the safety systems including the field instrumentation should be arranged to avoid spurious shutdown, e.g. as a result of a faulty gas detector or a wire break in a sensor loop; and

.5 where two or more fuel supply systems are required to meet the provisions, each system should be fitted with its own set of independent fuel control and fuel safety systems.

### 15.3 General provisions

Suitable instrumentation devices should be fitted to allow a local and a remote reading of essential parameters to ensure a safe management of the whole fuel gas equipment including bunkering.

### 15.4 Provisions for bunkering and fuel tank monitoring

#### 15.4.1 *Level indicators for fuel tanks*

15.4.1.1 With regard to level indicators for fuel tanks:

.1 each fuel tank should be fitted with liquid level gauging device(s), arranged to ensure a level reading is always obtainable whenever the fuel tank is operational. The device(s) should be designed to operate throughout the design pressure range of the liquefied gas fuel tank and at temperatures within the fuel operating temperature range;

.2 where only one liquid level gauge is fitted, it should be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank; and

.3 fuel tank liquid level gauges may be of the following types:

  .1 indirect devices, which determine the amount of fuel by means such as weighing or in-line flow metering; or

  .2 closed devices, which do not penetrate the fuel tank, such as devices using radioisotopes or ultrasonic devices.

#### *15.4.2 Overflow control*

15.4.2.1 With regard to overflow control:

.1 each fuel tank should be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated;

.2 an additional sensor operating independently of the high liquid level alarm should automatically actuate a shutoff valve in a manner that will both avoid excessive liquid pressure in the bunkering line and prevent the fuel tank from becoming liquid full;

.3 the position of the sensors in the fuel tank should 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 should be conducted by raising the fuel liquid level in the fuel tank to the alarm point;

.4 all elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overfill alarms, should be capable of being functionally tested. Systems should be tested prior to fuel operation; and

.5 where arrangements are provided for overriding the overflow control system, they should be such that inadvertent operation is prevented. When this override is operated, a continuous visual indication is to be provided at the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.3 The vapour space of each fuel tank should be provided with a direct pressure reading gauge. Additionally, an indirect pressure indication should be provided on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.4 The pressure indicators should be clearly marked with the highest and lowest pressure permitted in the fuel tank.

15.4.5 A high-pressure alarm and, if vacuum protection is required, a low-pressure alarm should be provided on the navigation bridge and at a continuously manned central control station or onboard safety centre. Alarms should be activated before the set pressures of the safety valves are reached.

15.4.6 Each fuel pump discharge line and each liquid and vapour bunker manifold should be provided with at least one local pressure indicator.

15.4.7 The local pressure indicators should be provided to indicate the pressure between ship's bunker manifold valves and hose connections to the bunkering facility.

15.4.8 Fuel storage hold spaces and interbarrier spaces without open connection to the atmosphere should be provided with pressure indicator.

15.4.9 For submerged fuel pump motors and their supply cables, arrangements should be made to alarm in low-liquid level and automatically shut down the motors in the event of low-low liquid level. The automatic shutdown may be accomplished by sensing low pump discharge pressure, low motor current, or low-low liquid level. This shutdown should give an audible and visual alarm on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.10 Each fuel tank should be provided with devices to measure and indicate the temperature of the fuel.

## 15.5 Provisions for bunkering control

15.5.1 Control of the bunkering should be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature, and tank level should be monitored. Remotely controlled valves required by 8.5.3 should be capable of being operated from this location. Overfill alarm and automatic shutdown should also be indicated at this location.

15.5.2 If ammonia leakage is detected in the secondary enclosure around the bunkering lines, an audible and visual alarm should be provided at the bunkering control location. The bunker valve and other valves required to isolate the leakage should be automatically closed by the safety system in accordance with table 1.

## 15.6 Provisions for gas compressor monitoring

15.6.1 Gas compressors should be fitted with audible and visual alarms both on the navigation bridge and in the engine control room. As a minimum, the alarms should include low gas input pressure, low gas output pressure, high gas output pressure and compressor operation.

15.6.2 Where bulkhead penetrations are used to separate the drive from a hazardous space, temperature monitoring for the bulkhead shaft glands and bearings should be provided, which automatically give a continuous audible and visual alarm on the navigation bridge or in a continuously manned central control station.

## 15.7 Provisions for gas engine monitoring

15.7.1 In addition to the instrumentation provided in accordance with part C of SOLAS chapter II-1, indicators should be fitted on the navigation bridge, the engine control room and the manoeuvring platform for:

.1 operation of the engine in case of ammonia-only engines; or

.2 operation and mode of operation of the engine in the case of dual fuel engines.

## 15.8 Provisions for leakage detection

15.8.1 Where gas detection should cause shutdown in accordance with table 1, detector voting should be applied where two units should detect gas to activate shutdown. A failed detector should be considered as an active detection.

15.8.2 Permanently installed gas detectors should be fitted in:

.1 tank connection spaces;

.2 all secondary enclosures around fuel pipes;

.3 machinery spaces containing gas piping, gas equipment or gas consumers;

.4 fuel preparation rooms;

.5 bunkering stations and other enclosed spaces containing fuel piping or other fuel equipment not protected by a secondary enclosure;

.6 other enclosed or semi-enclosed spaces where fuel vapours may accumulate including interbarrier spaces and fuel storage hold spaces of independent tanks other than type C;

.7 airlocks and entry spaces to tank connection spaces;

.8 gas heating circuit expansion tanks;

.9 motor rooms for compressors as specified in 15.6.2 (if fitted);

.10 at ventilation inlets to accommodation and machinery spaces where required based on the risk assessment in 4.2;

.11 at ventilation inlets for safe haven; and

.12 at outlet from tank pressure relief valves.

15.8.3 The number of detectors in each space should be considered taking into account the size, layout and ventilation of the space, and each space shall be covered by a sufficient number of detectors to allow for voting in accordance with table 1.

15.8.4 The detection equipment should be located where gas may accumulate and in the ventilation outlets. Gas dispersal analysis should be used to find the best location of gas detectors.

15.8.5 Gas detection equipment should be designed, installed and tested in accordance with a recognized standard.

15.8.6 Fuel piping should also be arranged with the detection of liquid leakages in the secondary enclosure at the lowest point.

15.8.7 Each tank connection space, fuel preparation room and bunker station should be provided with liquid leakage detection. Alarm should be given at high liquid level and low temperature indication should activate the safety system.

15.8.8 An audible and visible alarm should be activated at an ammonia vapour concentration of 110 ppm as specified in table 1. The safety system should be activated at an ammonia vapour concentration of 220 ppm with actions as specified in table 1. In addition, at an ammonia vapour concentration, a visual local indication should be given at all entrances to enclosed spaces affected.

15.8.9 Audible and visible alarms from the leakage detection equipment should be located on the navigation bridge, in the continuously manned central control station and inside and outside the space where the leakage is detected.

15.8.10 Gas detection required by this section should be continuous without delay.

**15.9 Provisions for prevention of condensation in fuel supply line**

15.9.1 Where gaseous ammonia fuel is supplied to a consumer, the following should be monitored:

.1 fuel pipe wall temperature; and

.2 fuel pressure.

15.9.2 The control system should be capable of calculating the dynamic dew point based on measurements of fuel pressure and fuel pipe wall temperature. If fuel pipe wall temperature falls within 10°C of the calculated dew point of the fuel, the fuel system should shut down and fuel system should be purged of ammonia fuel.

**15.10 Provisions for ventilation**

Any reduction of the required ventilating capacity in tank connection spaces, fuel preparation rooms or other enclosed spaces containing fuel piping or other fuel equipment not protected by a secondary enclosure should give an audible and visual alarm on the navigation bridge or in a continuously manned central control station or safety centre. Loss of ventilation should result in automatic closing of valves as specified in table 1.

**15.11 Provisions for safety functions of fuel supply systems**

15.11.1 If the fuel supply is shut off due to activation of an automatic valve, the fuel supply should not be opened until the reason for the disconnection is ascertained and the necessary precautions taken. A readily visible notice giving instruction to this effect should be placed at the operating station for the shutoff valves in the fuel supply lines.

15.11.2 A caution placard or signboard should be permanently fitted in the machinery space containing gas-fuelled engines, stating that heavy lifting, implying danger of damage to the fuel pipes, should not be done unless the fuel supply lines are free from ammonia.

15.11.3 Compressors, pumps and fuel supply should be arranged for manual remote emergency stop from the following locations as applicable:

.1 navigation bridge;

.2 cargo control room;

.3 onboard safety centre;

.4 engine control room;

.5 fire-control station; and

.6 adjacent to the exit of fuel preparation rooms.

15.11.4 The ammonia compressor should also be arranged for manual local emergency stop.

**Table 1: Monitoring of ammonia fuel installation**

| Parameter | Alarm | Automatic shutdown of bunker valve | Automatic shutdown of tank valve(s) | Automatic shutdown of fuel preparation room valve(s) | Automatic shutdown of master valve(s) | Comments |
|---|---|---|---|---|---|---|
| Ammonia detection in enclosed spaces at 25 ppm | X (see comment) | | | | | Local indication at all entrances to the space, no alarm at the alarm system |
| High-level fuel tank | X | | | | | |
| High-high level fuel tank | X | X | X | | | |
| Submerged fuel pumps, low level in tank | X | | | | | Stop fuel pumps at low-low liquid level |
| Ammonia detection in bunker station at 110 ppm | X | | | | | |
| Ammonia detection in bunker station at 220 ppm | | X | | | | |
| Liquid leakage detection in bunker station | X | X | | | | Close valve at low temperature |
| Ammonia detection in secondary enclosure around bunkering lines at 110 ppm | X | | | | | |
| Ammonia detection in secondary enclosure around bunkering lines at 220 ppm | | X | X | | | |

| Parameter | Alarm | Automatic shutdown of bunker valve | Automatic shutdown of tank valve(s) | Automatic shutdown of fuel preparation room valve(s) | Automatic shutdown of master valve(s) | Comments |
|---|---|---|---|---|---|---|
| Liquid leakage detection in secondary enclosure around bunkering lines | X | X | X | | | |
| Ammonia detection in tank connection space at 110 ppm | X | | | | | |
| Ammonia detection on two detectors in tank connection space at 220 ppm | X | | X | | | |
| Liquid leakage detection in tank connection space | X | | X | | | Close valve at low temperature |
| Ammonia detection in fuel preparation room at 110 ppm | X | | | | | |
| Ammonia detection on two detectors in fuel preparation room at 220 ppm | X | | | X | | |
| Liquid leakage detection in fuel preparation room | X | | | X | | Close valve at low temperature |
| Ammonia detection in | X | | | | | |

| Parameter | Alarm | Automatic shutdown of bunker valve | Automatic shutdown of tank valve(s) | Automatic shutdown of fuel preparation room valve(s) | Automatic shutdown of master valve(s) | Comments |
|---|---|---|---|---|---|---|
| secondary enclosure of fuel supply piping at 110 ppm | | | | | | |
| Ammonia detection on two detectors in secondary enclosure of fuel supply piping at 220 ppm | X | | X | X | X | All valves required to isolate the leakage should close.<br><br>Transient releases which are expected in normal operation of the consumers should not cause shutdown of the consumers. |
| Liquid leakage detection in secondary enclosure of fuel supply pipes | X | | X | X | X | All valves required to isolate the leakage should close |
| Reduced ventilation in tank connection space | X | | | | | |
| Loss of ventilation in tank connection space | | | X | | | |
| Reduced ventilation in fuel preparation room | X | | | | | |
| Loss of ventilation in | | | | X | | |

| Parameter | Alarm | Automatic shutdown of bunker valve | Automatic shutdown of tank valve(s) | Automatic shutdown of fuel preparation room valve(s) | Automatic shutdown of master valve(s) | Comments |
|---|---|---|---|---|---|---|
| fuel preparation room | | | | | | |
| Manually activated emergency shutdown of master fuel valve(s) engine | X | | | | X | |
| Ammonia concentration from discharge of ARMS at 110 ppm | X | | | | | |

An alarm as indicated in table 1 should include an audible and visual alarm at a manned location in accordance with the 2009 Code on Alerts and Indicators.

## 16 MANUFACTURE, WORKMANSHIP AND TESTING

The provisions of the IGF Code, part B-1, chapter 16, should apply to ships using ammonia as fuel, where appropriate.

## 17 DRILLS AND EMERGENCY EXERCISES

17.1 Drills and emergency exercises on board should be conducted at regular intervals.

17.2 Such ammonia-related exercises could include, for example:

.1 tabletop exercise;

.2 review of fuelling procedures based on the fuel handling manual;

.3 responses to potential contingencies;

.4 tests of equipment intended for contingency response; and

.5 reviews that assigned seafarers are trained to perform assigned duties during fuelling and contingency response.

17.3 Ammonia-related exercises may be incorporated into periodical drills required by SOLAS.

17.4 The response and safety system for hazards and accident control should be reviewed and tested.

## 18 OPERATION

## 18.1 Goal

The goal of this chapter is to ensure that operational procedures for the loading, storage, operation, maintenance and inspection of systems for ammonia minimize the risk to persons, the ship, and the environment, and that they are consistent with practices for a conventional oil-fuelled ship whilst taking into account the nature of ammonia.

## 18.2 Functional requirements

18.2.1 This chapter relates to the functional requirements in 3.2.1 to 3.2.3, 3.2.10, 3.2.12, 3.2.15, 3.2.16 and 3.2.17 of these Interim Guidelines. In particular, the following apply:

.1 a copy of these Interim Guidelines, or national regulations incorporating the provisions of the same, should be on board every ship covered by these Interim Guidelines;

.2 maintenance procedures and information for all ammonia-related installations should be available on board;

.3 the ship should be provided with operational procedures including a suitably detailed fuel handling manual, such that trained personnel can safely operate the fuel bunkering, storage and transfer systems; and

.4 the ship should be provided with suitable emergency procedures.

## 18.3 Reference to the IGF Code

The IGF Code chapter 18 should be taken into account, where applicable, in order to fulfil the functional requirements.

# 19 TRAINING

## 19.1 Goal

The goal of this chapter is to ensure that seafarers on board ships to which these Interim Guidelines apply are adequately qualified, trained and experienced.

## 19.2 Functional requirements

19.2.1 The company should ensure that seafarers on board ships using ammonia fuel should have completed training to attain the abilities that are appropriate to the capacity to be filled, and duties and responsibilities to be taken up.

19.2.2 The master, officers, ratings and other personnel on ships using ammonia fuel should have received training and be qualified in the use of gaseous fuel in accordance with the STCW Convention and the STCW Code, taking into account the specific hazards of ammonia.

# 20 PERSONNEL PROTECTION

## 20.1 Goal

The goal of this chapter is to ensure that protective equipment is provided for persons on board, considering both routine operations and emergency situations and possible short- or long-term effects of ammonia exposure.

## 20.2 Functional requirements

20.2.1 This chapter relates to functional requirements in 3.2.1, 3.2.12 and 3.2.16. In particular the following apply:

.1 for the protection of crew members who are engaged in operations, maintenance of ammonia fuel systems, and emergency response, the ship should have on board protective equipment suitable for ammonia exposure, taking the exposure risk of different operations into account;

.2 for the protection and treatment of crew members affected by ammonia leakages, the ship should have on board suitable emergency equipment; and

.3 suitable respiratory and eye protection for emergency escape purposes should be provided for every person on board.

## 20.3 Protective equipment

20.3.1 Suitable protective equipment, including eye protection, to a recognized national or international standard, should be provided for the protection of crew members engaged in normal operations related to the ammonia fuel system.

20.3.2 Personal protective and safety equipment required in this chapter should be kept in suitable, clearly marked lockers located in readily accessible places.

## 20.4 Emergency equipment

20.4.1 Suitably marked decontamination showers and eyewashes should be available in convenient locations:

.1 close to bunkering stations;

.2 close to exit from tank connection spaces;

.3 close to exit from fuel preparation rooms;

.4 in machinery spaces for ammonia-fuelled consumers; and

.5 close to lifeboat embarkation stations.

20.4.2 The showers and eyewashes should be operable in all ambient conditions. A heating system with temperature control is required if pipe routeing of the water supply exposes the piping to freezing conditions. Water supply capacity should be sufficient for simultaneous use of at least two units. Thermal insulation is not considered as an alternative to a system with temperature control.

20.4.3 A stretcher that is suitable for hoisting an injured person from spaces, such as tank hold spaces, should be kept in a readily accessible location.

20.4.4 The ship should have onboard medical first aid equipment, including oxygen resuscitation equipment, based on the requirements of the *Medical First Aid Guide* (MFAG) for ammonia.

20.4.5 Suitable respiratory and eye protection for emergency escape purposes should be provided for every person on board, subject to the following:

.1 filter-type respiratory protection is unacceptable;

.2 self-contained breathing apparatus should have at least 15 minutes of service time; and

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

**20.5 Safety equipment**

20.5.1 Sufficient, but not less than three complete sets of safety equipment, should be provided in addition to fire-fighter's outfits required by SOLAS regulation II-2/10.10. These additional sets should provide adequate personal protection to permit entry and work in a gas-filled space, and be equipped with two-way portable radiotelephone apparatus comprising of earpiece with microphone and push-to-talk units. This equipment should consider the nature of ammonia.

20.5.2 Each complete set of safety equipment should consist of:

.1 one self-contained positive pressure air breathing apparatus incorporating full face mask not using stored oxygen and having a capacity of at least 1,200 litres of free air. Each set should be compatible with that required by SOLAS regulation II-2/10.10;

.2 gastight protective clothing, boots and gloves to a recognized standard;

.3 steel-cored rescue line with belt; and

.4 explosion-proof lamp.

20.5.3 An adequate supply of compressed air should be provided and should consist of:

.1 at least one fully charged spare air bottle for each breathing apparatus required by 20.5.1;

.2 an air compressor of adequate capacity capable of continuous operation, suitable for the supply of high-pressure air of breathable quality; and

.3 a charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus required by 20.5.1.

20.5.4 The compressed air equipment should be inspected at least once a month by a responsible officer and the inspection should be logged in the ship's records. This equipment should also be inspected and tested by a competent person at least once a year.

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