Subject

Introduction to the Outcomes of MSC 95

ClassNK

Technical Information

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To whom it may concern

The ninety-fifth session of the Maritime Safety Committee (MSC 95) was held at the IMO in London, U.K. from 3 to 12 June 2015. Since the minutes, resolutions and circulars of the meeting were recently released from the IMO, a summary of the decisions taken at MSC 95 is provided as below for your information.

1. Adopted Mandatory Requirements
   Mandatory requirements were adopted at MSC 95 as follows:
   (1) The International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) (See attachment 1 and 2)
   The IGF Code (new code) which specifies the requirements for ships using gases or other low-flashpoint fuels and amendments to SOLAS II-1 and II-2 to make the IGF Code mandatory were adopted. Please see section 3. for more details.

   Applied to: ships contracted for construction on or after 1 January 2017
   ships keel laid on or after 1 July 2017, in the absence of a building contract
   ships delivered on or after 1 January 2021
   ships converted to use gaseous or other low-flashpoint fuels on or after 1 January 2017

   (2) Training and qualifications for crews on ships subject to IGF Code (See attachment 6 and 7)
   In association with the development of the IGF Code, amendments to STCW I, V and STCW Code were adopted to specify the special training and qualification requirements for crews.

   Applied: on and after 1 January 2017

   (3) Revision of certificate forms in SOLAS (See attachment 2, 4 and 5)
   In association with the development of the IGF Code, amendments to SOLAS Appendix were adopted to revise the form of safety construction certificate for cargo ships and the form of safety certificate for passenger ships so that the information about the application of the IGF Code is stated.

   Applied: on and after 1 January 2017

(To be continued)

(4) Venting arrangements of cargo tanks (See attachment 2)
Amendments to SOLAS II-2/4 and 11 to require P/V valves in each cargo tank were adopted.

Applied to: ships keel laid on or after 1 January 2017

(5) Air quality control system (See Attachment 2)
Amendments to SOLAS II-2/20 to accept a decreased number of air changes and/or a decreased amount of ventilation in ro-ro or vehicle spaces where an air quality control system is provided were adopted. In addition, MSC.1/Circ.1515 (See attachment 8) was approved to revise the design guidelines and operational recommendations for ventilation systems in ro-ro cargo spaces.

Applied: on and after 1 January 2017

(6) Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code (See Attachment 3)
Amendments to the IMSBC Code, which include the introduction of new requirements for 18 cargoes, the exclusion of the measurement of moisture content etc. for carrying liquefied cargoes to ships with self-unloading system using compressed air, the addition of the adequacy information of harmful to the marine environment (HME) in cargo information, were adopted.

Applied: on and after 1 January 2017 (Administrations may apply it on a voluntary basis as from 1 January 2016.)

In addition, the following MSC Circulars relevant to the IMSBC Code were approved.

- List of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective (MSC.1/Circ.1395/Rev.2) (See attachment 9)
- Guidelines for the submission of information and completion of the format for the properties of cargoes not listed in the IMSBC Code and their conditions of carriage (MSC.1/Circ.1453/Rev.1) (See attachment 10)
- Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy (MSC.1/Circ.1454/Rev.1) (See attachment 11)

2. Approved Mandatory Requirements
Mandatory requirements were approved at this session as follows, which are expected to be considered for adoption at MSC 96 (May 2016).

(To be continued)

(1) New establishment of chapter 17 of FSS Code regarding the foam fire-fighting system in helicopter facilities and amendments to SOLAS regulation II-2/18 to make the code mandatory.
(2) Amendments to chapter 8 of FSS Code regarding the specification of water quality to prevent internal corrosion and clogging of sprinklers.
(3) Amendments to SOLAS regulation II-2/13 to make the evacuation analysis mandatory for passenger ship.
(4) Amendments to 2011 ESP Code in line with the revised recommendations for entering enclosed spaces aboard ships (Resolution A.1050(27))

3. The International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code)
The work on the development of the IGF Code had been conducted since 2010 based on "Interim Guidelines on Safety for Natural Gas-fuelled Engine Installations in Ships (Resolution MSC. 285(86))", developed in 2009.
At this session, the newly established IGF Code which was approved in principal at MSC 94 in November 2014 and the amendments to SOLAS II-1 and II-2 to make the IGF Code mandatory as well as the amendments to STCW Convention and STCW Code associated with the implementation of IGF Code were adopted. For the composition and overview of the IGF Code, please see table 1.
This code applies to ships contracted for construction on or after 1 January 2017 (in the absence of a building contract, ships keel laid on or after 1 July 2017), ships delivered on or after 1 January 2021 or ships converted to use gaseous or other low-flashpoint fuels on or after 1 January 2017. The code includes specific requirements for the ships using natural gas as fuels.
The requirements for ships using methanol, ethanol or low-flashpoint fuels are under development by the Sub-Committee on Carriage of Cargoes and Containers.

4. Large container ship safety
In response to the casualty of "MOL COMFORT" which occurred in June 2013, the Japanese government established the Committee on Large Container Ship Safety and the Committee released the final report which summarizes the safety measures in March 2015.
At this session, Japan and Bahamas submitted the final report and a document which contains the following recommendations to classification societies and IACS based on knowledge acquired from the results of the investigation:
(1) the effect of the lateral loads which induce bi-axial stress of bottom shell plates should be considered in the requirements of the hull girder ultimate strength, taking into account the close relationship between the lateral loads and the hull girder ultimate strength;
(2) effects of whipping responses should be explicitly considered in the requirements of the vertical bending strength; and
(3) representation of technical background of the requirements for vertical bending strength, such as sea states, etc. should be considered.

As a result of deliberation, it was agreed to invite IACS to keep informed of further developments on relevant IACS requirements for large containership safety at future sessions.

(To be continued)

5. Testing arrangements for watertight compartment

At MSC 86 in May 2009, amendments to SOLAS II-1/11 were referred to the Sub-Committee on Ship Design and Equipment (DE) based on the proposal from Marshall Islands. Responding to this, the technical consideration has started since DE 56 in February 2012. After that, through restructuring of Sub-Committees, the Sub-Committee on Ship Design and Construction (SDC) discussed continuously.

At SDC 2 in February 2015, it was agreed to report to MSC 95 that the Sub-Committee concluded that the majority disagreed with the necessity of the amendments to SOLAS. Further, it was agreed to commit to MSC the decision on the course of action including the handling of draft guidelines for testing of watertight compartments.

At this session, IACS proposed that an issuance of draft MSC circular be prepared based on the tank testing guidelines. It is to ensure the adequacy of testing arrangements for watertight compartments and to allow the Administrations to use the guidelines with a view to lighten the burden of the Administrations, ROs, shipbuilders and shipowners.

As a result of deliberation, it was decided not to publish the MSC circular. However, it was specified in the report that the contents of the draft Guidelines are based upon an IACS unified requirements and, therefore, it is available for any Administration to use on a case-by-case basis.

6. Approval of Guidelines etc.

The following guidelines were developed at MSC 95. (See attachment 12)

IACS Unified Interpretations (UIs) shown as below are available from our website (http://www.classnk.or.jp/hp/en/info_service/iacs_ur_and_ui/index.aspx#UI) or IACS website (http://www.iacs.org.uk/publications/publications.aspx?pageid=4&sectionid=4).

(1) Unified interpretation of SOLAS II-2/16.3.3 and IBC Code 15.13.5 for products requiring oxygen-dependent inhibitors, that the minimum level of oxygen in inert gases is maintained as specified in the Certificate of Protection, was approved. (MSC.1/Circ.1501 and MSC-MEPC.5/Circ.10)

(2) Guidance on pressure testing of boundaries of cargo oil tanks under direction of the master was approved in line with the amendments to 2011 ESP Code that the pressure test may be conducted by crews under direction of the master. (MSC.1/Circ.1502)

(3) Unified interpretation to clarify fire resistance requirements for FRP gratings used for safe access to tanker bows was approved. It was considered based on IACS UI SC253 and the recognized standards for structural fire integrity were changed from USCG Marine Safety Manual Vol. II, Para 5.C.6 - Level 3 specified in the UI to ASTM F3059-14.

(4) Unified interpretation to clarify two means of escape from ro-ro spaces, location of "fore and aft ends" to provide the escape routes and mark of escape routes was approved. (MSC.1/Circ.1505)

(To be continued)

(5) Unified interpretation to clarify that the term "deck" in 3.14 of the resolution MSC.158(78), which specifies requirements for vertical ladder providing access to a tank, was approved. It was clarified, in case where the deck with entrance into space is weather deck, the requirement of the resolution is applied. This was developed based on IACS UI SC191 (Rev.6). (MSC.1/Circ.1507)

(6) Unified interpretation to clarify the term "continuous hatchway treated as a trunk" in regulation 36(6) of ICLL was approved. In case of a single hatchway, the hatchway may be regarded as a "continuous hatchway", and in case where more than one hatchway is fitted, hatchways may be regarded as "continuous hatchways" provided that detached hatchways are linked by weathertight steel structures. This was developed based on IACS UI LL79. (MSC.1/Circ.1508)

(7) Unified interpretation to clarify measurement methods of noise levels, noise levels of spaces, assessment methods for airborne sound insulation properties for the bulkheads in accommodation, etc. specified in the code on noise levels on board ships (resolution MSC.337(91)) was approved. (MSC.1/Circ.1509)

(8) Amendment to the unified interpretation on SOLAS II-2, FSS Code and FTP Code has been circulated as MSC/Circ.1120 was approved. It was clarified the cutting back the lower part of insulation to a maximum of 100 mm for drainage referred in figure 3 of the explanatory sketch for SOLAS II-2/9.3.4 in the appendix that the lining and steel coaming/gutter bar are applied to accommodation spaces only. In addition, the unified interpretation applies to the deck and bulkhead which are steel structure (not applicable for aluminium structure). (MSC.1/Circ.1510)

(9) Unified interpretations regarding the requirements of fire integrity in SOLAS II-2/9 and means of escape in SOLAS II-2/13 were approved as follows (MSC.1/Circ.1511):

- Unified interpretation to clarify the diameter of escape trunk, inclination and clear width of ladder and stairways in machinery spaces of category A, and safe position outside the space which is an escape destination from the lower part of machinery space of category A
- Unified interpretation to clarify "the lowest open deck" with regard to the escape from the accommodation, service space, control station
- Unified interpretation to clarify the terms "machinery control room", "main workshop" and "continuous fire shelter" in SOLAS II-2/13 which specifies two means of escape from machinery control rooms and main workshops located in machinery spaces of category A
- Unified interpretation to clarify fire integrity of decks and bulkheads, hatches, access doors, movable ramps, ventilation ducts and ventilators in SOLAS II-2/9 which specifies "A-30" fire integrity for the boundaries of ro-ro/vehicle spaces and "A-0" fire integrity for the boundaries between ro-ro/vehicle space and open deck

(10) Performance standard, functional requirements and system requirements for the assessment of smoke management system, which is required to install to passenger ships, were approved. (MSC.1/Circ.1514)

(To be continued)

(11) Amendments to the guidelines for the application of plastic pipes on ships (resolution A.753(18)), as amended by resolution MSC.313(88), to specify the test methods and criteria for flame spread, smoke generation and toxicity were adopted. (resolution MSC.399(95))

(12) Amendments to the revised performance standards and functional requirements for the long-range identification and tracking of ships (LRIT) (resolution MSC.263(84), as amended) to provide the information for "type of ship" were adopted. (resolution MSC.400(95))

7. GBS (Goal-Based Standards for the design and construction of new ships)

GBS of new ships for oil tankers and bulk carriers have been discussed since MSC 78 in May 2004 and adopted at MSC 87 in May 2010 along with amendments to SOLAS to implement GBS. GBS is applied to ships contracted for construction on or after 1 July 2016, while the detailed technical requirements are to be compliant with the rules of classification societies deemed by IMO as compliant with IMO GBS. The verification audits on the classification societies such as IACS members were started in March 2014.

At this session, the progress of the audit process was reported by IMO Secretariat. The final report will be submitted to MSC 96 to be held in May 2016.

8. Consideration on mooring arrangement

At this session, a new work plan to consider amendments to SOLAS regulation II-1 which requires the appropriate design for mooring arrangement by evaluating the risk of accident was proposed by Denmark et al. to prevent unsafe work situations during mooring operations. Further, Japan proposed to develop guideline on maintenance of mooring rope due to the fact that the accidents caused by poor maintenance of the mooring rope have also occurred at the port.

As a result of deliberation, the new work plan to consider the amendments to SOLAS regulation II-1 regarding the mooring arrangement and the development of the guideline on maintenance of mooring rope with terms of 2016 to 2017 years was approved.

A summary of the outcomes of MSC 95 is also available on the IMO website. (http://www.imo.org/MediaCentre/MeetingSummaries/MSC/Pages/Default.aspx)
ClassNK will consider amending our Rules based on the mandatory requirements which were adopted by MSC 95. The amendments to our Rules are available on our website by registration in "My page". (http://www.classnk.or.jp/hp/en/index.html)

(To be continued)

Table 1 Composition and overview of IGF Code

Ch.	Items	Summary
1	Preamble	Background of the establishment of this code
Part A		
2	General	Application, definitions and alternative design
3	Goal and functional requirements	Safety and reliability which are equivalent to oil-fuelled ships
4	General requirements	Risk assessment regarding the limitation of explosion consequences
Part A-1: Specific requirements for ships using natural gas as fuel		
5	Ship design and arrangement	Arrangement of fuel tank and engine room
6	Fuel containment system	Detailed design requirements for fuel tank
7	Material and general pipe design	Materials and general pipe design for fuel tank and fuel pipe.
8	Bunkering	Arrangement requirements of bunkering system
9	Fuel supply to consumers	Requirements of gas supply system
10	Power generation including propulsion and other gas consumers	Design requirements of engine, boiler and turbines using natural gas
11	Fire safety	Requirements of isolation distance between fuel containment system and other compartment, water spray system, fire-extinguishing system and fire detection and alarm system
12	Explosion prevention	Provisions on hazardous area zones classification
13	Ventilation	Structure, arrangement and the number of air changes of ventilation
14	Electrical installations	Requirements of explosion protection type electrical installations
15	Control, monitoring and safety systems	Liquid level monitoring for fuel tank and arrangement requirements of gas detectors
Part B-1		
16	Manufacture, workmanship and testing	Testing method for materials using fuel tank
Part C-1		
17	Drills and emergency exercises	Provision of periodic drills on board
18	Operation	Requirements of maintenance and bunkering operations
Part D-1		
19	Training	Thorough on training for crew

(To be continued)

For any questions about the above, please contact:

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Attachment:

1. IGF Code (Resolution MSC.391(95))
2. Amendments to SOLAS II-1, II-2 and Appendix (Resolution MSC.392 (95))
3. Amendments to IMSBC Code (Resolution MSC.393(95))
4. Amendments to 1978 SOLAS Protocol Appendix (Resolution MSC.394(95))
5. Amendments to 1988 SOLAS Protocol Appendix (Resolution MSC.395(95))
6. Amendments to STCW I and V (Resolution MSC.396(95))
7. Amendments to STCW Code (Resolution MSC.397(95))
8. Revised design guidelines and operational recommendations for ventilation systems in ro-ro cargo spaces (MSC.1/Circ.1515)
9. List of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective (MSC.1/Circ.1395/Rev.2)
10. Guidelines for the submission of information and completion of the format for the properties of cargoes not listed in the IMSBC Code and their conditions of carriage (MSC.1/Circ.1453/Rev.1)
11. Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy (MSC.1/Circ.1454/Rev.1)
12. IMO Resolutions and Circulars referred in the section 6. above.

ANNEX 1

RESOLUTION MSC.391(95)
(adopted on 11 June 2015)

ADOPTION OF 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 function of the Committee,

RECOGNIZING the need for a mandatory code for ships using gases or other low-flashpoint fuels,

NOTING resolution MSC.392(95), by which it adopted, inter alia, amendments to chapters II-1,II-2 and the appendix to the annex of the International Convention for the Safety of Life at Sea, 1974 ("the Convention"), to make the provisions of the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) mandatory under the Convention,

HAVING CONSIDERED, at its ninety-fifth session, the draft International Code of Safety for Ships using Gases or other Low-flashpoint Fuels,

1 ADOPTS the IGF Code, the text of which is set out in the annex to the present resolution;

2 INVITES Contracting Governments to the Convention to note that the IGF Code will take effect on 1 January 2017 upon entry into force of amendments to chapters II-1, II-2 and the appendix to the annex of the Convention;

3 INVITES ALSO Contracting Governments to consider the voluntary application of the IGF Code, as far as practicable, to cargo ships of less than 500 gross tonnage using gases or other low-flashpoint fuels;

4 RECOGNIZES that requirements for additional low-flashpoint fuels will be added to the IGF Code, as and when they are developed by the Organization;

5 REQUESTS the Secretary-General of the Organization to transmit certified copies of the present resolution and the text of the IGF Code, contained in the annex, to all Contracting Governments to the Convention;

6 REQUESTS ALSO the Secretary-General of the Organization to transmit copies of the present resolution and the text of the IGF Code contained in the annex to all Members of the Organization which are not Contracting Governments to the SOLAS Convention.

ANNEX

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

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1 PREAMBLE

The purpose of this Code is to provide an international standard for ships using low-flashpoint fuel, other than ships covered by the IGC Code.

The basic philosophy of this Code is to provide mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuel to minimize the risk to the ship, its crew and the environment, having regard to the nature of the fuels involved.

Throughout the development of this Code it was recognized that it must be based upon sound naval architectural and engineering principles and the best understanding available of current operational experience, field data and research and development. Due to the rapidly evolving new fuels technology, the Organization will periodically review this Code, taking into account both experience and technical developments.

This Code addresses all areas that need special consideration for the usage of the low-flashpoint fuel. The basic philosophy of the IGF Code considers the goal based approach (MSC.1/Circ.1394). Therefore, goals and functional requirements were specified for each section forming the basis for the design, construction and operation.

The current version of this Code includes regulations to meet the functional requirements for natural gas fuel. Regulations for other low-flashpoint fuels will be added to this Code as, and when, they are developed by the Organization.

In the meantime, for other low-flashpoint fuels, compliance with the functional requirements of this Code must be demonstrated through alternative design.

PART A

2 GENERAL

2.1 Application

Unless expressly provided otherwise this Code applies to ships to which part G of SOLAS chapter II-1 applies.

2.2 Definitions

Unless otherwise stated below, definitions are as defined in SOLAS chapter II-2.

2.2.1 *Accident* means an uncontrolled event that may entail the loss of human life, personal injuries, environmental damage or the loss of assets and financial interests.

2.2.2 *Breadth (B)* means the greatest moulded breadth of the ship at or below the deepest draught (summer load line draught) (refer to SOLAS regulation II-1/2.8).

2.2.3 *Bunkering* means the transfer of liquid or gaseous fuel from land based or floating facilities into a ships' permanent tanks or connection of portable tanks to the fuel supply system.

2.2.4 *Certified safe type* means electrical equipment that is certified safe by the relevant authorities recognized by the Administration for operation in a flammable atmosphere based on a recognized standard.[1]

2.2.5 *CNG* means compressed natural gas (see also 2.2.26).

2.2.6 *Control station* means those spaces defined in SOLAS chapter II-2 and additionally for this Code, the engine control room.

2.2.7 *Design temperature* for selection of materials is the minimum temperature at which liquefied gas fuel may be loaded or transported in the liquefied gas fuel tanks.

2.2.8 *Design vapour pressure "P_0"* is the maximum gauge pressure, at the top of the tank, to be used in the design of the tank.

2.2.9 *Double block and bleed valve* means a set of two valves in series in a pipe and a third valve enabling the pressure release from the pipe between those two valves. The arrangement may also consist of a two-way valve and a closing valve instead of three separate valves.

2.2.10 *Dual fuel engines* means engines that employ fuel covered by this Code (with pilot fuel) and oil fuel. Oil fuels may include distillate and residual fuels.

2.2.11 *Enclosed space* means any space within which, in the absence of artificial ventilation, the ventilation will be limited and any explosive atmosphere will not be dispersed naturally.[2]

2.2.12 *ESD* means emergency shutdown.

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1 Refer to IEC 60079 series, Explosive atmospheres and IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features.

2 See also definition in IEC 60092-502:1999.

2.2.13 *Explosion* means a deflagration event of uncontrolled combustion.

2.2.14 *Explosion pressure relief* means measures provided to prevent the explosion pressure in a container or an enclosed space exceeding the maximum overpressure the container or space is designed for, by releasing the overpressure through designated openings.

2.2.15 *Fuel containment system* is the arrangement for the storage of fuel including tank connections. It includes where fitted, a primary and secondary barrier, associated insulation and any intervening spaces, and adjacent structure if necessary for the support of these elements. If the secondary barrier is part of the hull structure it may be a boundary of the fuel storage hold space.

The spaces around the fuel tank are defined as follows:

.1 *Fuel storage hold space* is the space enclosed by the ship's structure in which a fuel containment system is situated. If tank connections are located in the fuel storage hold space, it will also be a tank connection space;

.2 *Interbarrier space* is the space between a primary and a secondary barrier, whether or not completely or partially occupied by insulation or other material; and

.3 *Tank connection space* is a space surrounding all tank connections and tank valves that is required for tanks with such connections in enclosed spaces.

2.2.16 *Filling limit (FL)* means the maximum liquid volume in a fuel tank relative to the total tank volume when the liquid fuel has reached the reference temperature.

2.2.17 *Fuel preparation room* means any space containing pumps, compressors and/or vaporizers for fuel preparation purposes.

2.2.18 *Gas* means a fluid having a vapour pressure exceeding 0.28 MPa absolute at a temperature of 37.8°C.

2.2.19 *Gas consumer* means any unit within the ship using gas as a fuel.

2.2.20 *Gas only engine* means an engine capable of operating only on gas, and not able to switch over to operation on any other type of fuel.

2.2.21 *Hazardous area* means an area in which an explosive gas atmosphere is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

2.2.22 *High pressure* means a maximum working pressure greater than 1.0 MPa.

2.2.23 *Independent tanks* are self-supporting, do not form part of the ship's hull and are not essential to the hull strength.

2.2.24 *LEL* means the lower explosive limit.

2.2.25 *Length (L)* is the length as defined in the International Convention on Load Lines in force.

2.2.26 *LNG* means liquefied natural gas.

2.2.27 *Loading limit (LL)* means the maximum allowable liquid volume relative to the tank volume to which the tank may be loaded.

2.2.28 *Low-flashpoint fuel* means gaseous or liquid fuel having a flashpoint lower than otherwise permitted under paragraph 2.1.1 of SOLAS regulation II-2/4.

2.2.29 *MARVS* means the maximum allowable relief valve setting.

2.2.30 *MAWP* means the maximum allowable working pressure of a system component or tank.

2.2.31 *Membrane tanks* are non-self-supporting tanks that consist of a thin liquid and gas tight layer (membrane) supported through insulation by the adjacent hull structure.

2.2.32 *Multi-fuel engines* means engines that can use two or more different fuels that are separate from each other.

2.2.33 *Non-hazardous area* means an area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment.

2.2.34 *Open deck* means a deck having no significant fire risk that at least is open on both ends/sides, or is open on one end and is provided with adequate natural ventilation that is effective over the entire length of the deck through permanent openings distributed in the side plating or deckhead.

2.2.35 *Risk i*s an expression for the combination of the likelihood and the severity of the consequences.

2.2.36 *Reference temperature* means the temperature corresponding to the vapour pressure of the fuel in a fuel tank at the set pressure of the pressure relief valves (PRVs).

2.2.37 *Secondary barrier* is the liquid-resisting outer element of a fuel containment system designed to afford temporary containment of any envisaged leakage of liquid fuel through the primary barrier and to prevent the lowering of the temperature of the ship's structure to an unsafe level.

2.2.38 *Semi-enclosed space* means a space where the natural conditions of ventilation are notably different from those on open deck due to the presence of structure such as roofs, windbreaks and bulkheads and which are so arranged that dispersion of gas may not occur.[3]

2.2.39 *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 atmosphere could be formed.

2.2.40 *Unacceptable loss of power* means that it is not possible to sustain or restore normal operation of the propulsion machinery in the event of one of the essential auxiliaries becoming inoperative, in accordance with SOLAS regulation II-1/26.3.

2.2.41 *Vapour pressure* is the equilibrium pressure of the saturated vapour above the liquid, expressed in MPa absolute at a specified temperature.

[3] Refer also to IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features.

2.3 Alternative design

2.3.1 This Code contains functional requirements for all appliances and arrangements related to the usage of low-flashpoint fuels.

2.3.2 Fuels, appliances and arrangements of low-flashpoint fuel systems may either:

.1 deviate from those set out in this Code, or

.2 be designed for use of a fuel not specifically addressed in this Code.

Such fuels, appliances and arrangements can be used provided that these meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety of the relevant chapters.

2.3.3 The equivalence of the alternative design shall be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration shall 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 this Code.

3 GOAL AND FUNCTIONAL REQUIREMENTS

3.1 Goal

The goal of this Code 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 gas or low-flashpoint fuel as fuel.

3.2 Functional requirements

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

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

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

3.2.4 Hazardous areas shall 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 shall be minimized to that required for operational purposes and shall be suitably and appropriately certified.

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

3.2.7 System components shall be protected against external damages.

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

3.2.9 It shall be arranged for safe and suitable fuel supply, storage and bunkering arrangements capable of receiving and containing the fuel in the required state without leakage. Other than when necessary for safety reasons, the system shall be designed to prevent venting under all normal operating conditions including idle periods.

3.2.10 Piping systems, containment and over-pressure relief arrangements that are of suitable design, construction and installation for their intended application shall be provided.

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

3.2.12 Fuel containment system and machinery spaces containing source that might release gas into the space shall be arranged and located such that a fire or explosion in either will not lead to an unacceptable loss of power or render equipment in other compartments inoperable.

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

3.2.14 Fixed gas detection suitable for all spaces and areas concerned shall be arranged.

3.2.15 Fire detection, protection and extinction measures appropriate to the hazards concerned shall be provided.

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

3.2.17 The technical documentation shall 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.

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

4 GENERAL REQUIREMENTS

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 to the persons on board, the environment or the ship.

4.2 Risk assessment

4.2.1 A risk assessment shall be conducted to ensure that risks arising from the use of low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed. Consideration shall be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

4.2.2 For ships to which part A-1 applies, the risk assessment required by 4.2.1 need only be conducted where explicitly required by paragraphs 5.10.5, 5.12.3, 6.4.1.1, 6.4.15.4.7.2, 8.3.1.1, 13.4.1, 13.7 and 15.8.1.10 as well as by paragraphs 4.4 and 6.8 of the annex.

4.2.3 The risks shall be analysed using acceptable and recognized risk analysis techniques, and loss of function, component damage, fire, explosion and electric shock shall as a minimum be considered. The analysis shall ensure that risks are eliminated wherever possible. Risks which cannot be eliminated shall be mitigated as necessary. Details of risks, and the means by which they are mitigated, shall be documented to the satisfaction of the Administration.

4.3 Limitation of explosion consequences

An explosion in any space containing any potential sources of release[4] and potential ignition sources shall 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 occur;

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

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

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

.6 disrupt the proper functioning of firefighting equipment located outside the explosion-damaged space;

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

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

[4] Double wall fuel pipes are not considered as potential sources of release.

PART A-1

SPECIFIC REQUIREMENTS FOR SHIPS USING NATURAL GAS AS FUEL

Fuel in the context of the regulations in this part means natural gas, either in its liquefied or gaseous state.

It should be recognized that the composition of natural gas may vary depending on the source of natural gas and the processing of the gas.

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, 3.2.6, 3.2.8, 3.2.12 to 3.2.15 and 3.2.17. In particular the following apply:

.1 the fuel tank(s) shall 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 shall be so located and arranged that released gas is lead to a safe location in the open air;

.3 the access or other openings to spaces containing fuel sources of release shall be so arranged that flammable, asphyxiating or toxic gas cannot escape to spaces that are not designed for the presence of such gases

.4 fuel piping shall be protected against mechanical damage;

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

.6 the probability of a gas explosion in a machinery space with gas or low-flashpoint fuelled machinery shall be minimized.

5.3 Regulations – General

5.3.1 Fuel storage tanks shall be protected against mechanical damage.

5.3.2 Fuel storage tanks and or equipment located on open deck shall be located to ensure sufficient natural ventilation, so as to prevent accumulation of escaped gas.

5.3.3 The fuel tank(s) shall be protected from external damage caused by collision or grounding in the following way:

.1 The fuel tanks shall be located at a minimum distance of B/5 or 11.5 m, whichever is less, measured inboard from the ship side at right angles to the centreline at the level of the summer load line draught;

where:

B is the greatest moulded breadth of the ship at or below the deepest draught (summer load line draught) (refer to SOLAS regulation II-1/2.8).

.2 The boundaries of each fuel tank shall be taken as the extreme outer longitudinal, transverse and vertical limits of the tank structure including its tank valves.

.3 For independent tanks the protective distance shall be measured to the tank shell (the primary barrier of the tank containment system). For membrane tanks the distance shall be measured to the bulkheads surrounding the tank insulation.

.4 In no case shall the boundary of the fuel tank be located closer to the shell plating or aft terminal of the ship than as follows:

.1 For passenger ships: B/10 but in no case less than 0.8 m. However, this distance need not be greater than B/15 or 2 m whichever is less where the shell plating is located inboard of B/5 or 11.5 m, whichever is less, as required by 5.3.3.1.

.2 For cargo ships:

.1 for V_c below or equal 1,000 m^3, 0.8 m;

.2 for 1,000 $m^3 < V_c <$ 5,000 m^3, $0.75 + V_c \times 0.2/4{,}000$ m;

.3 for 5,000 $m^3 \leq V_c <$ 30,000 m^3, $0.8 + V_c/25{,}000$ m; and

.4 for $V_c \geq$ 30,000 m^3, 2 m,

where:

V_c corresponds to 100% of the gross design volume of the individual fuel tank at 20°C, including domes and appendages.

.5 The lowermost boundary of the fuel tank(s) shall be located above the minimum distance of B/15 or 2.0 m, whichever is less, measured from the moulded line of the bottom shell plating at the centreline.

.6 For multihull ships the value of B may be specially considered.

.7 The fuel tank(s) shall be abaft a transverse plane at 0.08L measured from the forward perpendicular in accordance with SOLAS regulation II-1/8.1 for passenger ships, and abaft the collision bulkhead for cargo ships.

where:

L is the length as defined in the International Convention on Load Lines (refer to SOLAS regulation II-1/2.5).

.8 For ships with a hull structure providing higher collision and/or grounding resistance, fuel tank location regulations may be specially considered in accordance with section 2.3.

5.3.4 As an alternative to 5.3.3.1 above, the following calculation method may be used to determine the acceptable location of the fuel tanks:

.1 The value f_{CN} calculated as described in the following shall be less than 0.02 for passenger ships and 0.04 for cargo ships. [5]

.2 The f_{CN} is calculated by the following formulation:

$$f_{CN} = f_l \times f_t \times f_v$$

where:

f_l is calculated by use of the formulations for factor p contained in SOLAS regulation II-1/7-1.1.1.1. The value of x1 shall correspond to the distance from the aft terminal to the aftmost boundary of the fuel tank and the value of x 2 shall correspond to the distance from the aft terminal to the foremost boundary of the fuel tank.

f_t is calculated by use of the formulations for factor r contained in SOLAS regulation II-1/7-1.1.2, and reflects the probability that the damage penetrates beyond the outer boundary of the fuel tank. The formulation is:

$$f_t = 1 - r(x1, x2, b)$$ [6]

f_v is calculated by use of the formulations for factor v contained in SOLAS regulation II-1/7-2.6.1.1 and reflects the probability that the damage is not extending vertically above the lowermost boundary of the fuel tank. The formulations to be used are:

$f_v = 1.0 - 0.8 \cdot ((H-d)/7.8)$, if $(H-d)$ is less than or equal to 7.8 m. f_v shall not be taken greater than 1.

$f_v = 0.2 - 0.2 \cdot ((H-d) - 7.8)/4.7)$, in all other cases f_v shall not be taken less than 0.

where:

H is the distance from baseline, in metres, to the lowermost boundary of the fuel tank; and

d is the deepest draught (summer load line draught).

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5 The value f_{CN} accounts for collision damages that may occur within a zone limited by the longitudinal projected boundaries of the fuel tank only, and cannot be considered or used as the probability for the fuel tank to become damaged given a collision. The real probability will be higher when accounting for longer damages that include zones forward and aft of the fuel tank.

6 When the outermost boundary of the fuel tank is outside the boundary given by the deepest subdivision waterline the value of b should be taken as 0.

.3 The boundaries of each fuel tank shall be taken as the extreme outer longitudinal, transverse and vertical limits of the tank structure including its tank valves.

.4 For independent tanks the protective distance shall be measured to the tank shell (the primary barrier of the tank containment system). For membrane tanks the distance shall be measured to the bulkheads surrounding the tank insulation.

.5 In no case shall the boundary of the fuel tank be located closer to the shell plating or aft terminal of the ship than as follows:

.1 For passenger ships: B/10 but in no case less than 0.8 m. However, this distance need not be greater than B/15 or 2 m whichever is less where the shell plating is located inboard of B/5 or 11.5 m, whichever is less, as required by 5.3.3.1.

.2 For cargo ships:

.1 for V_c below or equal 1,000 m^3, 0.8 m;

.2 for 1,000 $m^3 < V_c <$ 5,000 m^3, 0.75+ V_c x 0.2/4,000 m;

.3 for 5,000 $m^3 \leq V_c <$ 30,000 m^3, 0.8 + V_c/25,000 m; and

.4 for $V_c \geq$ 30,000 m^3, 2 m,

where:

V_c corresponds to 100% of the gross design volume of the individual fuel tank at 20°C, including domes and appendages.

.6 In case of more than one non-overlapping fuel tank located in the longitudinal direction, f_{CN} shall be calculated in accordance with paragraph 5.3.4.2 for each fuel tank separately. The value used for the complete fuel tank arrangement is the sum of all values for f_{CN} obtained for each separate tank.

.7 In case the fuel tank arrangement is unsymmetrical about the centreline of the ship, the calculations of f_{CN} shall be calculated on both starboard and port side and the average value shall be used for the assessment. The minimum distance as set forth in paragraph 5.3.4.5 shall be met on both sides.

.8 For ships with a hull structure providing higher collision and/or grounding resistance, fuel tank location regulations may be specially considered in accordance with section 2.3.

5.3.5 When fuel is carried in a fuel containment system requiring a complete or partial secondary barrier:

.1 fuel storage hold spaces shall be segregated from the sea by a double bottom; and

.2 the ship shall also have a longitudinal bulkhead forming side tanks.

5.4 Machinery space concepts

5.4.1 In order to minimize the probability of a gas explosion in a machinery space with gas-fuelled machinery one of these two alternative concepts may be applied:

.1 Gas safe machinery spaces: Arrangements in machinery spaces are such that the spaces are considered gas safe under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.

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

.2 ESD-protected machinery spaces: Arrangements in machinery spaces are such that the spaces are considered non-hazardous under normal conditions, but under certain abnormal conditions may have the potential to become hazardous. In the event of abnormal conditions involving gas hazards, emergency shutdown (ESD) of non-safe equipment (ignition sources) and machinery shall be automatically executed while equipment or machinery in use or active during these conditions shall be of a certified safe type.

In an ESD protected machinery space a single failure may result in a gas release into the space. Venting is designed to accommodate a probable maximum leakage scenario due to technical failures.

Failures leading to dangerous gas concentrations, e.g. gas pipe ruptures or blow out of gaskets are covered by explosion pressure relief devices and ESD arrangements.

5.5 Regulations for gas safe machinery space

5.5.1 A single failure within the fuel system shall not lead to a gas release into the machinery space.

5.5.2 All fuel piping within machinery space boundaries shall be enclosed in a gas tight enclosure in accordance with 9.6.

5.6 Regulations for ESD-protected machinery spaces

5.6.1 ESD protection shall be limited to machinery spaces that are certified for periodically unattended operation.

5.6.2 Measures shall be applied to protect against explosion, damage of areas outside of the machinery space and ensure redundancy of power supply. The following arrangement shall be provided but may not be limited to:

.1 gas detector;

.2 shutoff valve;

.3 redundancy; and

.4 efficient ventilation.

5.6.3 Gas supply piping within machinery spaces may be accepted without a gastight external enclosure on the following conditions:

.1 Engines for generating propulsion power and electric power shall be located in two or more machinery spaces not having any common boundaries unless it can be documented that a single casualty will not affect both spaces.

.2 The gas machinery space shall contain only a minimum of such necessary equipment, components and systems as are required to ensure that the gas machinery maintains its function.

.3 A fixed gas detection system arranged to automatically shutdown the gas supply, and disconnect all electrical equipment or installations not of a certified safe type, shall be fitted.

5.6.4 Distribution of engines between the different machinery spaces shall be such that shutdown of fuel supply to any one machinery space does not lead to an unacceptable loss of power.

5.6.5 ESD protected machinery spaces separated by a single bulkhead shall have sufficient strength to withstand the effects of a local gas explosion in either space, without affecting the integrity of the adjacent space and equipment within that space.

5.6.6 ESD protected machinery spaces shall be designed to provide a geometrical shape that will minimize the accumulation of gases or formation of gas pockets.

5.6.7 The ventilation system of ESD-protected machinery spaces shall be arranged in accordance with 13.5.

5.7 Regulations for location and protection of fuel piping

5.7.1 Fuel pipes shall not be located less than 800 mm from the ship's side.

5.7.2 Fuel piping shall not be led directly through accommodation spaces, service spaces, electrical equipment rooms or control stations as defined in the SOLAS Convention.

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

5.7.4 Gas fuel piping in ESD protected machinery spaces shall be located as far as practicable from the electrical installations and tanks containing flammable liquids.

5.7.5 Gas fuel piping in ESD protected machinery spaces shall be protected against mechanical damage.

5.8 Regulations for fuel preparation room design

Fuel preparation rooms shall be located on an open deck, unless those rooms are arranged and fitted in accordance with the regulations of this Code for tank connection spaces.

5.9 Regulations for bilge systems

5.9.1 Bilge systems installed in areas where fuel covered by this Code can be present shall be segregated from the bilge system of spaces where fuel cannot be present.

5.9.2 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 shall be provided. The bilge system shall not lead to pumps in safe spaces. Means of detecting such leakage shall be provided.

5.9.3 The hold or interbarrier spaces of type A independent tanks for liquid gas shall be provided with a drainage system suitable for handling liquid fuel in the event of fuel tank leakage or rupture.

5.10 Regulations for drip trays

5.10.1 Drip trays shall be fitted where leakage may occur which can cause damage to the ship structure or where limitation of the area which is effected from a spill is necessary.

5.10.2 Drip trays shall be made of suitable material.

5.10.3 The drip tray shall 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.

5.10.4 Each tray shall be fitted with a drain valve to enable rain water to be drained over the ship's side.

5.10.5 Each tray shall have a sufficient capacity to ensure that the maximum amount of spill according to the risk assessment can be handled.

5.11 Regulations for arrangement of entrances and other openings in enclosed spaces

5.11.1 Direct access shall 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 5.12 shall be provided.

5.11.2 If the fuel preparation room is approved located below deck, the room shall, as far as practicable, have an independent access direct from the open deck. Where a separate access from deck is not practicable, an airlock which complies with 5.12 shall be provided.

5.11.3 Unless access to the tank connection space is independent and direct from open deck it shall be arranged as a bolted hatch. The space containing the bolted hatch will be a hazardous space.

5.11.4 If the access to an ESD-protected machinery space is from another enclosed space in the ship, the entrances shall be arranged with an airlock which complies with 5.12.

5.11.5 For inerted spaces access arrangements shall be such that unintended entry by personnel shall be prevented. If access to such spaces is not from an open deck, sealing arrangements shall ensure that leakages of inert gas to adjacent spaces are prevented.

5.12 Regulations for airlocks

5.12.1 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 shall not be less than 300 mm in height. The doors shall be self-closing without any holding back arrangements.

5.12.2 Airlocks shall be mechanically ventilated at an overpressure relative to the adjacent hazardous area or space.

5.12.3 The airlock shall 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 shall be evaluated in the risk analysis according to 4.2.

5.12.4 Airlocks shall have a simple geometrical form. They shall provide free and easy passage, and shall have a deck area not less than 1.5 m^2. Airlocks shall not be used for other purposes, for instance as store rooms.

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

5.12.6 For non-hazardous spaces with access from hazardous spaces below deck where the access is protected by an airlock, upon loss of underpressure in the hazardous space access to the space is to be restricted until the ventilation has been reinstated. Audible and visual alarms shall be given at a manned location to indicate both loss of pressure and opening of the airlock doors when pressure is lost.

5.12.7 Essential equipment required for safety shall not be de-energized and shall be of a certified safe type. This may include lighting, fire detection, public address, general alarms systems.

6 FUEL CONTAINMENT SYSTEM

6.1 Goal

The goal of this chapter is to provide that gas 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 and 3.2.8 to 3.2.17. In particular the following apply:

.1 the fuel containment system shall 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 shall be kept within the design limits of the containment system and possible carriage requirements of the fuel;

.3 the fuel containment arrangement shall be so designed that safety actions after any gas leakage do not lead to an unacceptable loss of power; and

.4 if portable tanks are used for fuel storage, the design of the fuel containment system shall be equivalent to permanent installed tanks as described in this chapter.

6.3 Regulations – General

6.3.1 Natural gas in a liquid state may be stored with a maximum allowable relief valve setting (MARVS) of up to 1.0 MPa.

6.3.2 The Maximum Allowable Working Pressure (MAWP) of the gas fuel tank shall not exceed 90% of the Maximum Allowable Relief Valve Setting (MARVS).

6.3.3 A fuel containment system located below deck shall be gas tight towards adjacent spaces.

6.3.4 All tank connections, fittings, flanges and tank valves must be enclosed in gas tight tank connection spaces, unless the tank connections are on open deck. The space shall be able to safely contain leakage from the tank in case of leakage from the tank connections.

6.3.5 Pipe connections to the fuel storage tank shall be mounted above the highest liquid level in the tanks, except for fuel storage tanks of type C. Connections below the highest liquid level may however also be accepted for other tank types after special consideration by the Administration.

6.3.6 Piping between the tank and the first valve which release liquid in case of pipe failure shall have equivalent safety as the type C tank, with dynamic stress not exceeding the values given in 6.4.15.3.1.2.

6.3.7 The material of the bulkheads of the tank connection space shall have a design temperature corresponding with the lowest temperature it can be subject to in a probable maximum leakage scenario. The tank connection space shall be designed to withstand the maximum pressure build up during such a leakage. Alternatively, pressure relief venting to a safe location (mast) can be provided.

6.3.8 The probable maximum leakage into the tank connection space shall be determined based on detail design, detection and shutdown systems.

6.3.9 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.

6.3.10 If liquefied gas fuel storage tanks are located on open deck the ship steel shall be protected from potential leakages from tank connections and other sources of leakage by use of drip trays. The material is to have a design temperature corresponding to the temperature of the fuel carried at atmospheric pressure. The normal operation pressure of the tanks shall be taken into consideration for protecting the steel structure of the ship.

6.3.11 Means shall be provided whereby liquefied gas in the storage tanks can be safely emptied.

6.3.12 It shall 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 shall be performed with an inert gas prior to venting with dry air to avoid an explosion hazardous atmosphere in tanks and fuel pipes. See detailed regulations in 6.10.

6.4 Regulations for liquefied gas fuel containment

6.4.1 General

6.4.1.1 The risk assessment required in 4.2 shall include evaluation of the ship's liquefied gas fuel containment system, and may lead to additional safety measures for integration into the overall vessel design.

6.4.1.2 The design life of fixed liquefied gas fuel containment system shall not be less than the design life of the ship or 20 years, whichever is greater.

6.4.1.3 The design life of portable tanks shall not be less than 20 years.

6.4.1.4 Liquefied gas fuel containment systems shall be designed in accordance with North Atlantic environmental conditions and relevant long-term sea state scatter diagrams for unrestricted navigation. Less demanding environmental conditions, consistent with the expected usage, may be accepted by the Administration for liquefied gas fuel containment systems used exclusively for restricted navigation. More demanding environmental conditions may be required for liquefied gas fuel containment systems operated in conditions more severe than the North Atlantic environment.[7,8]

6.4.1.5 Liquefied gas fuel containment systems shall be designed with suitable safety margins:

.1 to withstand, in the intact condition, the environmental conditions anticipated for the liquefied gas fuel containment system's design life and the loading conditions appropriate for them, which shall include full homogeneous and partial load conditions and partial filling to any intermediate levels; and

.2 being appropriate for uncertainties in loads, structural modelling, fatigue, corrosion, thermal effects, material variability, aging and construction tolerances.

6.4.1.6 The liquefied gas fuel containment system structural strength shall be assessed against failure modes, including but not limited to plastic deformation, buckling and fatigue. The specific design conditions that shall be considered for the design of each liquefied gas fuel containment system are given in 6.4.15. There are three main categories of design conditions:

.1 Ultimate Design Conditions – The liquefied gas fuel containment system structure and its structural components shall withstand loads liable to occur during its construction, testing and anticipated use in service, without loss of structural integrity. The design shall take into account proper combinations of the following loads:

.1 internal pressure;

.2 external pressure;

.3 dynamic loads due to the motion of the ship in all loading conditions;

.4 thermal loads;

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7 Refer to IACS Rec.034.

8 North Atlantic environmental conditions refer to wave conditions. Assumed temperatures are used for determining appropriate material qualities with respect to design temperatures and is another matter not intended to be covered in 6.4.1.4.

.5 sloshing loads;

.6 loads corresponding to ship deflections;

.7 tank and liquefied gas fuel weight with the corresponding reaction in way of supports;

.8 insulation weight;

.9 loads in way of towers and other attachments; and

.10 test loads.

.2 Fatigue Design Conditions – The liquefied gas fuel containment system structure and its structural components shall not fail under accumulated cyclic loading.

.3 Accidental Design Conditions – The liquefied gas fuel containment system shall meet each of the following accident design conditions (accidental or abnormal events), addressed in this Code:

.1 Collision – The liquefied gas fuel containment system shall withstand the collision loads specified in 6.4.9.5.1 without deformation of the supports or the tank structure in way of the supports likely to endanger the tank and its supporting structure.

.2 Fire – The liquefied gas fuel containment systems shall sustain without rupture the rise in internal pressure specified in 6.7.3.1 under the fire scenarios envisaged therein.

.3 Flooded compartment causing buoyancy on tank – the anti-flotation arrangements shall sustain the upward force, specified in 6.4.9.5.2 and there shall be no endangering plastic deformation to the hull. Plastic deformation may occur in the fuel containment system provided it does not endanger the safe evacuation of the ship.

6.4.1.7 Measures shall be applied to ensure that scantlings required meet the structural strength provisions and are maintained throughout the design life. Measures may include, but are not limited to, material selection, coatings, corrosion additions, cathodic protection and inerting.

6.4.1.8 An inspection/survey plan for the liquefied gas fuel containment system shall be developed and approved by the Administration. The inspection/survey plan shall identify aspects to be examined and/or validated during surveys throughout the liquefied gas fuel containment system's life and, in particular, any necessary in-service survey, maintenance and testing that was assumed when selecting liquefied gas fuel containment system design parameters. The inspection/survey plan may include specific critical locations as per 6.4.12.2.8 or 6.4.12.2.9.

6.4.1.9 Liquefied gas fuel containment systems shall be designed, constructed and equipped to provide adequate means of access to areas that need inspection as specified in the inspection/survey plan. Liquefied gas fuel containment systems, including all associated internal equipment shall be designed and built to ensure safety during operations, inspection and maintenance.

6.4.2 Liquefied gas fuel containment safety principles

6.4.2.1 The containment systems shall be provided with a complete secondary liquid-tight barrier capable of safely containing all potential leakages through the primary barrier and, in conjunction with the thermal insulation system, of preventing lowering of the temperature of the ship structure to an unsafe level.

6.4.2.2 The size and configuration or arrangement of the secondary barrier may be reduced or omitted where an equivalent level of safety can be demonstrated in accordance with 6.4.2.3 to 6.4.2.5 as applicable.

6.4.2.3 Liquefied gas fuel containment systems for which the probability for structural failures to develop into a critical state has been determined to be extremely low but where the possibility of leakages through the primary barrier cannot be excluded, shall be equipped with a partial secondary barrier and small leak protection system capable of safely handling and disposing of the leakages (a critical state means that the crack develops into unstable condition).

The arrangements shall comply with the following:

.1 failure developments that can be reliably detected before reaching a critical state (e.g. by gas detection or inspection) shall have a sufficiently long development time for remedial actions to be taken; and

.2 failure developments that cannot be safely detected before reaching a critical state shall have a predicted development time that is much longer than the expected lifetime of the tank.

6.4.2.4 No secondary barrier is required for liquefied gas fuel containment systems, e.g. type C independent tanks, where the probability for structural failures and leakages through the primary barrier is extremely low and can be neglected.

6.4.2.5 For independent tanks requiring full or partial secondary barrier, means for safely disposing of leakages from the tank shall be arranged.

6.4.3 Secondary barriers in relation to tank types

Secondary barriers in relation to the tank types defined in 6.4.15 shall be provided in accordance with the following table.

Basic tank type	Secondary barrier requirements
Membrane	Complete secondary barrier
Independent	
Type A	Complete secondary barrier
Type B	Partial secondary barrier
Type C	No secondary barrier required

6.4.4 Design of secondary barriers

The design of the secondary barrier, including spray shield if fitted, shall be such that:

.1 it is capable of containing any envisaged leakage of liquefied gas fuel for a period of 15 days unless different criteria apply for particular voyages, taking into account the load spectrum referred to in 6.4.12.2.6;

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

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

.4 it is capable of being periodically checked for its effectiveness by means of a visual inspection or other suitable means acceptable to the Administration;

.5 the methods required in 6.4.4.4 shall be approved by the Administration and shall include, as a minimum:

  .1 details on the size of defect acceptable and the location within the secondary barrier, before its liquid tight effectiveness is compromised;

  .2 accuracy and range of values of the proposed method for detecting defects in .1 above;

  .3 scaling factors to be used in determining the acceptance criteria if full-scale model testing is not undertaken; and

  .4 effects of thermal and mechanical cyclic loading on the effectiveness of the proposed test.

.6 the secondary barrier shall fulfil its functional requirements at a static angle of heel of 30°.

6.4.5 Partial secondary barriers and primary barrier small leak protection system

6.4.5.1 Partial secondary barriers as permitted in 6.4.2.3 shall be used with a small leak protection system and meet all the regulations in 6.4.4.

The small leak protection system shall include means to detect a leak in the primary barrier, provision such as a spray shield to deflect any liquefied gas fuel down into the partial secondary barrier, and means to dispose of the liquid, which may be by natural evaporation.

6.4.5.2 The capacity of the partial secondary barrier shall be determined, based on the liquefied gas fuel leakage corresponding to the extent of failure resulting from the load spectrum referred to in 6.4.12.2.6, after the initial detection of a primary leak. Due account may be taken of liquid evaporation, rate of leakage, pumping capacity and other relevant factors.

6.4.5.3 The required liquid leakage detection may be by means of liquid sensors, or by an effective use of pressure, temperature or gas detection systems, or any combination thereof.

6.4.5.4 For independent tanks for which the geometry does not present obvious locations for leakage to collect, the partial secondary barrier shall also fulfil its functional requirements at a nominal static angle of trim.

6.4.6 Supporting arrangements

6.4.6.1 The liquefied gas fuel tanks shall be supported by the hull in a manner that prevents bodily movement of the tank under the static and dynamic loads defined in 6.4.9.2 to 6.4.9.5, where applicable, while allowing contraction and expansion of the tank under temperature variations and hull deflections without undue stressing of the tank and the hull.

6.4.6.2 Anti-flotation arrangements shall be provided for independent tanks and capable of withstanding the loads defined in 6.4.9.5.2 without plastic deformation likely to endanger the hull structure.

6.4.6.3 Supports and supporting arrangements shall withstand the loads defined in 6.4.9.3.3.8 and 6.4.9.5, but these loads need not be combined with each other or with wave-induced loads.

6.4.7 Associated structure and equipment

6.4.7.1 Liquefied gas fuel containment systems shall be designed for the loads imposed by associated structure and equipment. This includes pump towers, liquefied gas fuel domes, liquefied gas fuel pumps and piping, stripping pumps and piping, nitrogen piping, access hatches, ladders, piping penetrations, liquid level gauges, independent level alarm gauges, spray nozzles, and instrumentation systems (such as pressure, temperature and strain gauges).

6.4.8 Thermal insulation

6.4.8.1 Thermal insulation shall be provided as required to protect the hull from temperatures below those allowable (see 6.4.13.1.1) and limit the heat flux into the tank to the levels that can be maintained by the pressure and temperature control system applied in 6.9.

6.4.9 Design loads

6.4.9.1 *General*

6.4.9.1.1 This section defines the design loads that shall be considered with regard to regulations in 6.4.10 to 6.4.12. This includes load categories (permanent, functional, environmental and accidental) and the description of the loads.

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

6.4.9.1.3 Tanks, together with their supporting structure and other fixtures, shall be designed taking into account relevant combinations of the loads described below.

6.4.9.2 *Permanent loads*

6.4.9.2.1 Gravity loads

The weight of tank, thermal insulation, loads caused by towers and other attachments shall be considered.

6.4.9.2.2 Permanent external loads

Gravity loads of structures and equipment acting externally on the tank shall be considered.

6.4.9.3 *Functional loads*

6.4.9.3.1 Loads arising from the operational use of the tank system shall be classified as functional loads.

6.4.9.3.2 All functional loads that are essential for ensuring the integrity of the tank system, during all design conditions, shall be considered.

6.4.9.3.3 As a minimum, the effects from the following criteria, as applicable, shall be considered when establishing functional loads:

(a) internal pressure

(b) external pressure

(c) thermally induced loads

(d) vibration

(e) interaction loads

(f) loads associated with construction and installation

(g) test loads

(h) static heel loads

(i) weight of liquefied gas fuel

(j) sloshing

(k) wind impact, wave impacts and green sea effect for tanks installed on open deck.

6.4.9.3.3.1 Internal pressure

.1 In all cases, including 6.4.9.3.3.1.2, P_0 shall not be less than MARVS.

.2 For liquefied gas fuel tanks where there is no temperature control and where the pressure of the liquefied gas fuel is dictated only by the ambient temperature, P_0 shall not be less than the gauge vapour pressure of the liquefied gas fuel at a temperature of 45°C except as follows:

.1 Lower values of ambient temperature may be accepted by the Administration for ships operating in restricted areas. Conversely, higher values of ambient temperature may be required.

.2 For ships on voyages of restricted duration, P_0 may be calculated based on the actual pressure rise during the voyage and account may be taken of any thermal insulation of the tank.

.3 Subject to special consideration by the Administration and to the limitations given in 6.4.15 for the various tank types, a vapour pressure P_h higher than P_0 may be accepted for site specific conditions (harbour or other locations), where dynamic loads are reduced.

.4 Pressure used for determining the internal pressure shall be:

.1 $(P_{gd})max$ is the associated liquid pressure determined using the maximum design accelerations.

.2 $(P_{gd\ site})max$ is the associated liquid pressure determined using site specific accelerations.

.3 P_{eq} should be the greater of P_{eq1} and P_{eq2}calculated as follows:

$$P_{eq1} = P_0 + (P_{gd})max \text{ (MPa)},$$

$$P_{eq2} = P_h + (P_{gd\ site})max \text{ (MPa)}.$$

.5 The internal liquid pressures are those created by the resulting acceleration of the centre of gravity of the liquefied gas fuel due to the motions of the ship referred to in 6.4.9.4.1.1. The value of internal liquid pressure P_{gd} resulting from combined effects of gravity and dynamic accelerations shall be calculated as follows:

$$P_{gd} = \alpha_\beta Z_\beta(\rho/(1.02 \times 10^5)) \text{ (MPa)}$$

where:

α_β = dimensionless acceleration (i.e. relative to the acceleration of gravity), resulting from gravitational and dynamic loads, in an arbitrary direction β; (see figure 6.4.1).

For large tanks, an acceleration ellipsoid, taking account of transverse vertical and longitudinal accelerations, should be used.

Z_β = largest liquid height (m) above the point where the pressure is to be determined measured from the tank shell in the β direction (see figure 6.4.2).

Tank domes considered to be part of the accepted total tank volume shall be taken into account when determining Z_β unless the total volume of tank domes V_d does not exceed the following value:

$$V_d = V_t\left(\frac{100 - FL}{FL}\right)$$

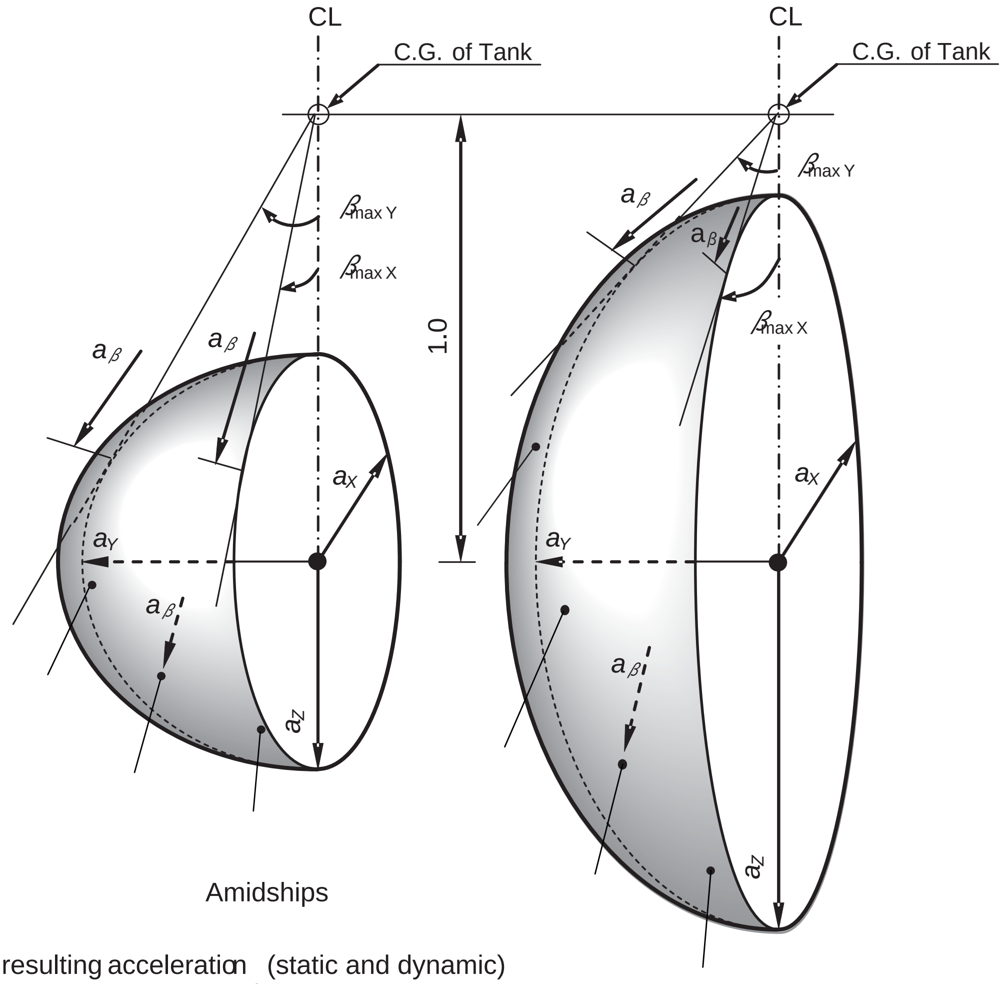
where:

V_t = tank volume without any domes; and

FL = filling limit according to 6.8.

ρ = maximum liquefied gas fuel density (kg/m^3) at the design temperature.

The direction that gives the maximum value $(P_{gd})max$ or $(P_{gd\,site})max$ shall be considered. Where acceleration components in three directions need to be considered, an ellipsoid shall be used instead of the ellipse in figure 6.4.1. The above formula applies only to full tanks.



a_β = resulting acceleration (static and dynamic) in arbitrary direction β

a_X = longitudinal component of acceleration

a_Y = transverse component of acceleration

a_Z = vertical component of acceleration (refer to 6.4.9.4.1.1)

Figure 6.4.1 – Acceleration ellipsoid

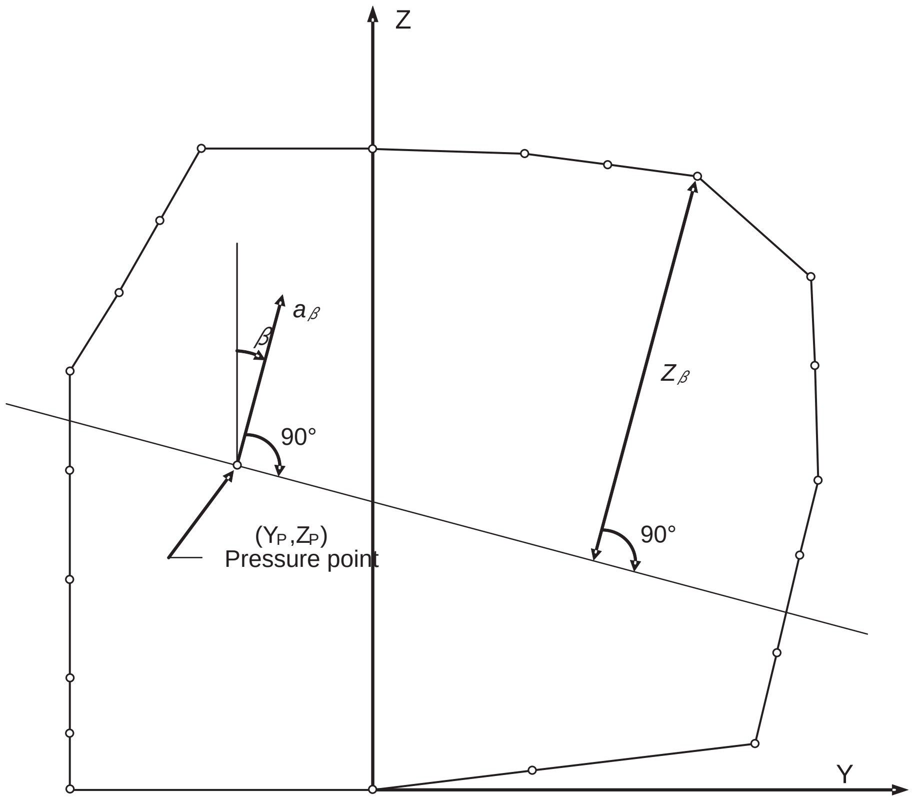


Figure 6.4.2 – Determination of internal pressure heads

6.4.9.3.3.2 External pressure

External design pressure loads shall be based on the difference between the minimum internal pressure and the maximum external pressure to which any portion of the tank may be simultaneously subjected.

6.4.9.3.3.3 Thermally induced loads

6.4.9.3.3.3.1 Transient thermally induced loads during cooling down periods shall be considered for tanks intended for liquefied gas fuel temperatures below minus 55°C.

6.4.9.3.3.3.2 Stationary thermally induced loads shall be considered for liquefied gas fuel containment systems where the design supporting arrangements or attachments and operating temperature may give rise to significant thermal stresses (see paragraph 6.9.2).

6.4.9.3.3.4 Vibration

The potentially damaging effects of vibration on the liquefied gas fuel containment system shall be considered.

6.4.9.3.3.5 Interaction loads

The static component of loads resulting from interaction between liquefied gas fuel containment system and the hull structure, as well as loads from associated structure and equipment, shall be considered.

6.4.9.3.3.6 Loads associated with construction and installation

Loads or conditions associated with construction and installation shall be considered, e.g. lifting.

6.4.9.3.3.7 Test loads

Account shall be taken of the loads corresponding to the testing of the liquefied gas fuel containment system referred to in 16.5.

6.4.9.3.3.8 Static heel loads

Loads corresponding to the most unfavourable static heel angle within the range 0° to 30°shall be considered.

6.4.9.3.3.9 Other loads

Any other loads not specifically addressed, which could have an effect on the liquefied gas fuel containment system, shall be taken into account.

6.4.9.4 Environmental loads

6.4.9.4.1 Environmental loads are defined as those loads on the liquefied gas fuel containment system that are caused by the surrounding environment and that are not otherwise classified as a permanent, functional or accidental load.

6.4.9.4.1.1 Loads due to ship motion

The determination of dynamic loads shall take into account the long-term distribution of ship motion in irregular seas, which the ship will experience during its operating life. Account may be taken of the reduction in dynamic loads due to necessary speed reduction and variation of heading. The ship's motion shall include surge, sway, heave, roll, pitch and yaw. The accelerations acting on tanks shall be estimated at their centre of gravity and include the following components:

.1 vertical acceleration: motion accelerations of heave, pitch and, possibly roll (normal to the ship base);

.2 transverse acceleration: motion accelerations of sway, yaw and roll and gravity component of roll; and

.3 longitudinal acceleration: motion accelerations of surge and pitch and gravity component of pitch.

Methods to predict accelerations due to ship motion shall be proposed and approved by the Administration[9].

Ships for restricted service may be given special consideration.

[9] Refer to section 4.28.2.1 of the IGC Code for guidance formulae for acceleration components.

6.4.9.4.1.2 Dynamic interaction loads

Account shall be taken of the dynamic component of loads resulting from interaction between liquefied gas fuel containment systems and the hull structure, including loads from associated structures and equipment.

6.4.9.4.1.3 Sloshing loads

The sloshing loads on a liquefied gas fuel containment system and internal components shall be evaluated for the full range of intended filling levels.

6.4.9.4.1.4 Snow and ice loads

Snow and icing shall be considered, if relevant.

6.4.9.4.1.5 Loads due to navigation in ice

Loads due to navigation in ice shall be considered for ships intended for such service.

6.4.9.4.1.6 Green sea loading

Account shall be taken to loads due to water on deck.

6.4.9.4.1.7 Wind loads

Account shall be taken to wind generated loads as relevant.

6.4.9.5 Accidental loads

Accidental loads are defined as loads that are imposed on a liquefied gas fuel containment system and it's supporting arrangements under abnormal and unplanned conditions.

6.4.9.5.1 Collision load

The collision load shall be determined based on the fuel containment system under fully loaded condition with an inertial force corresponding to "a" in the table below in forward direction and "a/2" in the aft direction, where "g" is gravitational acceleration.

Ship length (L)	Design acceleration (a)
L > 100 m	0,5 g
60 < L ≤ 100 m	$\left(2-\frac{3(L-60)}{80}\right)g$
L ≤ 60 m	2g

Special consideration should be given to ships with Froude number (Fn) > 0,4.

6.4.9.5.2 Loads due to flooding on ship

For independent tanks, loads caused by the buoyancy of a fully submerged empty tank shall be considered in the design of anti-flotation chocks and the supporting structure in both the adjacent hull and tank structure.

6.4.10 Structural integrity

6.4.10.1 General

6.4.10.1.1 The structural design shall ensure that tanks have an adequate capacity to sustain all relevant loads with an adequate margin of safety. This shall take into account the possibility of plastic deformation, buckling, fatigue and loss of liquid and gas tightness.

6.4.10.1.2 The structural integrity of liquefied gas fuel containment systems can be demonstrated by compliance with 6.4.15, as appropriate for the liquefied gas fuel containment system type.

6.4.10.1.3 For other liquefied gas fuel containment system types, that are of novel design or differ significantly from those covered by 6.4.15, the structural integrity shall be demonstrated by compliance with 6.4.16.

6.4.11 Structural analysis

6.4.11.1 *Analysis*

6.4.11.1.1 The design analyses shall be based on accepted principles of statics, dynamics and strength of materials.

6.4.11.1.2 Simplified methods or simplified analyses may be used to calculate the load effects, provided that they are conservative. Model tests may be used in combination with, or instead of, theoretical calculations. In cases where theoretical methods are inadequate, model or full-scale tests may be required.

6.4.11.1.3 When determining responses to dynamic loads, the dynamic effect shall be taken into account where it may affect structural integrity.

6.4.11.2 *Load scenarios*

6.4.11.2.1 For each location or part of the liquefied gas fuel containment system to be considered and for each possible mode of failure to be analysed, all relevant combinations of loads that may act simultaneously shall be considered.

6.4.11.2.2 The most unfavourable scenarios for all relevant phases during construction, handling, testing and in service conditions shall be considered.

6.4.11.2.3 When the static and dynamic stresses are calculated separately and unless other methods of calculation are justified, the total stresses shall be calculated according to:

$$\sigma_x = \sigma_{x.st} \pm \sqrt{\sum (\sigma_{x.dyn})^2}$$

$$\sigma_y = \sigma_{y.st} \pm \sqrt{\sum (\sigma_{y.dyn})^2}$$

$$\sigma_z = \sigma_{z.st} \pm \sqrt{\sum (\sigma_{z.dyn})^2}$$

$$\tau_{xy} = \tau_{xy.st} \pm \sqrt{\sum (\tau_{xy.dyn})^2}$$

$$\tau_{xz} = \tau_{xz.st} \pm \sqrt{\sum (\tau_{xz.dyn})^2}$$

$$\tau_{yz} = \tau_{yz.st} \pm \sqrt{\sum (\tau_{yz.dyn})^2}$$

where:

$\sigma_{x.st}$, $\sigma_{y.st}$, $\sigma_{z.st}$, $\tau_{xy.st}$, $\tau_{xz.st}$ and $\tau_{yz.st}$ are static stresses; and

$\sigma_{x.dyn}$, $\sigma_{y.dyn}$, $\sigma_{z.dyn}$, $\tau_{xy.dyn}$, $\tau_{xz.dyn}$ and $\tau_{yz.dyn}$ are dynamic stresses,

each shall be determined separately from acceleration components and hull strain components due to deflection and torsion.

6.4.12 Design conditions

All relevant failure modes shall be considered in the design for all relevant load scenarios and design conditions. The design conditions are given in the earlier part of this chapter, and the load scenarios are covered by 6.4.11.2.

6.4.12.1 *Ultimate design condition*

6.4.12.1.1 Structural capacity may be determined by testing, or by analysis, taking into account both the elastic and plastic material properties, by simplified linear elastic analysis or by the provisions of this Code:

.1 Plastic deformation and buckling shall be considered.

.2 Analysis shall be based on characteristic load values as follows:

Permanent loads	Expected values
Functional loads	Specified values
Environmental loads	For wave loads: most probable largest load encountered during 10^8 wave encounters.

.3 For the purpose of ultimate strength assessment the following material parameters apply:

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

.2 R_m = specified minimum tensile strength at room temperature (N/mm^2).

For welded connections where under-matched welds, i.e. where the weld metal has lower tensile strength than the parent metal, are unavoidable, such as in some aluminium alloys, the respective R_e and R_m of the welds, after any applied heat treatment, shall be used. In such cases the transverse weld tensile strength shall not be less than the actual yield strength of the parent metal. If this cannot be achieved, welded structures made from such materials shall not be incorporated in liquefied gas fuel containment systems.

The above properties shall correspond to the minimum specified mechanical properties of the material, including the weld metal in the as fabricated condition. Subject to special consideration by the Administration, account may be taken of the enhanced yield stress and tensile strength at low temperature.

.4 The equivalent stress σ_c (von Mises, Huber) shall be determined by:

$$\sigma_c = \sqrt{\sigma_x^2 + \sigma_y^2 + \sigma_z^2 - \sigma_x\sigma_y - \sigma_x\sigma_z - \sigma_y\sigma_z + 3(\tau_{xy}^2 + \tau_{xz}^2 + \tau_{yz}^2)}$$

where:

σ_x = total normal stress in x-direction;
σ_y = total normal stress in y-direction;
σ_z = total normal stress in z-direction;
τ_{xy} = total shear stress in x-y plane;
τ_{xz} = total shear stress in x-z plane; and
τ_{yz} = total shear stress in y-z plane.

The above values shall be calculated as described in 6.4.11.2.3.

.5 Allowable stresses for materials other than those covered by 7.4 shall be subject to approval by the Administration in each case.

.6 Stresses may be further limited by fatigue analysis, crack propagation analysis and buckling criteria.

6.4.12.2 *Fatigue Design Condition*

.1 The fatigue design condition is the design condition with respect to accumulated cyclic loading.

.2 Where a fatigue analysis is required the cumulative effect of the fatigue load shall comply with:

$$\sum \frac{n_i}{N_i} + \frac{n_{Loading}}{N_{Loading}} \leq C_w$$

where:

n_i = number of stress cycles at each stress level during the life of the tank;

N_i = *number of cycles to fracture for the respective stress level according to the Wohler (S-N) curve;*

$n_{Loading}$ = number of loading and unloading cycles during the life of the tank not to be less than 1000. Loading and unloading cycles include a complete pressure and thermal cycle;

$N_{Loading}$ = number of cycles to fracture for the fatigue loads due to loading and unloading; and

C_w = maximum allowable cumulative fatigue damage ratio.

The fatigue damage shall be based on the design life of the tank but not less than 10^8 wave encounters.

.3 Where required, the liquefied gas fuel containment system shall be subject to fatigue analysis, considering all fatigue loads and their appropriate combinations for the expected life of the liquefied gas fuel containment system. Consideration shall be given to various filling conditions.

.4 Design S-N curves used in the analysis shall be applicable to the materials and weldments, construction details, fabrication procedures and applicable state of the stress envisioned.

The S-N curves shall be based on a 97.6% probability of survival corresponding to the mean-minus-two-standard-deviation curves of relevant experimental data up to final failure. Use of S-N curves derived in a different way requires adjustments to the acceptable Cw values specified in 6.4.12.2.7 to 6.4.12.2.9.

.5 Analysis shall be based on characteristic load values as follows:

Permanent loads	Expected values
Functional loads	Specified values or specified history
Environmental loads	Expected load history, but not less than 10^8 cycles

If simplified dynamic loading spectra are used for the estimation of the fatigue life, those shall be specially considered by the Administration.

.6 Where the size of the secondary barrier is reduced, as is provided for in 6.4.2.3, fracture mechanics analyses of fatigue crack growth shall be carried out to determine:

.1 crack propagation paths in the structure, where necessitated by 6.4.12.2.7 to 6.4.12.2.9, as applicable;

.2 crack growth rate;

.3 the time required for a crack to propagate to cause a leakage from the tank;

.4 the size and shape of through thickness cracks; and

.5 the time required for detectable cracks to reach a critical state after penetration through the thickness.

The fracture mechanics are in general based on crack growth data taken as a mean value plus two standard deviations of the test data. Methods for fatigue crack growth analysis and fracture mechanics shall be based on recognized standards.

In analysing crack propagation the largest initial crack not detectable by the inspection method applied shall be assumed, taking into account the allowable non-destructive testing and visual inspection criterion as applicable.

Crack propagation analysis specified in 6.4.12.2.7 the simplified load distribution and sequence over a period of 15 days may be used. Such distributions may be obtained as indicated in figure 6.4.3. Load distribution and sequence for longer periods, such as in 6.4.12.2.8 and 6.4.12.2.9 shall be approved by the Administration.

The arrangements shall comply with 6.4.12.2.7 to 6.4.12.2.9 as applicable.

.7 For failures that can be reliably detected by means of leakage detection:

C_w shall be less than or equal to 0.5.

Predicted remaining failure development time, from the point of detection of leakage till reaching a critical state, shall not be less than 15 days unless different regulations apply for ships engaged in particular voyages.

.8 For failures that cannot be detected by leakage but that can be reliably detected at the time of in-service inspections:

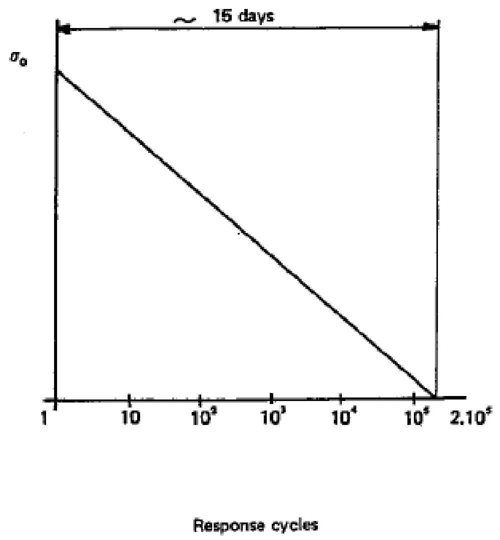
C_w shall be less than or equal to 0.5.

Predicted remaining failure development time, from the largest crack not detectable by in-service inspection methods until reaching a critical state, shall not be less than three (3) times the inspection interval.

.9 In particular locations of the tank where effective defect or crack development detection cannot be assured, the following, more stringent, fatigue acceptance criteria shall be applied as a minimum:

C_w shall be less than or equal to 0.1.

Predicted failure development time, from the assumed initial defect until reaching a critical state, shall not be less than three (3) times the lifetime of the tank.



σ_o = most probable maximum stress over the life of the ship

Response cycle scale is logarithmic; the value of 2.10^5 is given as an example of estimate.

Figure 6.4.3 – Simplified load distribution

6.4.12.3 *Accidental design condition*

6.4.12.3.1 The accidental design condition is a design condition for accidental loads with extremely low probability of occurrence.

6.4.12.3.2 Analysis shall be based on the characteristic values as follows:

Permanent loads	Expected values
Functional loads	Specified values
Environmental loads	Specified values
Accidental loads	Specified values or expected values

Loads mentioned in 6.4.9.3.3.8 and 6.4.9.5 need not be combined with each other or with wave-induced loads.

6.4.13 Materials and construction

6.4.13.1 Materials

6.4.13.1.1 Materials forming ship structure

6.4.13.1.1.1 To determine the grade of plate and sections used in the hull structure, a temperature calculation shall be performed for all tank types. The following assumptions shall be made in this calculation:

.1 The primary barrier of all tanks shall be assumed to be at the liquefied gas fuel temperature.

.2 In addition to .1 above, where a complete or partial secondary barrier is required it shall be assumed to be at the liquefied gas fuel temperature at atmospheric pressure for any one tank only.

.3 For worldwide service, ambient temperatures shall be taken as 5°C for air and 0°C for seawater. Higher values may be accepted for ships operating in restricted areas and conversely, lower values may be imposed by the Administration for ships trading to areas where lower temperatures are expected during the winter months.

.4 Still air and sea water conditions shall be assumed, i.e. no adjustment for forced convection.

.5 Degradation of the thermal insulation properties over the life of the ship due to factors such as thermal and mechanical ageing, compaction, ship motions and tank vibrations as defined in 6.4.13.3.6 and 6.4.13.3.7 shall be assumed.

.6 The cooling effect of the rising boil-off vapour from the leaked liquefied gas fuel shall be taken into account where applicable.

.7 Credit for hull heating may be taken in accordance with 6.4.13.1.1.3, provided the heating arrangements are in compliance with 6.4.13.1.1.4.

.8 No credit shall be given for any means of heating, except as described in 6.4.13.1.1.3.

.9 For members connecting inner and outer hulls, the mean temperature may be taken for determining the steel grade.

6.4.13.1.1.2 The materials of all hull structures for which the calculated temperature in the design condition is below 0°C, due to the influence of liquefied gas fuel temperature, shall be in accordance with table 7.5. This includes hull structure supporting the liquefied gas fuel tanks, inner bottom plating, longitudinal bulkhead plating, transverse bulkhead plating, floors, webs, stringers and all attached stiffening members.

6.4.13.1.1.3 Means of heating structural materials may be used to ensure that the material temperature does not fall below the minimum allowed for the grade of material specified in table 7.5. In the calculations required in 6.4.13.1.1.1, credit for such heating may be taken in accordance with the following principles:

.1 for any transverse hull structure;

.2 for longitudinal hull structure referred to in 6.4.13.1.1.2 where colder ambient temperatures are specified, provided the material remains suitable for the ambient temperature conditions of plus 5°C for air and 0°C for seawater with no credit taken in the calculations for heating; and

.3 as an alternative to 6.4.13.1.1.3.2, for longitudinal bulkhead between liquefied gas fuel tanks, credit may be taken for heating provided the material remain suitable for a minimum design temperature of minus 30°C, or a temperature 30°C lower than that determined by 6.4.13.1.1.1 with the heating considered, whichever is less. In this case, the ship's longitudinal strength shall comply with SOLAS regulation II-1/3-1 for both when those bulkhead(s) are considered effective and not.

6.4.13.1.1.4 The means of heating referred to in 6.4.13.1.1.3 shall comply with the following:

.1 the heating system shall be arranged so that, in the event of failure in any part of the system, standby heating can be maintained equal to no less than 100% of the theoretical heat requirement;

.2 the heating system shall be considered as an essential auxiliary. All electrical components of at least one of the systems provided in accordance with 6.4.13.1.1.3.1 shall be supplied from the emergency source of electrical power; and

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

6.4.13.2 Materials of primary and secondary barriers

6.4.13.2.1 Metallic materials used in the construction of primary and secondary barriers not forming the hull, shall be suitable for the design loads that they may be subjected to, and be in accordance with table 7.1, 7.2 or 7.3.

6.4.13.2.2 Materials, either non-metallic or metallic but not covered by tables 7.1, 7.2 and 7.3, used in the primary and secondary barriers may be approved by the Administration considering the design loads that they may be subjected to, their properties and their intended use.

6.4.13.2.3 Where non-metallic materials,[10] including composites, are used for or incorporated in the primary or secondary barriers, they shall be tested for the following properties, as applicable, to ensure that they are adequate for the intended service:

.1 compatibility with the liquefied gas fuels;

.2 ageing;

.3 mechanical properties;

.4 thermal expansion and contraction;

.5 abrasion;

.6 cohesion;

.7 resistance to vibrations;

.8 resistance to fire and flame spread; and

.9 resistance to fatigue failure and crack propagation.

6.4.13.2.4 The above properties, where applicable, shall be tested for the range between the expected maximum temperature in service and 5°C below the minimum design temperature, but not lower than minus196°C.

6.4.13.2.5 Where non-metallic materials, including composites, are used for the primary and secondary barriers, the joining processes shall also be tested as described above.

6.4.13.2.6 Consideration may be given to the use of materials in the primary and secondary barrier, which are not resistant to fire and flame spread, provided they are protected by a suitable system such as a permanent inert gas environment, or are provided with a fire retardant barrier.

6.4.13.3 Thermal insulation and other materials used in liquefied gas fuel containment systems

6.4.13.3.1 Load-bearing thermal insulation and other materials used in liquefied gas fuel containment systems shall be suitable for the design loads.

6.4.13.3.2 Thermal insulation and other materials used in liquefied gas fuel containment systems shall have the following properties, as applicable, to ensure that they are adequate for the intended service:

.1 compatibility with the liquefied gas fuels;

.2 solubility in the liquefied gas fuel;

.3 absorption of the liquefied gas fuel;

.4 shrinkage;

.5 ageing;

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10 Refer to section 6.4.16.

.6 closed cell content;

.7 density;

.8 mechanical properties, to the extent that they are subjected to liquefied gas fuel and other loading effects, thermal expansion and contraction;

.9 abrasion;

.10 cohesion;

.11 thermal conductivity;

.12 resistance to vibrations;

.13 resistance to fire and flame spread; and

.14 resistance to fatigue failure and crack propagation.

6.4.13.3.3 The above properties, where applicable, shall be tested for the range between the expected maximum temperature in service and 5°C below the minimum design temperature, but not lower than minus 196°C.

6.4.13.3.4 Due to location or environmental conditions, thermal 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. Where the thermal insulation is located on or above the exposed deck, and in way of tank cover penetrations, it shall have suitable fire resistance properties in accordance with a recognized standard or be covered with a material having low flame spread characteristics and forming an efficient approved vapour seal.

6.4.13.3.5 Thermal insulation that does not meet recognized standards for fire resistance may be used in fuel storage hold spaces that are not kept permanently inerted, provided its surfaces are covered with material with low flame spread characteristics and that forms an efficient approved vapour seal.

6.4.13.3.6 Testing for thermal conductivity of thermal insulation shall be carried out on suitably aged samples.

6.4.13.3.7 Where powder or granulated thermal insulation is used, measures shall be taken to reduce compaction in service and to maintain the required thermal conductivity and also prevent any undue increase of pressure on the liquefied gas fuel containment system.

6.4.14 Construction processes

6.4.14.1 Weld joint design

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

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

.1 All longitudinal and circumferential joints shall be of butt welded, full penetration, double vee or single vee type. Full penetration butt welds shall be obtained by double welding or by the use of backing rings. If used, backing rings shall be removed except from very small process pressure vessels.[11] Other edge preparations may be permitted, depending on the results of the tests carried out at the approval of the welding procedure. For connections of tank shell to a longitudinal bulkhead of type C bilobe tanks, tee welds of the full penetration type may be accepted.

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

6.4.14.2 Design for gluing and other joining processes

6.4.14.2.1 The design of the joint to be glued (or joined by some other process except welding) shall take account of the strength characteristics of the joining process.

6.4.15 Tank types

6.4.15.1 Type A independent tanks

6.4.15.1.1 Design basis

6.4.15.1.1.1 Type A independent tanks are tanks primarily designed using classical ship-structural analysis procedures in accordance with the requirements of the Administration. Where such tanks are primarily constructed of plane surfaces, the design vapour pressure P_0 shall be less than 0.07 MPa.

6.4.15.1.1.2 A complete secondary barrier is required as defined in 6.4.3. The secondary barrier shall be designed in accordance with 6.4.4.

6.4.15.1.2 Structural analysis

6.4.15.1.2.1 A structural analysis shall be performed taking into account the internal pressure as indicated in 6.4.9.3.3.1, and the interaction loads with the supporting and keying system as well as a reasonable part of the ship's hull.

6.4.15.1.2.2 For parts, such as structure in way of supports, not otherwise covered by the regulations in this Code, stresses shall be determined by direct calculations, taking into account the loads referred to in 6.4.9.2 to 6.4.9.5 as far as applicable, and the ship deflection in way of supports.

6.4.15.1.2.3 The tanks with supports shall be designed for the accidental loads specified in 6.4.9.5. These loads need not be combined with each other or with environmental loads.

[11] For vacuum insulated tanks without manhole, the longitudinal and circumferential joints should meet the aforementioned requirements, except for the erection weld joint of the outer shell, which may be a one-side welding with backing rings.

6.4.15.1.3 Ultimate design condition

6.4.15.1.3.1 For tanks primarily constructed of plane surfaces, the nominal membrane stresses for primary and secondary members (stiffeners, web frames, stringers, girders), when calculated by classical analysis procedures, shall not exceed the lower of $R_m/2.66$ or $R_e/1.33$ for nickel steels, carbon-manganese steels, austenitic steels and aluminium alloys, where R_m and R_e are defined in 6.4.12.1.1.3. However, if detailed calculations are carried out for the primary members, the equivalent stress σ_c, as defined in 6.4.12.1.1.4, may be increased over that indicated above to a stress acceptable to the Administration. Calculations shall take into account the effects of bending, shear, axial and torsional deformation as well as the hull/liquefied gas fuel tank interaction forces due to the deflection of the hull structure and liquefied gas fuel tank bottoms.

6.4.15.1.3.2 Tank boundary scantlings shall meet at least the requirements of the Administration for deep tanks taking into account the internal pressure as indicated in 6.4.9.3.3.1 and any corrosion allowance required by 6.4.1.7.

6.4.15.1.3.3 The liquefied gas fuel tank structure shall be reviewed against potential buckling.

6.4.15.1.4 Accidental design condition

6.4.15.1.4.1 The tanks and the tank supports shall be designed for the accidental loads and design conditions specified in 6.4.9.5 and 6.4.1.6.3 as relevant.

6.4.15.1.4.2 When subjected to the accidental loads specified in 6.4.9.5, the stress shall comply with the acceptance criteria specified in 6.4.15.1.3, modified as appropriate taking into account their lower probability of occurrence.

6.4.15.2 Type B independent tanks

6.4.15.2.1 Design basis

6.4.15.2.1.1 Type B independent tanks are tanks designed using model tests, refined analytical tools and analysis methods to determine stress levels, fatigue life and crack propagation characteristics. Where such tanks are primarily constructed of plane surfaces (prismatic tanks) the design vapour pressure P_0 shall be less than 0.07 MPa.

6.4.15.2.1.2 A partial secondary barrier with a protection system is required as defined in 6.4.3. The small leak protection system shall be designed according to 6.4.5.

6.4.15.2.2 Structural analysis

6.4.15.2.2.1 The effects of all dynamic and static loads shall be used to determine the suitability of the structure with respect to:

.1 plastic deformation;

.2 buckling;

.3 fatigue failure; and

.4 crack propagation.

Finite element analysis or similar methods and fracture mechanics analysis or an equivalent approach, shall be carried out.

6.4.15.2.2.2 A three-dimensional analysis shall be carried out to evaluate the stress levels, including interaction with the ship's hull. The model for this analysis shall include the liquefied gas fuel tank with its supporting and keying system, as well as a reasonable part of the hull.

6.4.15.2.2.3 A complete analysis of the particular ship accelerations and motions in irregular waves, and of the response of the ship and its liquefied gas fuel tanks to these forces and motions, shall be performed unless the data is available from similar ships.

6.4.15.2.3 Ultimate design condition

6.4.15.2.3.1 Plastic deformation

For type B independent tanks, primarily constructed of bodies of revolution, the allowable stresses shall not exceed:

$\sigma_m \leq f$
$\sigma_L \leq 1.5f$
$\sigma_b \leq 1.5F$
$\sigma_L+\sigma_b \leq 1.5F$
$\sigma_m+\sigma_b \leq 1.5F$
$\sigma_m+\sigma_b+\sigma_g \leq 3.0F$
$\sigma_L+\sigma_b+\sigma_g \leq 3.0F$

where:

σ_m = equivalent primary general membrane stress;

σ_L = equivalent primary local membrane stress;

σ_b = equivalent primary bending stress;

σ_g = equivalent secondary stress;

f = the lesser of (R_m / A) or (R_e / B); and

F = the lesser of (R_m / C) or (R_e / D),

with R_m and R_e as defined in 6.4.12.1.1.3. With regard to the stresses σ_m, σ_L, σ_g and σ_b see also the definition of stress categories in 6.4.15.2.3.6.

The values A and B shall have at least the following minimum values:

	Nickel steels and carbon manganese steels	Austenitic steel	Aluminium alloys
A	3	3.5	4
B	2	1.6	1.5
C	3	3	3
D	1.5	1.5	1.5

The above figures may be altered considering the design condition considered in acceptance with the Administration. For type B independent tanks, primarily constructed of plane surfaces, the allowable membrane equivalent stresses applied for finite element analysis shall not exceed:

.1 for nickel steels and carbon-manganese steels, the lesser of R_m/2 or R_e/1.2;

.2 for austenitic steels, the lesser of R_m /2.5 or R_e /1.2; and

.3 for aluminium alloys, the lesser of R_m /2.5 or R^e /1.2.

The above figures may be amended considering the locality of the stress, stress analysis methods and design condition considered in acceptance with the Administration.

The thickness of the skin plate and the size of the stiffener shall not be less than those required for type A independent tanks.

6.4.15.2.3.2 Buckling

Buckling strength analyses of liquefied gas fuel tanks subject to external pressure and other loads causing compressive stresses shall be carried out in accordance with recognized standards. The method shall adequately account for the difference in theoretical and actual buckling stress as a result of plate edge misalignment, lack of straightness or flatness, ovality and deviation from true circular form over a specified arc or chord length, as applicable.

6.4.15.2.3.3 Fatigue design condition

6.4.15.2.3.3.1 Fatigue and crack propagation assessment shall be performed in accordance with the provisions of 6.4.12.2. The acceptance criteria shall comply with 6.4.12.2.7, 6.4.12.2.8 or 6.4.12.2.9, depending on the detectability of the defect.

6.4.15.2.3.3.2 Fatigue analysis shall consider construction tolerances.

6.4.15.2.3.3.3 Where deemed necessary by the Administration, model tests may be required to determine stress concentration factors and fatigue life of structural elements.

6.4.15.2.3.4 Accidental design condition

6.4.15.2.3.4.1 The tanks and the tank supports shall be designed for the accidental loads and design conditions specified in 6.4.9.5 and 6.4.1.6.3, as relevant.

6.4.15.2.3.4.2 When subjected to the accidental loads specified in 6.4.9.5, the stress shall comply with the acceptance criteria specified in 6.4.15.2.3, modified as appropriate, taking into account their lower probability of occurrence.

6.4.15.2.3.5 Marking

Any marking of the pressure vessel shall be achieved by a method that does not cause unacceptable local stress raisers.

6.4.15.2.3.6 Stress categories

For the purpose of stress evaluation, stress categories are defined in this section as follows:

.1 *Normal stress* is the component of stress normal to the plane of reference.

.2 *Membrane stress* is the component of normal stress that is uniformly distributed and equal to the average value of the stress across the thickness of the section under consideration.

.3 *Bending stress* is the variable stress across the thickness of the section under consideration, after the subtraction of the membrane stress.

.4 *Shear stress* is the component of the stress acting in the plane of reference.

.5 *Primary stress* is a stress produced by the imposed loading, which is necessary to balance the external forces and moments. The basic characteristic of a primary stress is that it is not self-limiting. Primary stresses that considerably exceed the yield strength will result in failure or at least in gross deformations.

.6 *Primary general membrane stress* is a primary membrane stress that is so distributed in the structure that no redistribution of load occurs as a result of yielding.

.7 *Primary local membrane stress* arises where a membrane stress produced by pressure or other mechanical loading and associated with a primary or a discontinuity effect produces excessive distortion in the transfer of loads for other portions of the structure. Such a stress is classified as a primary local membrane stress, although it has some characteristics of a secondary stress. A stress region may be considered as local, if:

$S_1 \leq 0.5\sqrt{Rt}$; and

$S_1 \geq 2.5\sqrt{Rt}$

where:

S_1 = distance in the meridional direction over which the equivalent stress exceeds $1.1f$;

S_2 = distance in the meridional direction to another region where the limits for primary general membrane stress are exceeded;

R = mean radius of the vessel;

t = wall thickness of the vessel at the location where the primary general membrane stress limit is exceeded; and

f = allowable primary general membrane stress.

.8 *Secondary stress* is a normal stress or shear stress developed by constraints of adjacent parts or by self-constraint of a structure. The basic characteristic of a secondary stress is that it is self-limiting. Local yielding and minor distortions can satisfy the conditions that cause the stress to occur.

6.4.15.3 Type C independent tanks

6.4.15.3.1 Design basis

6.4.15.3.1.1 The design basis for type C independent tanks is based on pressure vessel criteria modified to include fracture mechanics and crack propagation criteria. The minimum design pressure defined in 6.4.15.3.1.2 is intended to ensure that the dynamic stress is sufficiently low so that an initial surface flaw will not propagate more than half the thickness of the shell during the lifetime of the tank.

6.4.15.3.1.2 The design vapour pressure shall not be less than:

$$P_0 = 0.2 + AC(\rho_r)^{1.5} \text{ (MPa)}$$

where:

$$A = 0.00185\left(\frac{\sigma_m}{\Delta\sigma_A}\right)^2$$

with:

σ_m = design primary membrane stress;

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

- 55 N/mm^2 for ferritic-perlitic, martensitic and austenitic steel;
- 25 N/mm^2 for aluminium alloy (5083-O);

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

h, 0.75*b* or 0.45*ℓ*,

with:

h = height of tank (dimension in ship's vertical direction) (m);

b = width of tank (dimension in ship's transverse direction) (m);

ℓ = length of tank (dimension in ship's longitudinal direction) (m);

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

6.4.15.3.2 Shell thickness

6.4.15.3.2.1 In considering the shell thickness the following apply:

.1 for pressure vessels, the thickness calculated according to 6.4.15.3.2.4 shall be considered as a minimum thickness after forming, without any negative tolerance;

.2 for pressure vessels, the minimum thickness of shell and heads including corrosion allowance, after forming, shall not be less than 5 mm for carbon manganese steels and nickel steels, 3 mm for austenitic steels or 7 mm for aluminium alloys; and

.3 the welded joint efficiency factor to be used in the calculation according to 6.4.15.3.2.4 shall be 0.95 when the inspection and the non-destructive testing referred to in 16.3.6.4 are carried out. This figure may be increased up to 1.0 when account is taken of other considerations, such as the material used, type of joints, welding procedure and type of loading. For process pressure vessels the Administration may accept partial non-destructive examinations, but not less than those of 16.3.6.4, depending on such factors as the material used, the design temperature, the nil ductility transition temperature of the material as fabricated and the type of joint and welding procedure, but in this case an efficiency factor of not more than 0.85 shall be adopted. For special materials the above-mentioned factors shall be reduced, depending on the specified mechanical properties of the welded joint.

6.4.15.3.2.2 The design liquid pressure defined in 6.4.9.3.3.1 shall be taken into account in the internal pressure calculations.

6.4.15.3.2.3 The design external pressure P_e, used for verifying the buckling of the pressure vessels, shall not be less than that given by:

$$P_e = P_1+P_2+P_3+P_4 \quad \text{(MPa)}$$

where:

P_1 = setting value of vacuum relief valves. For vessels not fitted with vacuum relief valves P_1 shall be specially considered, but shall not in general be taken as less than 0.025 MPa.

P_2 = the set pressure of the pressure relief valves (PRVs) for completely closed spaces containing pressure vessels or parts of pressure vessels; elsewhere $P_2 = 0$.

P_3 = compressive actions in or on the shell due to the weight and contraction of thermal insulation, weight of shell including corrosion allowance and other miscellaneous external pressure loads to which the pressure vessel may be subjected. These include, but are not limited to, weight of domes, weight of towers and piping, effect of product in the partially filled condition, accelerations and hull deflection. In addition, the local effect of external or internal pressures or both shall be taken into account.

P_4 = external pressure due to head of water for pressure vessels or part of pressure vessels on exposed decks; elsewhere $P_4 = 0$.

6.4.15.3.2.4 Scantlings based on internal pressure shall be calculated as follows:

The thickness and form of pressure-containing parts of pressure vessels, under internal pressure, as defined in 6.4.9.3.3.1, including flanges, shall be determined. These calculations shall in all cases be based on accepted pressure vessel design theory. Openings in pressure-containing parts of pressure vessels shall be reinforced in accordance with a recognized standard acceptable to the Administration.

6.4.15.3.2.5 Stress analysis in respect of static and dynamic loads shall be performed as follows:

.1 pressure vessel scantlings shall be determined in accordance with 6.4.15.3.2.1 to 6.4.15.3.2.4 and 6.4.15.3.3;

.2 calculations of the loads and stresses in way of the supports and the shell attachment of the support shall be made. Loads referred to in 6.4.9.2 to 6.4.9.5 shall be used, as applicable. Stresses in way of the supports shall be to a recognized standard acceptable to the Administration. In special cases a fatigue analysis may be required by the Administration; and

.3 if required by the Administration, secondary stresses and thermal stresses shall be specially considered.

6.4.15.3.3 Ultimate design condition

6.4.15.3.3.1 Plastic deformation

For type C independent tanks, the allowable stresses shall not exceed:

$\sigma_m \leq f$
$\sigma_L \leq 1.5f$
$\sigma_b \leq 1.5f$
$\sigma_L+\sigma_b \leq 1.5f$
$\sigma_m+\sigma_b \leq 1.5f$
$\sigma_m+\sigma_b+\sigma_g \leq 3.0f$
$\sigma_L+\sigma_b+\sigma_g \leq 3.0f$

where:

σ_m = equivalent primary general membrane stress;

σ_L = equivalent primary local membrane stress;

σ_b = equivalent primary bending stress;

σ_g = equivalent secondary stress; and

f = the lesser of R_m /A or R_e /B,

with R_m and R_e as defined in 6.4.12.1.1.3. With regard to the stresses σ_m, σ_L, σ_g and σ_b see also the definition of stress categories in 6.4.15.2.3.6. The values A and B shall have at least the following minimum values:

	Nickel steels and carbon-manganese steels	**Austenitic steels**	**Aluminium alloys**
A	3	3.5	4
B	1.5	1.5	1.5

6.4.15.3.3.2 Buckling criteria shall be as follows:

The thickness and form of pressure vessels subject to external pressure and other loads causing compressive stresses shall be based on calculations using accepted pressure vessel buckling theory and shall adequately account for the difference in theoretical and actual buckling stress as a result of plate edge misalignment, ovality and deviation from true circular form over a specified arc or chord length.

6.4.15.3.4 Fatigue design condition

6.4.15.3.4.1 For type C independent tanks where the liquefied gas fuel at atmospheric pressure is below minus 55°C, the Administration may require additional verification to check their compliance with 6.4.15.3.1.1, regarding static and dynamic stress depending on the tank size, the configuration of the tank and arrangement of its supports and attachments.

6.4.15.3.4.2 For vacuum insulated tanks, special attention shall be made to the fatigue strength of the support design and special considerations shall also be made to the limited inspection possibilities between the inside and outer shell.

6.4.15.3.5 Accidental design condition

6.4.15.3.5.1 The tanks and the tank supports shall be designed for the accidental loads and design conditions specified in 6.4.9.5 and 6.4.1.6.3, as relevant.

6.4.15.3.5.2 When subjected to the accidental loads specified in 6.4.9.5, the stress shall comply with the acceptance criteria specified in 6.4.15.3.3.1, modified as appropriate taking into account their lower probability of occurrence.

6.4.15.3.6 Marking

The required marking of the pressure vessel shall be achieved by a method that does not cause unacceptable local stress raisers.

6.4.15.4 Membrane tanks

6.4.15.4.1 Design basis

6.4.15.4.1.1 The design basis for membrane containment systems is that thermal and other expansion or contraction is compensated for without undue risk of losing the tightness of the membrane.

6.4.15.4.1.2 A systematic approach, based on analysis and testing, shall be used to demonstrate that the system will provide its intended function in consideration of the identified in service events as specified in 6.4.15.4.2.1.

6.4.15.4.1.3 A complete secondary barrier is required as defined in 6.4.3. The secondary barrier shall be designed according to 6.4.4.

6.4.15.4.1.4 The design vapour pressure P_0 shall not normally exceed 0.025 MPa. If the hull scantlings are increased accordingly and consideration is given, where appropriate, to the strength of the supporting thermal insulation, P_0 may be increased to a higher value but less than 0.070 MPa.

6.4.15.4.1.5 The definition of membrane tanks does not exclude designs such as those in which non-metallic membranes are used or where membranes are included or incorporated into the thermal insulation.

6.4.15.4.1.6 The thickness of the membranes shall normally not exceed 10 mm.

6.4.15.4.1.7 The circulation of inert gas throughout the primary and the secondary insulation spaces, in accordance with 6.11.1 shall be sufficient to allow for effective means of gas detection.

6.4.15.4.2 Design considerations

6.4.15.4.2.1 Potential incidents that could lead to loss of fluid tightness over the life of the membranes shall be evaluated. These include, but are not limited to:

.1 Ultimate design events:

.1 tensile failure of membranes;

.2 compressive collapse of thermal insulation;

.3 thermal ageing;

.4 loss of attachment between thermal insulation and hull structure;

.5 loss of attachment of membranes to thermal insulation system;

.6 structural integrity of internal structures and their associated supporting structures; and

.7 failure of the supporting hull structure.

.2 Fatigue design events:

.1 fatigue of membranes including joints and attachments to hull structure;

.2 fatigue cracking of thermal insulation;

.3 fatigue of internal structures and their associated supporting structures; and

.4 fatigue cracking of inner hull leading to ballast water ingress.

.3 Accident design events:

.1 accidental mechanical damage (such as dropped objects inside the tank while in service);

.2 accidental over pressurization of thermal insulation spaces;

.3 accidental vacuum in the tank; and

.4 water ingress through the inner hull structure.

Designs where a single internal event could cause simultaneous or cascading failure of both membranes are unacceptable.

6.4.15.4.2.2 The necessary physical properties (mechanical, thermal, chemical, etc.) of the materials used in the construction of the liquefied gas fuel containment system shall be established during the design development in accordance with 6.4.15.4.1.2.

6.4.15.4.3 Loads, load combinations

Particular consideration shall be paid to the possible loss of tank integrity due to either an overpressure in the interbarrier space, a possible vacuum in the liquefied gas fuel tank, the sloshing effects, to hull vibration effects, or any combination of these events.

6.4.15.4.4 Structural analyses

6.4.15.4.4.1 Structural analyses and/or testing for the purpose of determining the ultimate strength and fatigue assessments of the liquefied gas fuel containment and associated structures and equipment noted in 6.4.7 shall be performed. The structural analysis shall provide the data required to assess each failure mode that has been identified as critical for the liquefied gas fuel containment system.

6.4.15.4.4.2 Structural analyses of the hull shall take into account the internal pressure as indicated in 6.4.9.3.3.1. Special attention shall be paid to deflections of the hull and their compatibility with the membrane and associated thermal insulation.

6.4.15.4.4.3 The analyses referred to in 6.4.15.4.4.1 and 6.4.15.4.4.2 shall be based on the particular motions, accelerations and response of ships and liquefied gas fuel containment systems.

6.4.15.4.5 Ultimate design condition

6.4.15.4.5.1 The structural resistance of every critical component, sub-system, or assembly, shall be established, in accordance with 6.4.15.4.1.2, for in-service conditions.

6.4.15.4.5.2 The choice of strength acceptance criteria for the failure modes of the liquefied gas fuel containment system, its attachments to the hull structure and internal tank structures, shall reflect the consequences associated with the considered mode of failure.

6.4.15.4.5.3 The inner hull scantlings shall meet the regulations for deep tanks, taking into account the internal pressure as indicated in 6.4.9.3.3.1 and the specified appropriate regulations for sloshing load as defined in 6.4.9.4.1.3.

6.4.15.4.6 Fatigue design condition

6.4.15.4.6.1 Fatigue analysis shall be carried out for structures inside the tank, i.e. pump towers, and for parts of membrane and pump tower attachments, where failure development cannot be reliably detected by continuous monitoring.

6.4.15.4.6.2 The fatigue calculations shall be carried out in accordance with 6.4.12.2, with relevant regulations depending on:

.1 the significance of the structural components with respect to structural integrity; and

.2 availability for inspection.

6.4.15.4.6.3 For structural elements for which it can be demonstrated by tests and/or analyses that a crack will not develop to cause simultaneous or cascading failure of both membranes, C_w shall be less than or equal to 0.5.

6.4.15.4.6.4 Structural elements subject to periodic inspection, and where an unattended fatigue crack can develop to cause simultaneous or cascading failure of both membranes, shall satisfy the fatigue and fracture mechanics regulations stated in 6.4.12.2.8.

6.4.15.4.6.5 Structural element not accessible for in-service inspection, and where a fatigue crack can develop without warning to cause simultaneous or cascading failure of both membranes, shall satisfy the fatigue and fracture mechanics regulations stated in 6.4.12.2.9.

6.4.15.4.7 Accidental design condition

6.4.15.4.7.1 The containment system and the supporting hull structure shall be designed for the accidental loads specified in 6.4.9.5. These loads need not be combined with each other or with environmental loads.

6.4.15.4.7.2 Additional relevant accidental scenarios shall be determined based on a risk analysis. Particular attention shall be paid to securing devices inside of tanks.

6.4.16 Limit state design for novel concepts

6.4.16.1 Fuel containment systems that are of a novel configuration that cannot be designed using section 6.4.15 shall be designed using this section and 6.4.1 to 6.4.14, as applicable. Fuel containment system design according to this section shall be based on the principles of limit state design which is an approach to structural design that can be applied to established design solutions as well as novel designs. This more generic approach maintains a level of safety similar to that achieved for known containment systems as designed using 6.4.15.

6.4.16.2.1 The limit state design is a systematic approach where each structural element is evaluated with respect to possible failure modes related to the design conditions identified in 6.4.1.6. A limit state can be defined as a condition beyond which the structure, or part of a structure, no longer satisfies the regulations.

6.4.16.2.2 For each failure mode, one or more limit states may be relevant. By consideration of all relevant limit states, the limit load for the structural element is found as the minimum limit load resulting from all the relevant limit states. The limit states are divided into the three following categories:

.1 Ultimate limit states (ULS), which correspond to the maximum load-carrying capacity or, in some cases, to the maximum applicable strain or deformation; under intact (undamaged) conditions.

.2 Fatigue limit states (FLS), which correspond to degradation due to the effect of time varying (cyclic) loading.

.3 Accident limit states (ALS), which concern the ability of the structure to resist accidental situations.

6.4.16.3 The procedure and relevant design parameters of the limit state design shall comply with the Standards for the Use of limit state methodologies in the design of fuel containment systems of novel configuration (LSD Standard), as set out in the annex to part A-1.

6.5 Regulations for portable liquefied gas fuel tanks

6.5.1 The design of the tank shall comply with 6.4.15.3. The tank support (container frame or truck chassis) shall be designed for the intended purpose.

6.5.2 Portable fuel tanks shall be located in dedicated areas fitted with:

.1 mechanical protection of the tanks depending on location and cargo operations;

.2 if located on open deck: spill protection and water spray systems for cooling; and

.3 if located in an enclosed space: the space is to be considered as a tank connection space.

6.5.3 Portable fuel tanks shall be secured to the deck while connected to the ship systems. The arrangement for supporting and fixing the tanks shall be designed for the maximum expected static and dynamic inclinations, as well as the maximum expected values of acceleration, taking into account the ship characteristics and the position of the tanks.

6.5.4 Consideration shall be given to the strength and the effect of the portable fuel tanks on the ship's stability.

6.5.5 Connections to the ship's fuel piping systems shall be made by means of approved flexible hoses or other suitable means designed to provide sufficient flexibility.

6.5.6 Arrangements shall be provided to limit the quantity of fuel spilled in case of inadvertent disconnection or rupture of the non-permanent connections.

6.5.7 The pressure relief system of portable tanks shall be connected to a fixed venting system.

6.5.8 Control and monitoring systems for portable fuel tanks shall be integrated in the ship's control and monitoring system. Safety system for portable fuel tanks shall be integrated in the ship's safety system (e.g. shutdown systems for tank valves, leak/gas detection systems).

6.5.9 Safe access to tank connections for the purpose of inspection and maintenance shall be ensured.

6.5.10 After connection to the ship's fuel piping system,

.1 with the exception of the pressure relief system in 6.5.6 each portable tank shall be capable of being isolated at any time;

.2 isolation of one tank shall not impair the availability of the remaining portable tanks; and

.3 the tank shall not exceed its filling limits as given in 6.8.

6.6 Regulations for CNG fuel containment

6.6.1 The storage tanks to be used for CNG shall be certified and approved by the Administration.

6.6.2 Tanks for CNG shall be fitted with pressure relief valves with a set point below the design pressure of the tank and with outlet located as required in 6.7.2.7 and 6.7.2.8.

6.6.3 Adequate means shall be provided to depressurize the tank in case of a fire which can affect the tank.

6.6.4 Storage of CNG in enclosed spaces is normally not acceptable, but may be permitted after special consideration and approval by the Administration provided the following is fulfilled in addition to 6.3.4 to 6.3.6:

.1 adequate means are provided to depressurize and inert the tank in case of a fire which can affect the tank;

.2 all surfaces within such enclosed spaces containing the CNG storage are provided with suitable thermal protection against any lost high-pressure gas and resulting condensation unless the bulkheads are designed for the lowest temperature that can arise from gas expansion leakage; and

.3 a fixed fire-extinguishing system is installed in the enclosed spaces containing the CNG storage. Special consideration should be given to the extinguishing of jet-fires.

6.7 Regulations for pressure relief system

6.7.1 General

6.7.1.1 All fuel storage tanks shall 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, tank connection spaces and tank cofferdams, 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 6.9 shall 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 shall be fitted with vacuum protection systems.

6.7.2 Pressure relief systems for liquefied gas fuel tanks

6.7.2.1 If fuel release into the vacuum space of a vacuum insulated tank cannot be excluded, the vacuum space shall be protected by a pressure relief device which shall be connected to a vent system if the tanks are located below deck. On open deck a direct release into the atmosphere may be accepted by the Administration for tanks not exceeding the size of a 40 ft container if the released gas cannot enter safe areas.

6.7.2.2 Liquefied gas fuel tanks shall be fitted with a minimum of 2 pressure relief valves (PRVs) allowing for disconnection of one PRV in case of malfunction or leakage.

6.7.2.3 Interbarrier spaces shall be provided with pressure relief devices.[12] For membrane systems, the designer shall demonstrate adequate sizing of interbarrier space PRVs.

6.7.2.4 The setting of the PRVs shall 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.

6.7.2.5 The following temperature regulations apply to PRVs fitted to pressure relief systems:

.1 PRVs on fuel tanks with a design temperature below 0ºC shall be designed and arranged to prevent their becoming inoperative due to ice formation;

.2 the effects of ice formation due to ambient temperatures shall be considered in the construction and arrangement of PRVs;

.3 PRVs shall 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 shall be of suitably robust construction to prevent damage.

6.7.2.6 In the event of a failure of a fuel tank PRV a safe means of emergency isolation shall be available.

.1 procedures shall be provided and included in the operation manual (refer to chapter 18);

.2 the procedures shall allow only one of the installed PRVs for the liquefied gas fuel tanks to be isolated, physical interlocks shall be included to this effect; and

.3 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 at the PRV.

6.7.2.7 Each pressure relief valve installed on a liquefied gas fuel tank shall be connected to a venting system, which shall 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 shall normally 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 lower value according to special consideration by the Administration.

12 Refer to IACS Unified Interpretation GC9 entitled *Guidance for sizing pressure relief systems for interbarrier spaces, 1988*.

6.7.2.8 The outlet from the pressure relief valves shall normally be located at least 10 m 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.

6.7.2.9 All other fuel gas vent outlets shall also be arranged in accordance with 6.7.2.7 and 6.7.2.8. Means shall be provided to prevent liquid overflow from gas vent outlets, due to hydrostatic pressure from spaces to which they are connected.

6.7.2.10 In the vent piping system, means for draining liquid from places where it may accumulate shall be provided. The PRVs and piping shall be arranged so that liquid can, under no circumstances, accumulate in or near the PRVs.

6.7.2.11 Suitable protection screens of not more than 13 mm square mesh shall be fitted on vent outlets to prevent the ingress of foreign objects without adversely affecting the flow.

6.7.2.12 All vent piping shall 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.

6.7.2.13 PRVs shall be connected to the highest part of the fuel tank. PRVs shall 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.

6.7.3 Sizing of pressure relieving system

6.7.3.1 Sizing of pressure relief valves

6.7.3.1.1 PRVs shall 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 computed using the following formula:

$$Q = FGA^{0.82} \text{ (m}^3\text{/s)}$$

where:

Q = minimum required rate of discharge of air at standard conditions of 273.15 Kelvin (K) and 0.1013 MPa.

F = fire exposure factor for different 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.

For independent tanks partly protruding through the weather decks, the fire exposure factor shall be determined on the basis of the surface areas above and below deck.

G = gas factor according to formula:

$$G = \frac{12.4}{LD}\sqrt{\frac{ZT}{M}}$$

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 6.7.1.

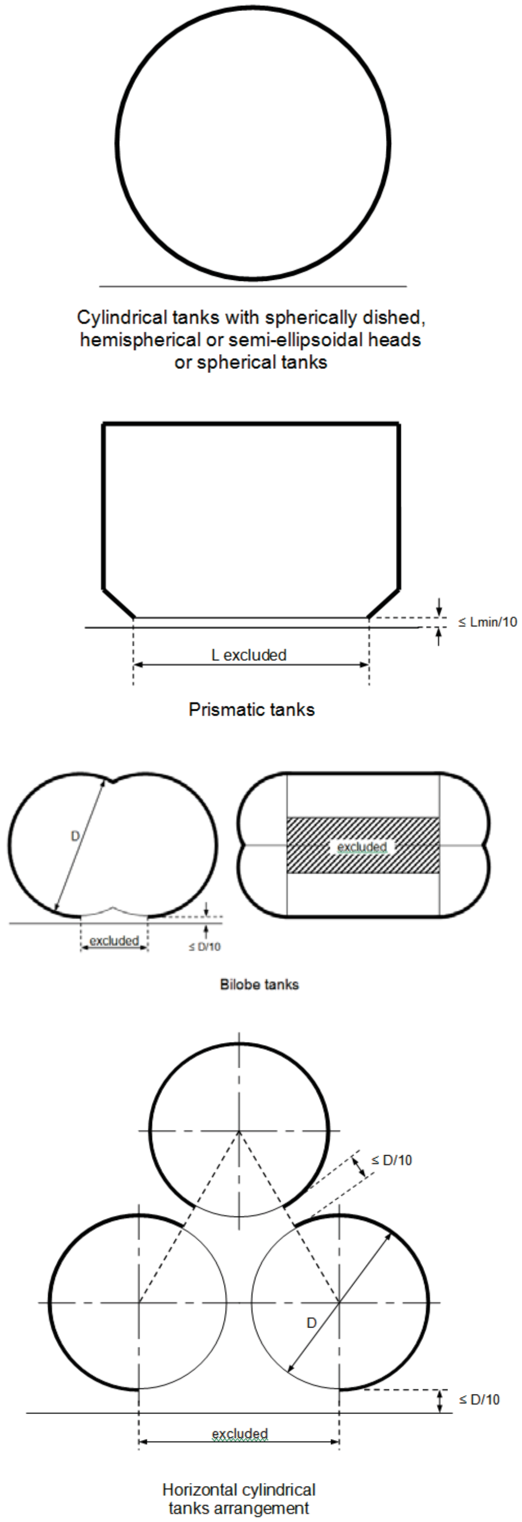

Figure 6.7.1

6.7.3.1.2 For vacuum insulated tanks in fuel storage hold spaces and for tanks in fuel storage hold spaces separated from potential fire loads by coffer dams or surrounded by ship spaces with no fire load the following applies:

If the pressure relief valves have to be sized for fire loads the fire factors according may be reduced to the following values:

F = 0.5 to F = 0.25

F = 0.2 to F = 0.1

The minimum fire factor is 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 (ρ_{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, shall be taken into account when determining their size to ensure the flow capacity required by 6.7.3.1.

6.7.3.2.2 Upstream pressure losses

.1 the pressure drop in the vent line from the tank to the PRV inlet shall not exceed 3% of the valve set pressure at the calculated flow rate, in accordance with 6.7.3.1;

.2 pilot-operated PRVs shall 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 shall be considered for flowing type pilots.

6.7.3.2.3 Downstream pressure losses

.1 Where common vent headers and vent masts are fitted, calculations shall include flow from all attached PRVs.

.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, shall 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 shall not be less than the sum of the inlet pressure loss and 0.02 MARVS at the rated capacity.

6.8 Regulations on loading limit for liquefied gas fuel tanks

6.8.1 Storage tanks for liquefied gas shall not be filled to more than a volume equivalent to 98% full at the reference temperature as defined in 2.2.36.

A loading limit curve for actual fuel loading temperatures shall be prepared from the following formula:

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

where:

LL = loading limit as defined in 2.2.27, expressed in per cent;

FL = filling limit as defined in 2.2.16 expressed in per cent, here 98%;

ρ_R = relative density of fuel at the reference temperature; and

ρ_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%. This also applies in cases where a second system for pressure maintenance is installed, (refer to 6.9). However, if the pressure can only be maintained / controlled by fuel consumers, the loading limit as calculated in 6.8.1 shall be used.

6.9 Regulations for the maintaining of fuel storage condition

6.9.1 Control of tank pressure and temperature

6.9.1.1 With the exception of liquefied gas fuel tanks designed to withstand the full gauge vapour pressure of the fuel under conditions of the upper ambient design temperature, liquefied gas fuel tanks' pressure and temperature shall be maintained at all times within their design range by means acceptable to the Administration, e.g. by one of the following methods:

.1 reliquefaction of vapours;

.2 thermal oxidation of vapours;

.3 pressure accumulation; or

.4 liquefied gas fuel cooling.

The method chosen shall be capable of maintaining tank pressure below the set pressure of the tank pressure relief valves for a period of 15 days assuming full tank at normal service pressure and the ship in idle condition, i.e. only power for domestic load is generated.

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 shall be sea 32°C and air 45°C. For service in particularly hot or cold zones, these design temperatures shall be increased or decreased, to the satisfaction of the Administration.

6.9.2.2 The overall capacity of the system shall be such that it can control the pressure within the design conditions without venting to atmosphere.

6.9.3 Reliquefaction systems

6.9.3.1 The reliquefaction system shall be designed and calculated according to 6.9.3.2. The system has to be sized in a sufficient way also in case of no or low consumption.

6.9.3.2 The reliquefaction system shall 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 methane during pressure control operations within the design conditions, these waste gases shall, as far as reasonably practicable, be disposed of without venting to atmosphere.

6.9.4 Thermal oxidation systems

6.9.4.1 Thermal oxidation can be done by either consumption of the vapours according to the regulations for consumers described in this Code or in a dedicated gas combustion unit (GCU). It shall be demonstrated that the capacity of the oxidation system is sufficient to consume the required quantity of vapours. In this regard, periods of slow steaming and/or no consumption from propulsion or other services of the ship shall be considered.

6.9.5 Compatibility

6.9.5.1 Refrigerants or auxiliary agents used for refrigeration or cooling of fuel shall 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 shall 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 shall be such that in case of a single failure (of 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 shall have a standby heat exchanger unless they have a capacity in excess of 25% of the largest required capacity for pressure control and they can be repaired on board without external sources.

6.10 Regulations on atmospheric control within the fuel containment system

6.10.1 A piping system shall be arranged to enable each fuel tank to be safely gas-freed, and to be safely filled with fuel from a gas-free condition. The system shall be arranged to minimize the possibility of pockets of gas or air remaining after changing the atmosphere.

6.10.2 The system shall be designed to eliminate the possibility of a flammable mixture existing in the fuel tank during any part of the atmosphere change operation by utilizing an inerting medium as an intermediate step.

6.10.3 Gas sampling points shall be provided for each fuel tank to monitor the progress of atmosphere change.

6.10.4 Inert gas utilized for gas freeing of fuel tanks may be provided externally to the ship.

6.11 Regulations on atmosphere control within fuel storage hold spaces (Fuel containment systems other than type C independent tanks)

6.11.1 Interbarrier and fuel storage hold spaces associated with liquefied gas fuel containment systems requiring full or partial secondary barriers shall be inerted with a suitable dry inert gas and kept inerted with make-up gas provided by a shipboard inert gas generation system, or by shipboard storage, which shall be sufficient for normal consumption for at least 30 days. Shorter periods may be considered by the Administration depending on the ship's service.

6.11.2 Alternatively, the spaces referred to in 6.11.1 requiring only a partial secondary barrier may be filled with dry air provided that the ship maintains a stored charge of inert gas or is fitted with an inert gas generation system sufficient to inert the largest of these spaces, and provided that the configuration of the spaces and the relevant vapour detection systems, together with the capability of the inerting arrangements, ensures that any leakage from the liquefied gas fuel tanks will be rapidly detected and inerting effected before a dangerous condition can develop. Equipment for the provision of sufficient dry air of suitable quality to satisfy the expected demand shall be provided.

6.12 Regulations on environmental control of spaces surrounding type C independent tanks

6.12.1 Spaces surrounding liquefied gas fuel tanks shall be filled with suitable dry air and be maintained in this condition with dry air provided by suitable air drying equipment. This is only applicable for liquefied gas fuel tanks where condensation and icing due to cold surfaces is an issue.

6.13 Regulations on inerting

6.13.1 Arrangements to prevent back-flow of fuel vapour into the inert gas system shall be provided as specified below.

6.13.2 To prevent the return of flammable gas to any non-hazardous spaces, the inert gas supply line shall be fitted with two shutoff valves in series with a venting valve in between (double block and bleed valves). In addition, a closable non-return valve shall be installed between the double block and bleed arrangement and the fuel system. These valves shall be located outside non-hazardous spaces.

6.13.3 Where the connections to the fuel piping systems are non-permanent, two non-return valves may be substituted for the valves required in 6.13.2.

6.13.4 The arrangements shall be such that each space being inerted can be isolated and the necessary controls and relief valves, etc. shall be provided for controlling pressure in these spaces.

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

6.14 Regulations on inert gas production and storage on board

6.14.1 The equipment shall be capable of producing inert gas with oxygen content at no time greater than 5% by volume. A continuous-reading oxygen content meter shall be fitted to the inert gas supply from the equipment and shall be fitted with an alarm set at a maximum of 5% oxygen content by volume.

6.14.2 An inert gas system shall have pressure controls and monitoring arrangements appropriate to the fuel containment system.

6.14.3 Where a nitrogen generator or nitrogen storage facilities are installed in a separate compartment outside of the engine-room, the separate compartment shall be fitted with an independent mechanical extraction ventilation system, providing a minimum of 6 air changes per hour. A low oxygen alarm shall be fitted.

6.14.4 Nitrogen pipes shall only be led through well ventilated spaces. Nitrogen pipes in enclosed spaces shall:

- be fully welded;
- have only a minimum of flange connections as needed for fitting of valves; and
- be as short as possible.

7 MATERIAL AND GENERAL PIPE DESIGN

7.1 Goal

7.1.1 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, 3.2.6, 3.2.8, 3.2.9 and 3.2.10. In particular the following apply:

7.2.1.1 Fuel piping shall be capable of absorbing thermal expansion or contraction caused by extreme temperatures of the fuel without developing substantial stresses.

7.2.1.2 Provision shall 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 shall be fitted.

7.2.1.4 Low temperature piping shall 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.

7.3 Regulations for general pipe design

7.3.1 General

7.3.1.1 Fuel pipes and all the other piping needed for a safe and reliable operation and maintenance shall be colour marked in accordance with a standard at least equivalent to those acceptable to the Organization.[13]

7.3.1.2 Where tanks or piping are separated from the ship's structure by thermal isolation, provision shall be made for electrically bonding to the ship's structure both the piping and the tanks. All gasketed pipe joints and hose connections shall be electrically bonded.

7.3.1.3 All pipelines or components which may be isolated in a liquid full condition shall be provided with relief valves.

7.3.1.4 Pipework, which may contain low temperature fuel, shall be thermally insulated to an extent which will minimize condensation of moisture.

7.3.1.5 Piping other than fuel supply piping and cabling may be arranged in the double wall piping or duct provided that they do not create a source of ignition or compromise the integrity of the double pipe or duct. The double wall piping or duct shall only contain piping or cabling necessary for operational purposes.

7.3.2 Wall thickness

7.3.2.1 The minimum wall thickness shall be calculated as follows:

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

where:

t_0 = theoretical thickness

t_0 = $PD / (2.0Ke + P)$ (mm)

with:

P = design pressure (MPa) referred to in 7.3.3;

D = outside diameter (mm);

K = allowable stress (N/mm²) referred to in 7.3.4; and

e = efficiency factory 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;

13 Refer to EN ISO 14726:2008 Ships and marine technology – Identification colours for the content of piping systems.

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

$b = D \cdot t_0 / 2.5r$ (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 (%).

7.3.2.2 The absolute minimum wall thickness shall be in accordance with a standard acceptable to the Administration.

7.3.3 Design condition

7.3.3.1 The greater of the following design conditions shall be used for piping, piping system and components as appropriate:[14,15]

.1 for systems or components which may be separated from their relief valves and which contain only vapour at all times, vapour pressure at 45°C assuming an initial condition of saturated vapour in the system at the system operating pressure and temperature; or

.2 the MARVS of the fuel tanks and fuel processing systems; or

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

.4 the maximum total discharge or loading head of the fuel piping system; or

.5 the relief valve setting on a pipeline system.

7.3.3.2 Piping, piping systems and components shall have a minimum design pressure of 1.0 MPa except for open ended lines where it is not to be less than 0.5 MPa.

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[14] Lower values of ambient temperature regarding design condition in 7.3.3.1.1 may be accepted by the Administration for ships operating in restricted areas. Conversely, higher values of ambient temperature may be required.

[15] For ships on voyages of restricted duration, P_0 may be calculated based on the actual pressure rise during the voyage and account may be taken of any thermal insulation of the tank. Reference is made to the *Application of amendments to gas carrier codes concerning type C tank loading limits (SIGTTO/IACS)*.

7.3.4 Allowable stress

7.3.4.1 For pipes made of steel including stainless steel, the allowable stress to be considered in the formula of the strength thickness in 7.3.2.1 shall be the lower of the following values:

$R_m/2.7$ or $R_e/1.8$

where:

R_m = specified minimum tensile strength at room temperature (N/mm²); and

R_e = specified minimum yield stress at room temperature (N/mm²). If the stress strain curve does not show a defined yield stress, the 0.2% proof stress applies.

7.3.4.2 Where necessary for mechanical strength to prevent damage, collapse, excessive sag or buckling of pipes due to superimposed loads, the wall thickness shall be increased over that required by 7.3.2 or, if this is impracticable or would cause excessive local stresses, these loads shall be reduced, protected against or eliminated by other design methods. Such superimposed loads may be due to; supports, ship deflections, liquid pressure surge during transfer operations, the weight of suspended valves, reaction to loading arm connections, or otherwise.

7.3.4.3 For pipes made of materials other than steel, the allowable stress shall be considered by the Administration.

7.3.4.4 High pressure fuel piping systems shall have sufficient constructive strength. This shall be confirmed by carrying out stress analysis and taking into account:

.1 stresses due to the weight of the piping system;

.2 acceleration loads when significant; and

.3 internal pressure and loads induced by hog and sag of the ship.

7.3.4.5 When the design temperature is minus 110°C or colder, a complete stress analysis, taking into account all the stresses due to weight of pipes, including acceleration loads if significant, internal pressure, thermal contraction and loads induced by hog and sag of the ship shall be carried out for each branch of the piping system.

7.3.5 Flexibility of piping

7.3.5.1 The arrangement and installation of fuel piping shall provide the necessary flexibility to maintain the integrity of the piping system in the actual service situations, taking potential for fatigue into account.

7.3.6 Piping fabrication and joining details

7.3.6.1 Flanges, valves and other fittings shall comply with a standard acceptable to the Administration, taking into account the design pressure defined in 7.3.3.1. For bellows and expansion joints used in vapour service, a lower minimum design pressure than defined in 7.3.3.1 may be accepted.

7.3.6.2 All valves and expansion joints used in high pressure fuel piping systems shall be approved according to a standard acceptable to the Administration.

7.3.6.3 The piping system shall be joined by welding with a minimum of flange connections. Gaskets shall be protected against blow-out.

7.3.6.4 Piping fabrication and joining details shall comply with the following:

7.3.6.4.1 Direct connections

.1 Butt-welded joints with complete penetration at the root may be used in all applications. For design temperatures colder than minus 10°C, butt welds shall be either double welded or equivalent to a double welded butt joint. This may be accomplished by use of a backing ring, consumable insert or inert gas back-up on the first pass. For design pressures in excess of 1.0 MPa and design temperatures of minus 10°C or colder, backing rings shall be removed.

.2 Slip-on welded joints with sleeves and related welding, having dimensions in accordance with recognized standards, shall only be used for instrument lines and open-ended lines with an external diameter of 50 mm or less and design temperatures not colder than minus 55°C.

.3 Screwed couplings complying with recognized standards shall only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less.

7.3.6.4.2 *Flanged connections*

.1 Flanges in flange connections shall be of the welded neck, slip-on or socket welded type; and

.2 For all piping except open ended, the following restrictions apply:

  .1 For design temperatures colder than minus 55°C, only welded neck flanges shall be used; and

  .2 For design temperatures colder than minus 10°C, slip-on flanges shall not be used in nominal sizes above 100 mm and socket welded flanges shall not be used in nominal sizes above 50 mm.

7.3.6.4.3 *Expansion joints*

Where bellows and expansion joints are provided in accordance with 7.3.6.1 the following apply:

.1 if necessary, bellows shall be protected against icing;

.2 slip joints shall not be used except within the liquefied gas fuel storage tanks; and

.3 bellows shall normally not be arranged in enclosed spaces.

7.3.6.4.4 Other connections

Piping connections shall be joined in accordance with 7.3.6.4.1 to 7.3.6.4.3 but for other exceptional cases the Administration may consider alternative arrangements.

7.4 Regulations for materials

7.4.1 Metallic materials

7.4.1.1 Materials for fuel containment and piping systems shall comply with the minimum regulations given in the following tables:

Table 7.1: Plates, pipes (seamless and welded), sections and forgings for fuel tanks and process pressure vessels for design temperatures not lower than 0°C.

Table 7.2: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below 0°C and down to minus 55°C.

Table 7.3: Plates, sections and forgings for fuel tanks, secondary barriers and process pressure vessels for design temperatures below minus 55°C and down to minus 165°C.

Table 7.4: Pipes (seamless and welded), forgings and castings for fuel and process piping for design temperatures below 0°C and down to minus 165°C.

Table 7.5: Plates and sections for hull structures required by 6.4.13.1.1.2.

Table 7.1

PLATES, PIPES (SEAMLESS AND WELDED) [1, 2], SECTIONS AND FORGINGS FOR FUEL TANKS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES NOT LOWER THAN 0°C		
CHEMICAL COMPOSITION AND HEAT TREATMENT		
◆ Carbon-manganese steel		
◆ Fully killed fine grain steel		
◆ Small additions of alloying elements by agreement with the Administration		
◆ Composition limits to be approved by the Administration		
◆ Normalized, or quenched and tempered[4]		
TENSILE AND TOUGHNESS (IMPACT) TEST REGULATIONS		
Sampling frequency		
◆ Plates	Each "piece" to be tested	
◆ Sections and forgings	Each "batch" to be tested.	
Mechanical properties		
◆ Tensile properties	Specified minimum yield stress not to exceed 410 N/mm^2 [5]	
Toughness (Charpy V-notch test)		
◆ Plates	Transverse test pieces. Minimum average energy value (KV) 27J	
◆ Sections and forgings	Longitudinal test pieces. Minimum average energy (KV) 41J	
◆ Test temperature	Thickness t (mm)	Test temperature (°C)
	T ≤ 20	0
	20 < t ≤40[3]	-20

Notes

1. For seamless pipes and fittings normal practice applies. The use of longitudinally and spirally welded pipes shall be specially approved by the Administration.
2. Charpy V-notch impact tests are not required for pipes.
3. This Table is generally applicable for material thicknesses up to 40 mm. Proposals for greater thicknesses shall be approved by the Administration.
4. A controlled rolling procedure or thermo-mechanical controlled processing (TMCP) may be used as an alternative.
5. Materials with specified minimum yield stress exceeding 410 N/mm^2 may be approved by the Administration. For these materials, particular attention shall be given to the hardness of the welded and heat affected zones.

Table 7.2

PLATES, SECTIONS AND FORGINGS [1] FOR FUEL TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW 0°C AND DOWN TO MINUS 55°C Maximum thickness 25 mm [2]	
CHEMICAL COMPOSITION AND HEAT TREATMENT	
◆ Carbon-manganese steel	
◆ Fully killed, aluminium treated fine grain steel	
◆ Chemical composition (ladle analysis)	

C	Mn	Si	S	P
0.16% max. [3]	0.70-1.60%	0.10-0.50%	0.025% max.	0.025% max.
Optional additions: Alloys and grain refining elements may be generally in accordance with the following				
Ni	Cr	Mo	Cu	Nb
0.80% max.	0.25% max.	0.08% max.	0.35% max.	0.05% max.
V				
0.10% max.				
Al content total 0.020% min. (Acid soluble 0.015% min.)				

◆ Normalized, or quenched and tempered [4]	
TENSILE AND TOUGHNESS (IMPACT) TEST REGULATIONS	
Sampling frequency	
◆ Plates	Each 'piece' to be tested
◆ Sections and forgings	Each 'batch' to be tested
Mechanical properties	
◆ Tensile properties	Specified minimum yield stress not to exceed 410 N/mm^2 [2, 5]
Toughness (Charpy V-notch test)	
◆ Plates	Transverse test pieces. Minimum average energy value (KV) 27J
◆ Sections and forgings	Longitudinal test pieces. Minimum average energy (KV) 41J
◆ Test temperature	5°C below the design temperature or -20°C whichever is lower

Notes

1. The Charpy V-notch and chemistry regulations for forgings may be specially considered by the Administration.
2. For material thickness of more than 25 mm, Charpy V-notch tests shall be conducted as follows:

Material thickness (mm)	Test temperature (°C)
25 < t ≤ 30	10°C below design temperature or -20°C whichever is lower
30 < t ≤ 35	15°C below design temperature or -20°C whichever is lower
35 < t ≤ 40	20°C below design temperature
40 < t	Temperature approved by the Administration

   The impact energy value shall be in accordance with the table for the applicable type of test specimen.
   Materials for tanks and parts of tanks which are completely thermally stress relieved after welding may be tested at a temperature 5°C below design temperature or -20°C whichever is lower.
   For thermally stress relieved reinforcements and other fittings, the test temperature shall be the same as that required for the adjacent tank-shell thickness.
3. By special agreement with the Administration, the carbon content may be increased to 0.18% maximum provided the design temperature is not lower than -40°C
4. A controlled rolling procedure or thermo-mechanical controlled processing (TMCP) may be used as an alternative.
5. Materials with specified minimum yield stress exceeding 410 N/mm^2 may be approved by the Administration. For these materials, particular attention shall be given to the hardness of the welded and heat affected zones.

Guidance:
For materials exceeding 25 mm in thickness for which the test temperature is -60°C or lower, the application of specially treated steels or steels in accordance with table 7.3 may be necessary.

Table 7.3

PLATES, SECTIONS AND FORGINGS [1] FOR FUEL TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW MINUS 55°C AND DOWN TO MINUS 165°C[2] **Maximum thickness 25 mm [3, 4]**		
Minimum design temp. (°C)	Chemical composition[5] and heat treatment	Impact test temp. (°C)
-60	1.5% nickel steel – normalized or normalized and tempered or quenched and tempered or TMCP [see note 6]	-65
-65	2.25% nickel steel – normalized or normalized and tempered or quenched and tempered or TMCP[6, 7]	-70
-90	3.5% nickel steel – normalized or normalized and tempered or quenched and tempered or TMCP[6, 7]	-95
-105	5% nickel steel – normalized or normalized and tempered or quenched and tempered[6, 7 and 8]	-110
-165	9% nickel steel – double normalized and tempered or quenched and tempered[6]	-196
-165	Austenitic steels, such as types 304, 304L, 316, 316L, 321 and 347 solution treated[9]	-196
-165	Aluminium alloys; such as type 5083 annealed	Not required
-165	Austenitic Fe-Ni alloy (36% nickel) Heat treatment as agreed	Not required

TENSILE AND TOUGHNESS (IMPACT) TEST REGULATIONS	
Sampling frequency	
◆ Plates	Each 'piece' to be tested
◆ Sections and forgings	Each 'batch' to be tested
Toughness (Charpy V-notch test)	
◆ Plates	Transverse test pieces. Minimum average energy value (KV) 27J
◆ Sections and forgings	Longitudinal test pieces. Minimum average energy (KV) 41J

Notes

1. The impact test required for forgings used in critical applications shall be subject to special consideration by the Administration.
2. The regulations for design temperatures below –165°C shall be specially agreed with the Administration.
3. For materials 1.5% Ni, 2.25% Ni, 3.5% Ni and 5% Ni, with thicknesses greater than 25 mm, the impact tests shall be conducted as follows:

Material thickness (mm)	Test temperature (°C)
$25 < t \leq 30$	10°C below design temperature
$30 < t \leq 35$	15°C below design temperature
$35 < t \leq 40$	20°C below design temperature

   The energy value shall be in accordance with the table for the applicable type of test specimen. For material thickness of more than 40 mm, the Charpy V-notch values shall be specially considered.
4. For 9% Ni steels, austenitic stainless steels and aluminium alloys, thickness greater than 25 mm may be used.
5. The chemical composition limits shall be in accordance with recognized standards.
6. Thermo-mechanical controlled processing (TMCP) nickel steels will be subject to acceptance by the Administration.
7. A lower minimum design temperature for quenched and tempered steels may be specially agreed with the Administration.
8. A specially heat treated 5% nickel steel, for example triple heat treated 5% nickel steel, may be used down to –165°C, provided that the impact tests are carried out at –196°C.
9. The impact test may be omitted subject to agreement with the Administration.

Table 7.4

PIPES (SEAMLESS AND WELDED)[1], FORGINGS[2] AND CASTINGS[2] FOR FUEL AND PROCESS PIPING FOR DESIGN TEMPERATURES BELOW 0°C AND DOWN TO MINUS 165°C[3] Maximum thickness 25 mm			
Minimum design temp.(°C)	Chemical composition[5] and heat treatment	Impact test	
		Test temp. (°C)	Minimum average energy (KV)
-55	Carbon-manganese steel. Fully killed fine grain. Normalized or as agreed.[6]	See note 4	27
-65	2.25% nickel steel. Normalized, Normalized and tempered or quenched and tempered.[6]	-70	34
-90	3.5% nickel steel. Normalized, Normalized and tempered or quenched and tempered.[6]	-95	34
-165	9% nickel steel[7]. Double normalized and tempered or quenched and tempered.	-196	41
	Austenitic steels, such as types 304, 304L, 316, 316L, 321 and 347. Solution treated.[8]	-196	41
	Aluminium alloys; such as type 5083 annealed		Not required
TENSILE AND TOUGHNESS (IMPACT) TEST REGULATIONS			
Sampling frequency			
◆ Each 'batch' to be tested.			
Toughness (Charpy V-notch test)			
◆ Impact test: Longitudinal test pieces			

Notes
1. The use of longitudinally or spirally welded pipes shall be specially approved by the Administration.
2. The regulations for forgings and castings may be subject to special consideration by the Administration.
3. The regulations for design temperatures below -165°C shall be specially agreed with the Administration.
4. The test temperature shall be 5°C below the design temperature or -20°C whichever is lower.
5. The composition limits shall be in accordance with Recognized Standards.
6. A lower design temperature may be specially agreed with the Administration for quenched and tempered materials.
7. This chemical composition is not suitable for castings.
8. Impact tests may be omitted subject to agreement with the Administration.

Table 7.5

PLATES AND SECTIONS FOR HULL STRUCTURES REQUIRED BY 6.4.13.1.1.2								
Minimum design temperature of hull structure (°C)	Maximum thickness (mm) for steel grades							
	A	B	D	E	AH	DH	EH	FH
0 and above	Recognized Standards							
down to -5	15	25	30	50	25	45	50	50
down to -10	x	20	25	50	20	40	50	50
down to -20	x	x	20	50	x	30	50	50
down to -30	x	x	x	40	x	20	40	50
Below -30	In accordance with table 7.2 except that the thickness limitation given in table 7.2 and in footnote 2 of that table does not apply.							

Notes
'x' means steel grade not to be used.

7.4.1.2 Materials having a melting point below 925°C shall not be used for piping outside the fuel tanks.

7.4.1.3 For CNG tanks, the use of materials not covered above may be specially considered by the Administration.

7.4.1.4 Where required the outer pipe or duct containing high pressure gas in the inner pipe shall as a minimum fulfil the material regulations for pipe materials with design temperature down to minus 55°C in table 7.4.

7.4.1.5 The outer pipe or duct around liquefied gas fuel pipes shall as a minimum fulfil the material regulations for pipe materials with design temperature down to minus 165°C in table 7.4.

8 BUNKERING

8.1 Goal

8.1.1 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 3.2.11 and 3.2.13 to 3.2.17. In particular the following apply:

8.2.1.1 The piping system for transfer of fuel to the storage tank shall be designed such that any leakage from the piping system cannot cause danger to personnel, the environment or the ship.

8.3 Regulations for bunkering station

8.3.1 General

8.3.1.1 The bunkering station shall be located on open deck so that sufficient natural ventilation is provided. Closed or semi-enclosed bunkering stations shall be subject to special consideration within the risk assessment.

8.3.1.2 Connections and piping shall be so positioned and arranged that any damage to the fuel piping does not cause damage to the ship's fuel containment system resulting in an uncontrolled gas discharge.

8.3.1.3 Arrangements shall be made for safe management of any spilled fuel.

8.3.1.4 Suitable means shall be provided to relieve the pressure and remove liquid contents from pump suctions and bunker lines. Liquid is to be discharged to the liquefied gas fuel tanks or other suitable location.

8.3.1.5 The surrounding hull or deck structures shall not be exposed to unacceptable cooling, in case of leakage of fuel.

8.3.1.6 For CNG bunkering stations, low temperature steel shielding shall be considered to determine if the escape of cold jets impinging on surrounding hull structure is possible.

8.3.2 Ships' fuel hoses

8.3.2.1 Liquid and vapour hoses used for fuel transfer shall 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, shall be designed for a bursting pressure not less than five times the maximum pressure the hose can be subjected to during bunkering.

8.4 Regulations for manifold

8.4.1 The bunkering manifold shall be designed to withstand the external loads during bunkering. The connections at the bunkering station shall be of dry-disconnect type equipped with additional safety dry break-away coupling/self-sealing quick release. The couplings shall be of a standard type.

8.5 Regulations for bunkering system

8.5.1 An arrangement for purging fuel bunkering lines with inert gas shall be provided.

8.5.2 The bunkering system shall be so arranged that no gas is discharged to the atmosphere during filling of storage tanks.

8.5.3 A manually operated stop valve and a remote operated shutdown valve in series, or a combined manually operated and remote valve shall be fitted in every bunkering line close to the connecting point. It shall be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

8.5.4 Means shall be provided for draining any fuel from the bunkering pipes upon completion of operation.

8.5.5 Bunkering lines shall be arranged for inerting and gas freeing. When not engaged in bunkering, the bunkering pipes shall be free of gas, unless the consequences of not gas freeing is evaluated and approved.

8.5.6 In case bunkering lines are arranged with a cross-over it shall be ensured by suitable isolation arrangements that no fuel is transferred inadvertently to the ship side not in use for bunkering.

8.5.7 A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source shall be fitted.

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 from the trigger of the alarm to full closure of the remote operated valve required by 8.5.3 shall be adjusted.

9 FUEL SUPPLY TO CONSUMERS

9.1 Goal

The goal of this chapter is to ensure safe and reliable distribution of fuel to the consumers.

9.2 Functional requirements

This chapter is related to functional requirements in 3.2.1 to 3.2.6, 3.2.8 to 3.2.11 and 3.2.13 to 3.2.17. In particular the following apply:

.1 the fuel supply system shall be so arranged that the consequences of any release of fuel will be minimized, while providing safe access for operation and inspection;

.2 the piping system for fuel transfer to the consumers shall 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; and

.3 fuel lines outside the machinery spaces shall be installed and protected so as to minimize the risk of injury to personnel and damage to the ship in case of leakage.

9.3 Regulations on redundancy of fuel supply

9.3.1 For single fuel installations the fuel supply system shall be arranged with full redundancy and segregation all the way from the fuel tanks to the 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 shall be divided between two or more tanks. The tanks shall 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 Regulations on safety functions of gas supply system

9.4.1 Fuel storage tank inlets and outlets shall be provided with valves located as close to the tank as possible. Valves required to be operated during normal operation[16] which are not accessible shall be remotely operated. Tank valves whether accessible or not shall be automatically operated when the safety system required in 15.2.2 is activated.

9.4.2 The main gas supply line to each gas consumer or set of consumers shall be equipped with a manually operated stop valve and an automatically operated "master gas fuel valve" coupled in series or a combined manually and automatically operated valve. The valves shall be situated in the part of the piping that is outside the machinery space containing gas consumers, and placed as near as possible to the installation for heating the gas, if fitted. The master gas fuel valve shall automatically cut off the gas supply when activated by the safety system required in 15.2.2.

16 Normal operation in this context is when gas is supplied to consumers and during bunkering operations.

9.4.3 The automatic master gas fuel valve shall be operable from safe locations on escape routes inside a machinery space containing a gas consumer, the engine control room, if applicable; outside the machinery space, and from the navigation bridge.

9.4.4 Each gas consumer shall be provided with "double block and bleed" valves arrangement. These valves shall 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 shall be in series in the gas fuel pipe to the gas consuming equipment. The bleed valve shall be in a pipe that vents to a safe location in the open air that portion of the gas 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 gas utilization unit will be blocked and the ventilation opened.

9.4.5 The two valves shall be of the fail-to-close type, while the ventilation valve shall be fail-to-open.

9.4.6 The double block and bleed valves shall also be used for normal stop of the engine.

9.4.7 In cases where the master gas fuel valve is automatically shutdown, the complete gas supply branch downstream of the double block and bleed valve shall be automatically ventilated assuming reverse flow from the engine to the pipe.

9.4.8 There shall be one manually operated shutdown valve in the gas supply line to each engine upstream of the double block and bleed valves to assure safe isolation during maintenance on the engine.

9.4.9 For single-engine installations and multi-engine installations, where a separate master valve is provided for each engine, the master gas fuel valve and the double block and bleed valve functions can be combined.

9.4.10 For each main gas supply line entering an ESD protected machinery space, and each gas supply line to high pressure installations means shall be provided for rapid detection of a rupture in the gas line in the engine-room. When rupture is detected a valve shall be automatically shut off.[17] This valve shall be located in the gas supply line before it enters the engine-room or as close as possible to the point of entry inside the engine-room. It can be a separate valve or combined with other functions, e.g. the master valve.

9.5 Regulations for fuel distribution outside of machinery space

9.5.1 Where fuel pipes pass through enclosed spaces in the ship, they shall be protected by a secondary enclosure. This enclosure can be a ventilated duct or a double wall piping system. The duct or double wall piping system shall be mechanically underpressure ventilated with 30 air changes per hour, and gas detection as required in 15.8 shall be provided. Other solutions providing an equivalent safety level may also be accepted by the Administration.

9.5.2 The requirement in 9.5.1 need not be applied for fully welded fuel gas vent pipes led through mechanically ventilated spaces.

[17] The shutdown shall be time delayed to prevent shutdown due to transient load variations.

9.6 Regulations for fuel supply to consumers in gas-safe machinery spaces

9.6.1 Fuel piping in gas-safe machinery spaces shall be completely enclosed by a double pipe or duct fulfilling one of the following conditions:

.1 the gas piping shall be a double wall piping system with the gas fuel contained in the inner pipe. The space between the concentric pipes shall be pressurized with inert gas at a pressure greater than the gas fuel pressure. Suitable alarms shall be provided to indicate a loss of inert gas pressure between the pipes. When the inner pipe contains high pressure gas, the system shall be so arranged that the pipe between the master gas valve and the engine is automatically purged with inert gas when the master gas valve is closed; or

.2 the gas fuel piping shall be installed within a ventilated pipe or duct. The air space between the gas fuel piping and the wall of the outer pipe or duct shall be equipped with mechanical underpressure ventilation having a capacity of at least 30 air changes per hour. This ventilation capacity may be reduced to 10 air changes per hour provided automatic filling of the duct with nitrogen upon detection of gas is arranged for. The fan motors shall comply with the required explosion protection in the installation area. The ventilation outlet shall be covered by a protection screen and placed in a position where no flammable gas-air mixture may be ignited; or

.3 other solutions providing an equivalent safety level may also be accepted by the Administration.

9.6.2 The connecting of gas piping and ducting to the gas injection valves shall be completely covered by the ducting. The arrangement shall facilitate replacement and/or overhaul of injection valves and cylinder covers. The double ducting is also required for all gas pipes on the engine itself, until gas is injected into the chamber.[18]

9.7 Regulations for gas fuel supply to consumers in ESD-protected machinery spaces

9.7.1 The pressure in the gas fuel supply system shall not exceed 1.0 MPa.

9.7.2 The gas fuel supply lines shall have a design pressure not less than 1.0 MPa.

9.8 Regulations for the design of ventilated duct, outer pipe against inner pipe gas leakage

9.8.1 The design pressure of the outer pipe or duct of fuel systems shall not be less than the maximum working pressure of the inner pipe. Alternatively for fuel piping systems with a working pressure greater than 1.0 MPa, the design pressure of the outer pipe or duct shall not be less than the maximum built-up pressure arising in the annular space considering the local instantaneous peak pressure in way of any rupture and the ventilation arrangements.

[18] If gas is supplied into the air inlet directly on each individual cylinder during air intake to the cylinder on a low pressure engine, such that a single failure will not lead to release of fuel gas into the machinery space, double ducting may be omitted on the air inlet pipe.

9.8.2 For high-pressure fuel piping the design pressure of the ducting 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 local instantaneous peak pressure in way of the rupture: this pressure shall be taken as the critical pressure 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

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

k = *1.31 for* CH_4

The tangential membrane stress of a straight pipe shall not exceed the tensile strength divided by 1.5 (R_m/1.5) when subjected to the above pressures. The pressure ratings of all other piping components shall reflect the same level of strength as straight pipes.

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

9.8.3 Verification of the strength shall be based on calculations demonstrating the duct or pipe integrity. As an alternative to calculations, the strength can be verified by representative tests.

9.8.4 For low pressure fuel piping the duct shall be dimensioned for a design pressure not less than the maximum working pressure of the fuel pipes. The duct shall be pressure tested to show that it can withstand the expected maximum pressure at fuel pipe rupture.

9.9 Regulations for compressors and pumps

9.9.1 If compressors or pumps are driven by shafting passing through a bulkhead or deck, the bulkhead penetration shall be of gastight type.

9.9.2 Compressors and pumps shall be suitable for their intended purpose. All equipment and machinery shall be such as to be adequately tested to ensure suitability for use within a marine environment. Such items to be considered would include, but not be limited to:

.1 environmental;

.2 shipboard vibrations and accelerations;

.3 effects of pitch, heave and roll motions, etc.; and

.4 gas composition.

9.9.3 Arrangements shall be made to ensure that under no circumstances liquefied gas can be introduced in the gas control section or gas-fuelled machinery, unless the machinery is designed to operate with gas in liquid state.

9.9.4 Compressors and pumps shall be fitted with accessories and instrumentation necessary for efficient and reliable function.

10 POWER GENERATION INCLUDING PROPULSION AND OTHER GAS CONSUMERS

10.1 Goal

10.1.1 The goal of this chapter is to provide safe and reliable delivery of mechanical, electrical or thermal energy.

10.2 Functional requirements

This chapter is related to functional requirements in 3.2.1, 3.2.11, 3.2.13, 3.2.16 and 3.2.17. In particular the following apply:

.1 the exhaust systems shall be configured to prevent any accumulation of un-burnt gaseous fuel;

.2 unless designed with the strength to withstand the worst case over pressure due to ignited gas leaks, engine components or systems containing or likely to contain an ignitable gas and air mixture shall 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 shall be led away from where personnel may normally be present; and

.4 all gas consumers shall have a separate exhaust system.

10.3 Regulations for internal combustion engines of piston type

10.3.1 General

10.3.1.1 The exhaust system shall be equipped with explosion relief ventilation sufficiently dimensioned to prevent excessive explosion pressures in the event of ignition failure of one cylinder followed by ignition of the unburned gas in the system.

10.3.1.2 For engines where the space below the piston is in direct communication with the crankcase a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase shall be carried out and reflected in the safety concept of the engine.

10.3.1.3 Each engine other than two-stroke crosshead diesel engines shall be fitted with vent systems independent of other engines for crankcases and sumps.

10.3.1.4 Where gas can leak directly into the auxiliary system medium (lubricating oil, cooling water), an appropriate means shall be fitted after the engine outlet to extract gas in order to prevent gas dispersion. The gas extracted from auxiliary systems media shall be vented to a safe location in the atmosphere.

10.3.1.5 For engines fitted with ignition systems, prior to admission of gas fuel, correct operation of the ignition system on each unit shall be verified.

10.3.1.6 A means shall be provided to monitor and detect poor combustion or misfiring. In the event that it is detected, gas operation may be allowed provided that the gas supply to the concerned cylinder is shut off and provided that the operation of the engine with one cylinder cut-off is acceptable with respects to torsional vibrations.

10.3.1.7 For engines starting on fuels covered by this Code, if combustion has not been detected by the engine monitoring system within an engine specific time after the opening of the fuel supply valve, the fuel supply valve shall be automatically shut off. Means to ensure that any unburnt fuel mixture is purged away from the exhaust system shall be provided.

10.3.2 Regulations for dual fuel engines

10.3.2.1 In case of shutoff of the gas fuel supply, the engines shall be capable of continuous operation by oil fuel only without interruption.

10.3.2.2 An automatic system shall be fitted to change over from gas fuel operation to oil fuel operation and vice versa with minimum fluctuation of the engine power. Acceptable reliability shall be demonstrated through testing. In the case of unstable operation on engines when gas firing, the engine shall automatically change to oil fuel mode. Manual activation of gas system shutdown shall always be possible.

10.3.2.3 In case of a normal stop or an emergency shutdown, the gas fuel supply shall be shut off not later than the ignition source. It shall not be possible to shut off the ignition source without first or simultaneously closing the gas supply to each cylinder or to the complete engine.

10.3.3 Regulations for gas-only engines

In case of a normal stop or an emergency shutdown, the gas fuel supply shall be shut off not later than the ignition source. It shall not be possible to shut off the ignition source without first or simultaneously closing the gas supply to each cylinder or to the complete engine.

10.3.4 Regulations for multi-fuel engines

10.3.4.1 In case of shutoff of one fuel supply, the engines shall be capable of continuous operation by an alternative fuel with minimum fluctuation of the engine power.

10.3.4.2 An automatic system shall be fitted to change over from one fuel operation to an alternative fuel operation with minimum fluctuation of the engine power. Acceptable reliability shall be demonstrated through testing. In the case of unstable operation on an engine when using a particular fuel, the engine shall automatically change to an alternative fuel mode. Manual activation shall always be possible.

	GAS ONLY		**DUAL FUEL**	**MULTI FUEL**
IGNITION MEDIUM	Spark	Pilot fuel	Pilot fuel	N/A
MAIN FUEL	Gas	Gas	Gas and/ or Oil fuel	Gas and/ or Liquid

10.4 Regulations for main and auxiliary boilers

10.4.1 Each boiler shall have a dedicated forced draught system. A crossover between boiler force draught systems may be fitted for emergency use providing that any relevant safety functions are maintained.

10.4.2 Combustion chambers and uptakes of boilers shall be designed to prevent any accumulation of gaseous fuel.

10.4.3 Burners shall be designed to maintain stable combustion under all firing conditions.

10.4.4 On main/propulsion boilers an automatic system shall be provided to change from gas fuel operation to oil fuel operation without interruption of boiler firing.

10.4.5 Gas nozzles and the burner control system shall be configured such that gas fuel can only be ignited by an established oil fuel flame, unless the boiler and combustion equipment is designed and approved by the Administration to light on gas fuel.

10.4.6 There shall be arrangements to ensure that gas fuel flow to the burner is automatically cut off unless satisfactory ignition has been established and maintained.

10.4.7 On the fuel pipe of each gas burner a manually operated shutoff valve shall be fitted.

10.4.8 Provisions shall be made for automatically purging the gas supply piping to the burners, by means of an inert gas, after the extinguishing of these burners.

10.4.9 The automatic fuel changeover system required by 10.4.4 shall be monitored with alarms to ensure continuous availability.

10.4.10 Arrangements shall be made that, in case of flame failure of all operating burners, the combustion chambers of the boilers are automatically purged before relighting.

10.4.11 Arrangements shall be made to enable the boilers purging sequence to be manually activated.

10.5 Regulations for gas turbines

10.5.1 Unless designed with the strength to withstand the worst case over pressure due to ignited gas leaks, pressure relief systems shall be suitably designed and fitted to the exhaust system, taking into consideration of explosions due to gas leaks. Pressure relief systems within the exhaust uptakes shall be lead to a safe location, away from personnel.

10.5.2 The gas turbine may be fitted in a gas-tight enclosure arranged in accordance with the ESD principle outlined in 5.6 and 9.7, however a pressure above 1.0 MPa in the gas supply piping may be accepted within this enclosure.

10.5.3 Gas detection systems and shutdown functions shall be as outlined for ESD protected machinery spaces.

10.5.4 Ventilation for the enclosure shall be as outlined in chapter 13 for ESD protected machinery spaces, but shall in addition be arranged with full redundancy (2 x 100% capacity fans from different electrical circuits).

10.5.5 For other than single fuel gas turbines, an automatic system shall be fitted to change over easily and quickly from gas fuel operation to oil fuel operation and vice-versa with minimum fluctuation of the engine power.

10.5.6 Means shall be provided to monitor and detect poor combustion that may lead to unburnt fuel gas in the exhaust system during operation. In the event that it is detected, the fuel gas supply shall be shutdown.

10.5.7 Each turbine shall be fitted with an automatic shutdown device for high exhaust temperatures.

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 natural gas as ship fuel.

11.2 Functional requirements

This chapter is related to functional requirements in 3.2.2, 3.2.4, 3.2.5, 3.2.7, 3.2.12, 3.2.14, 3.2.15 and 3.2.17.

11.3 Regulations for fire protection

11.3.1 Any space containing equipment for the fuel preparation such as pumps, compressors, heat exchangers, vaporizers and pressure vessels shall be regarded as a machinery space of category A for fire protection purposes.

11.3.2 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, and any boundaries above that, including navigation bridge windows, shall have A-0 class divisions. In addition, fuel tanks shall be segregated from cargo in accordance with the requirements of the International Maritime Dangerous Goods (IMDG) Code where the fuel tanks are regarded as bulk packaging. For the purposes of the stowage and segregation requirements of the IMDG Code, a fuel tank on the open deck shall be considered a class 2.1 package.

11.3.3 The space containing fuel containment system shall be separated from the machinery spaces of category A or other rooms with high fire risks. The separation shall be done by a cofferdam of at least 900 mm with insulation of A-60 class. When determining the insulation of the space containing fuel containment system from other spaces with lower fire risks, the fuel containment system shall be considered as a machinery space of category A, in accordance with SOLAS regulation II-2/9. The boundary between spaces containing fuel containment systems shall be either a cofferdam of at least 900 mm or A-60 class division. For type C tanks, the fuel storage hold space may be considered as a cofferdam.

11.3.4 The fuel storage hold space shall not be used for machinery or equipment that may have a fire risk.

11.3.5 The fire protection of fuel pipes led through ro-ro spaces shall be subject to special consideration by the Administration depending on the use and expected pressure in the pipes.

11.3.6 The bunkering station shall be separated by A-60 class divisions towards machinery spaces of category A, accommodation, control stations and high fire risk spaces, except for spaces such as tanks, voids, auxiliary machinery spaces of little or no fire risk, sanitary and similar spaces where the insulation standard may be reduced to class A-0.

11.3.7 If an ESD protected machinery spaces is separated by a single boundary, the boundary shall be of A-60 class division.

11.4 Regulations for fire main

11.4.1 The water spray system required below may be part of the fire main system provided that the required fire pump capacity and working pressure are sufficient for the operation of both the required numbers of hydrants and hoses and the water spray system simultaneously.

11.4.2 When the fuel storage tank(s) is located on the open deck, isolating valves shall be fitted in the fire main in order to isolate damaged sections of the fire main. Isolation of a section of fire main shall not deprive the fire line ahead of the isolated section from the supply of water.

11.5 Regulations for water spray system

11.5.1 A water spray system shall be installed for cooling and fire prevention to cover exposed parts of fuel storage tank(s) located on open deck.

11.5.2 The water spray system shall also provide coverage for boundaries of the superstructures, compressor rooms, pump-rooms, cargo control rooms, bunkering control stations, bunkering stations and any other normally occupied deck houses that face the storage tank on open decks unless the tank is located 10 metres or more from the boundaries.

11.5.3 The system shall be designed to cover all areas as specified above with an application rate of 10 $l/min/m^2$ for the largest horizontal projected surfaces and 4 $l/min/m^2$ for vertical surfaces.

11.5.4 Stop valves shall be fitted in the water spray application main supply line(s), at intervals not exceeding 40 metres, 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 not likely to be inaccessible in case of fire in the areas protected.

11.5.5 The capacity of the water spray pump shall be sufficient to deliver the required amount of water to the hydraulically most demanding area as specified above in the areas protected.

11.5.6 If the water spray system is not part of the fire main system, a connection to the ship's fire main through a stop valve shall be provided.

11.5.7 Remote start of pumps supplying the water spray system and remote operation of any normally closed valves to the system shall be located in a readily accessible position which is not likely to be inaccessible in case of fire in the areas protected.

11.5.8 The nozzles shall be of an approved full bore type and they shall be arranged to ensure an effective distribution of water throughout the space being protected.

11.6 Regulations for dry chemical powder fire-extinguishing system

11.6.1 A permanently installed dry chemical powder fire-extinguishing system shall be installed in the bunkering station area to cover all possible leak points. The capacity shall be at least 3.5 kg/s for a minimum of 45 s. The system shall be arranged for easy manual release from a safe location outside the protected area.

11.6.2 In addition to any other portable fire extinguishers that may be required elsewhere in IMO instruments, one portable dry powder extinguisher of at least 5 kg capacity shall be located near the bunkering station.

11.7 Regulations for fire detection and alarm system

11.7.1 A fixed fire detection and fire alarm system complying with the Fire Safety Systems Code shall be provided for the fuel storage hold spaces and the ventilation trunk for fuel containment system below deck, and for all other rooms of the fuel gas system where fire cannot be excluded.

11.7.2 Smoke detectors alone shall not be considered sufficient for rapid detection of a fire.

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

This chapter is related to functional requirements in 3.2.2 to 3.2.5, 3.2.7, 3.2.8, 3.2.12 to 3.2.14 and 3.2.17. In particular the following apply:

The probability of explosions shall be reduced to a minimum by:

.1 reducing number of sources of ignition; and

.2 reducing the probability of formation of ignitable mixtures.

12.3 Regulations – General

12.3.1 Hazardous areas on open deck and other spaces not addressed in this chapter shall be decided based on a recognized standard.[19] The electrical equipment fitted within hazardous areas shall be according to the same standard.

12.3.2 Electrical equipment and wiring shall in general not be installed in hazardous areas unless essential for operational purposes based on a recognized standard.[20]

[19] Refer to IEC standard 60092-502, part 4.4: Tankers carrying flammable liquefied gases as applicable.

[20] Refer to IEC standard 60092-502: IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features and IEC 60079-10-1:2008 Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres, according to the area classification.

12.3.3 Electrical equipment fitted in an ESD-protected machinery space shall fulfil the following:

.1 in addition to fire and gas hydrocarbon detectors and fire and gas alarms, lighting and ventilation fans shall be certified safe for hazardous area zone 1; and

.2 all electrical equipment in a machinery space containing gas-fuelled engines, and not certified for zone 1 shall be automatically disconnected, if gas concentrations above 40% LEL is detected by two detectors in the space containing gas-fuelled consumers.

12.4 Regulations on area classification

12.4.1 Area classification is a method of analysing and classifying the areas where explosive gas atmospheres may occur. The object of the classification is to allow the selection of electrical apparatus able to be operated safely in these areas.

12.4.2 In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2.[21] See also 12.5 below.

12.4.3 Ventilation ducts shall have the same area classification as the ventilated space.

12.5 Hazardous area zones

12.5.1 Hazardous area zone 0

This zone includes, but is not limited to the interiors of fuel tanks, any pipework for pressure-relief or other venting systems for fuel tanks, pipes and equipment containing fuel.

12.5.2 Hazardous area zone 1[22]

This zone includes, but is not limited to:

.1 tank connection spaces, fuel storage hold spaces[23] and interbarrier spaces;

.2 fuel preparation room arranged with ventilation according to 13.6;

.3 areas on open deck, or semi-enclosed spaces on deck, within 3 m of any fuel tank outlet, gas or vapour outlet,[24] bunker manifold valve, other fuel valve, fuel pipe flange, fuel preparation room ventilation outlets and fuel tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation;

.4 areas on open deck or semi-enclosed spaces on deck, within 1.5 m of fuel preparation room entrances, fuel preparation room ventilation inlets and other openings into zone 1 spaces;

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21 Refer to standards IEC 60079-10-1:2008 Explosive atmospheres part 10-1: Classification of areas – Explosive gas atmospheres and guidance and informative examples given in IEC 60092-502:1999, Electrical Installations in Ships – Tankers – Special Features for tankers.

22 Instrumentation and electrical apparatus installed within these areas should be of a type suitable for zone 1.

23 Fuel storage hold spaces for type C tanks are normally not considered as zone 1.

24 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.

.5 areas on the open deck within spillage coamings surrounding gas bunker manifold valves and 3 m beyond these, up to a height of 2.4 m above the deck;

.6 enclosed or semi-enclosed spaces in which pipes containing fuel are located, e.g. ducts around fuel pipes, semi-enclosed bunkering stations;

.7 the ESD-protected machinery space is considered a non-hazardous area during normal operation, but will require equipment required to operate following detection of gas leakage to be certified as suitable for zone 1;

.8 a space protected by an airlock is considered as non-hazardous area during normal operation, but will require equipment required to operate following loss of differential pressure between the protected space and the hazardous area to be certified as suitable for zone 1; and

.9 except for type C tanks, an area within 2.4 m of the outer surface of a fuel containment system where such surface is exposed to the weather.

12.5.3 Hazardous area zone 2[25]

12.5.3.1 This zone includes, but is not limited to areas within 1.5 m surrounding open or semi-enclosed spaces of zone 1.

12.5.3.2 Space containing bolted hatch to tank connection space.

13 VENTILATION

13.1 Goal

The goal of this chapter is to provide for the ventilation required for safe operation of gas-fuelled machinery and equipment.

13.2 Functional requirements

This chapter is related to functional requirements in 3.2.2, 3.2.5, 3.2.8, 3.2.10, 3.2.12 to 3.2.14 and 3.2.17.

13.3 Regulations – General

13.3.1 Any ducting used for the ventilation of hazardous spaces shall be separate from that used for the ventilation of non-hazardous spaces. The ventilation shall function at all temperatures and environmental conditions the ship will be operating in.

13.3.2 Electric motors for ventilation fans shall not be located in ventilation ducts for hazardous spaces unless the motors are certified for the same hazard zone as the space served.

[25] Instrumentation and electrical apparatus installed within these areas should be of a type suitable for zone 2.

13.3.3 Design of ventilation fans serving spaces containing gas sources shall fulfil the following:

.1 Ventilation fans shall not produce a source of vapour ignition in either the ventilated space or the ventilation system associated with the space. Ventilation fans and fan ducts, in way of fans only, shall be of non-sparking construction defined as:

.1 impellers or housings of non-metallic material, due regard being paid to the elimination of static electricity;

.2 impellers and housings of non-ferrous metals;

.3 impellers and housings of austenitic stainless steel;

.4 impellers of aluminium alloys or magnesium alloys and a ferrous (including austenitic stainless steel) housing on which a ring of suitable thickness of non-ferrous materials is fitted in way of the impeller, due regard being paid to static electricity and corrosion between ring and housing; or

.5 any combination of ferrous (including austenitic stainless steel) impellers and housings with not less than 13 mm tip design clearance.

.2 In no case shall the radial air gap between the impeller and the casing be less than 0.1 of the diameter of the impeller shaft in way of the bearing but not less than 2 mm. The gap need not be more than 13 mm.

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

13.3.4 Ventilation systems required to avoid any gas accumulation shall consist of independent fans, each of sufficient capacity, unless otherwise specified in this Code.

13.3.5 Air inlets for hazardous enclosed spaces shall be taken from areas that, in the absence of the considered inlet, 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. Where the inlet duct passes through a more hazardous space, the duct shall be gas-tight and have over-pressure relative to this space.

13.3.6 Air outlets from non-hazardous spaces shall be located outside hazardous areas.

13.3.7 Air outlets from hazardous enclosed spaces shall be located in an open area that, in the absence of the considered outlet, would be of the same or lesser hazard than the ventilated space.

13.3.8 The required capacity of the ventilation plant is normally based on the total volume of the room. An increase in required ventilation capacity may be necessary for rooms having a complicated form.

13.3.9 Non-hazardous spaces with entry openings to a hazardous area shall be arranged with an airlock and be maintained at overpressure relative to the external hazardous area. The overpressure ventilation shall be arranged according to the following:

.1 During initial start-up or after loss of overpressure ventilation, before energizing any electrical installations not certified safe for the space in the absence of pressurization, it shall be required to:

.1 proceed with purging (at least 5 air changes) or confirm by measurements that the space is non-hazardous; and

.2 pressurize the space.

.2 Operation of the overpressure ventilation shall be monitored and in the event of failure of the overpressure ventilation:

.1 an audible and visual alarm shall be given at a manned location; and

.2 if overpressure cannot be immediately restored, automatic or programmed, disconnection of electrical installations according to a recognized standard[26] shall be required.

13.3.10 Non-hazardous spaces with entry openings to a hazardous enclosed space shall be arranged with an airlock and the hazardous space shall be maintained at underpressure relative to the non-hazardous space. Operation of the extraction ventilation in the hazardous space shall be monitored and in the event of failure of the extraction ventilation:

.1 an audible and visual alarm shall be given at a manned location; and

.2 if underpressure cannot be immediately restored, automatic or programmed, disconnection of electrical installations according to a recognized standard in the non-hazardous space shall be required.

13.4 Regulations for tank connection space

13.4.1 The tank connection space shall be provided with an effective mechanical forced ventilation system of extraction type. A ventilation capacity of at least 30 air changes per hour shall be provided. The rate of air changes may be reduced if other adequate means of explosion protection are installed. The equivalence of alternative installations shall be demonstrated by a risk assessment.

13.4.2 Approved automatic fail-safe fire dampers shall be fitted in the ventilation trunk for the tank connection space.

13.5 Regulations for machinery spaces

13.5.1 The ventilation system for machinery spaces containing gas-fuelled consumers shall be independent of all other ventilation systems.

[26] Refer to IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features, table 5.

13.5.2 ESD protected machinery spaces shall have ventilation with a capacity of at least 30 air changes per hour. The ventilation system shall ensure a good air circulation in all spaces, and in particular ensure that any formation of gas pockets in the room are detected. As an alternative, arrangements whereby under normal operation the machinery spaces are ventilated with at least 15 air changes an hour is acceptable provided that, if gas is detected in the machinery space, the number of air changes will automatically be increased to 30 an hour.

13.5.3 For ESD protected machinery spaces the ventilation arrangements shall provide sufficient redundancy to ensure a high level of ventilation availability as defined in a standard acceptable to the Organization.[27]

13.5.4 The number and power of the ventilation fans for ESD protected engine-rooms and for double pipe ventilation systems for gas safe engine-rooms shall be such that the capacity is not reduced by more than 50% of the total ventilation capacity if a fan with a separate circuit from the main switchboard or emergency switchboard or a group of fans with common circuit from the main switchboard or emergency switchboard, is inoperable.

13.6 Regulations for fuel preparation room

13.6.1 Fuel preparation rooms, shall be fitted with effective mechanical ventilation system of the underpressure type, providing a ventilation capacity of at least 30 air changes per hour.

13.6.2 The number and power of the ventilation fans shall be such that the capacity is not reduced by more than 50%, if a fan with a separate circuit from the main switchboard or emergency switchboard or a group of fans with common circuit from the main switchboard or emergency switchboard, is inoperable.

13.6.3 Ventilation systems for fuel preparation rooms, shall be in operation when pumps or compressors are working.

13.7 Regulations for bunkering station

Bunkering stations that are not located on open deck shall be suitably ventilated to ensure that any vapour being released during bunkering operations will be removed outside. If the natural ventilation is not sufficient, mechanical ventilation shall be provided in accordance with the risk assessment required by 8.3.1.1.

13.8 Regulations for ducts and double pipes

13.8.1 Ducts and double pipes containing fuel piping shall be fitted with effective mechanical ventilation system of the extraction type, providing a ventilation capacity of at least 30 air changes per hour. This is not applicable to double pipes in the engine-room if fulfilling 9.6.1.1.

13.8.2 The ventilation system for double piping and for gas valve unit spaces in gas safe engine-rooms shall be independent of all other ventilation systems.

13.8.3 The ventilation inlet for the double wall piping or duct shall always be located in a non-hazardous area away from ignition sources. The inlet opening shall be fitted with a suitable wire mesh guard and protected from ingress of water.

13.8.4 The capacity of the ventilation for a pipe duct or double wall piping may be below 30 air changes per hour if a flow velocity of minimum 3 m/s is ensured. The flow velocity shall be calculated for the duct with fuel pipes and other components installed.

[27] Refer to IEC 60079-10-1.

14 ELECTRICAL INSTALLATIONS

14.1 Goal

The goal of this chapter is to provide for electrical installations that minimizes the risk of ignition in the presence of a flammable atmosphere.

14.2 Functional requirements

This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.4, 3.2.7, 3.2.8, 3.2.11, 3.2.13 and 3.2.16 to 3.2.18. In particular the following apply:

Electrical generation and distribution systems, and associated control systems, shall be designed such that a single fault will not result in the loss of ability to maintain fuel tank pressures and hull structure temperature within normal operating limits.

14.3 Regulations – General

14.3.1 Electrical installations shall be in compliance with a standard at least equivalent to those acceptable to the Organization.[28]

14.3.2 Electrical equipment or wiring shall not be installed in hazardous areas unless essential for operational purposes or safety enhancement.

14.3.3 Where electrical equipment is installed in hazardous areas as provided in 14.3.2 it shall be selected, installed and maintained in accordance with standards at least equivalent to those acceptable to the Organization.[29]

Equipment for hazardous areas shall be evaluated and certified or listed by an accredited testing authority or notified body recognized by the Administration.

14.3.4 Failure modes and effects of single failure for electrical generation and distribution systems in 14.2 shall be analysed and documented to be at least equivalent to those acceptable to the Organization.[30]

14.3.5 The lighting system in hazardous areas shall be divided between at least two branch circuits. All switches and protective devices shall interrupt all poles or phases and shall be located in a non-hazardous area.

14.3.6 The installation on board of the electrical equipment units shall be such as to ensure the safe bonding to the hull of the units themselves.

14.3.7 Arrangements shall be made to alarm in low-liquid level and automatically shutdown the motors in the event of low-liquid level. The automatic shutdown may be accomplished by sensing low pump discharge pressure, low motor current, or low-liquid level. This shutdown shall give an audible and visual alarm on the navigation bridge, continuously manned central control station or onboard safety centre.

14.3.8 Submerged fuel pump motors and their supply cables may be fitted in liquefied gas fuel containment systems. Fuel pump motors shall be capable of being isolated from their electrical supply during gas-freeing operations.

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[28] Refer to IEC 60092 series standards, as applicable.

[29] Refer to the recommendation published by the International Electrotechnical Commission, in particular to publication IEC 60092-502:1999.

[30] Refer to IEC 60812.

14.3.9 For non-hazardous spaces with access from hazardous open deck where the access is protected by an airlock, electrical equipment which is not of the certified safe type shall be de-energized upon loss of overpressure in the space.

14.3.10 Electrical equipment for propulsion, power generation, manoeuvring, anchoring and mooring, as well as emergency fire pumps, that are located in spaces protected by airlocks, shall be of a certified safe type.

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 gas-fuelled installation as covered in the other chapters of this Code.

15.2 Functional requirements

This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.11, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18. In particular the following apply:

.1 the control, monitoring and safety systems of the gas-fuelled installation shall 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 a gas safety system shall be arranged to close down the gas 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 for ESD protected machinery configurations the safety system shall shutdown gas supply upon gas leakage and in addition disconnect all non-certified safe type electrical equipment in the machinery space;

.4 the safety functions shall 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;

.5 the safety systems including the field instrumentation shall 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

.6 where two or more gas supply systems are required to meet the regulations, each system shall be fitted with its own set of independent gas control and gas safety systems.

15.3 Regulations – General

15.3.1 Suitable instrumentation devices shall 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.

15.3.2 A bilge well in each tank connection space of an independent liquefied gas storage tank shall be provided with both a level indicator and a temperature sensor. Alarm shall be given at high level in the bilge well. Low temperature indication shall activate the safety system.

15.3.3 For tanks not permanently installed in the ship a monitoring system shall be provided as for permanently installed tanks.

15.4 Regulations for bunkering and liquefied gas fuel tank monitoring

15.4.1 Level indicators for liquefied gas fuel tanks

.1 Each liquefied gas fuel tank shall be fitted with liquid level gauging device(s), arranged to ensure a level reading is always obtainable whenever the liquefied gas fuel tank is operational. The device(s) shall 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 shall be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank.

.3 Liquefied gas 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 liquefied gas fuel tank, such as devices using radio-isotopes or ultrasonic devices;

15.4.2 Overflow control

.1 Each liquefied gas fuel tank shall 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 shall automatically actuate a shutoff valve in a manner that will both avoid excessive liquid pressure in the bunkering line and prevent the liquefied gas fuel tank from becoming liquid full.

.3 The position of the sensors in the liquefied gas fuel tank shall be capable of being verified before commissioning. At the first occasion of full loading after delivery and after each dry-docking, testing of high level alarms shall be conducted by raising the fuel liquid level in the liquefied gas 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, shall be capable of being functionally tested. Systems shall be tested prior to fuel operation in accordance with 18.4.3.

.5 Where arrangements are provided for overriding the overflow control system, they shall be such that inadvertent operation is prevented. When this override is operated continuous visual indication 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 liquefied gas fuel tank shall be provided with a direct reading gauge. Additionally, an indirect indication is to be provided on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.4 The pressure indicators shall be clearly marked with the highest and lowest pressure permitted in the liquefied gas fuel tank.

15.4.5 A high-pressure alarm and, if vacuum protection is required, a low-pressure alarm shall be provided on the navigation bridge and at a continuously manned central control station or onboard safety centre. Alarms shall 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 fuel manifold shall be provided with at least one local pressure indicator.

15.4.7 Local-reading manifold pressure indicator shall be provided to indicate the pressure between ship's manifold valves and hose connections to the shore.

15.4.8 Fuel storage hold spaces and interbarrier spaces without open connection to the atmosphere shall be provided with pressure indicator.

15.4.9 At least one of the pressure indicators provided shall be capable of indicating throughout the operating pressure range.

15.4.10 For submerged fuel-pump motors and their supply cables, arrangements shall be made to alarm in low-liquid level and automatically shutdown the motors in the event of low-liquid level. The automatic shutdown may be accomplished by sensing low pump discharge pressure, low motor current, or low-liquid level. This shutdown shall give an audible and visual alarm on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.11 Except for independent tanks of type C supplied with vacuum insulation system and pressure build-up fuel discharge unit, each fuel tank shall be provided with devices to measure and indicate the temperature of the fuel in at least three locations; at the bottom and middle of the tank as well as the top of the tank below the highest allowable liquid level.

15.5 Regulations for bunkering control

15.5.1 Control of the bunkering shall be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature if required by 15.4.11, and tank level shall be monitored. Remotely controlled valves required by 8.5.3 and 11.5.7 shall be capable of being operated from this location. Overfill alarm and automatic shutdown shall also be indicated at this location.

15.5.2 If the ventilation in the ducting enclosing the bunkering lines stops, an audible and visual alarm shall be provided at the bunkering control location, see also 15.8.

15.5.3 If gas is detected in the ducting around the bunkering lines an audible and visual alarm and emergency shutdown shall be provided at the bunkering control location.

15.6 Regulations for gas compressor monitoring

15.6.1 Gas compressors shall be fitted with audible and visual alarms both on the navigation bridge and in the engine control room. As a minimum the alarms shall include low gas input pressure, low gas output pressure, high gas output pressure and compressor operation.

15.6.2 Temperature monitoring for the bulkhead shaft glands and bearings shall 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 Regulations for gas engine monitoring

In addition to the instrumentation provided in accordance with part C of SOLAS chapter II-1, indicators shall be fitted on the navigation bridge, the engine control room and the manoeuvring platform for:

.1 operation of the engine in case of gas-only engines; or

.2 operation and mode of operation of the engine in the case of dual fuel engines.

15.8 Regulations for gas detection

15.8.1 Permanently installed gas detectors shall be fitted in:

.1 the tank connection spaces;

.2 all ducts around fuel pipes;

.3 machinery spaces containing gas piping, gas equipment or gas consumers;

.4 compressor rooms and fuel preparation rooms;

.5 other enclosed spaces containing fuel piping or other fuel equipment without ducting;

.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;

.8 gas heating circuit expansion tanks;

.9 motor rooms associated with the fuel systems; and

.10 or at ventilation inlets to accommodation and machinery spaces if required based on the risk assessment required in 4.2.

15.8.2 In each ESD-protected machinery space, redundant gas detection systems shall be provided.

15.8.3 The number of detectors in each space shall be considered taking into account the size, layout and ventilation of the space.

15.8.4 The detection equipment shall be located where gas may accumulate and in the ventilation outlets. Gas dispersal analysis or a physical smoke test shall be used to find the best arrangement.

15.8.5 Gas detection equipment shall be designed, installed and tested in accordance with a recognized standard.[31]

[31] Refer to IEC 60079-29-1 – Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable detectors.

15.8.6 An audible and visible alarm shall be activated at a gas vapour concentration of 20% of the lower explosion limit (LEL). The safety system shall be activated at 40% of LEL at two detectors (see footnote 1 in table 1).

15.8.7 For ventilated ducts around gas pipes in the machinery spaces containing gas-fuelled engines, the alarm limit can be set to 30% LEL. The safety system shall be activated at 60% of LEL at two detectors (see footnote 1 in table 1).

15.8.8 Audible and visible alarms from the gas detection equipment shall be located on the navigation bridge or in the continuously manned central control station.

15.8.9 Gas detection required by this section shall be continuous without delay.

15.9 Regulations for fire detection

Required safety actions at fire detection in the machinery space containing gas-fuelled engines and rooms containing independent tanks for fuel storage hold spaces are given in table 1 below.

15.10 Regulations for ventilation

15.10.1 Any loss of the required ventilating capacity shall give an audible and visual alarm on the navigation bridge or in a continuously manned central control station or safety centre.

15.10.2 For ESD protected machinery spaces the safety system shall be activated upon loss of ventilation in engine-room.

15.11 Regulations on 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 shall 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 shall be placed at the operating station for the shutoff valves in the fuel supply lines.

15.11.2 If a fuel leak leading to a fuel supply shutdown occurs, the fuel supply shall not be operated until the leak has been found and dealt with. Instructions to this effect shall be placed in a prominent position in the machinery space.

15.11.3 A caution placard or signboard shall be permanently fitted in the machinery space containing gas-fuelled engines stating that heavy lifting, implying danger of damage to the fuel pipes, shall not be done when the engine(s) is running on gas.

15.11.4 Compressors, pumps and fuel supply shall 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.

The gas compressor shall also be arranged for manual local emergency stop.

Table 1: Monitoring of gas supply system to engines

Parameter	Alarm	Automatic shutdown of tank valve[6)]	Automatic shutdown of gas supply to machinery space containing gas-fuelled engines	Comments
Gas detection in tank connection space at 20% LEL	X			
Gas detection on two detectors[1)] in tank connection space at 40% LEL	X	X		
Fire detection in fuel storage hold space	X			
Fire detection in ventilation trunk for fuel containment system below deck	X			
Bilge well high level in tank connection space	X			
Bilge well low temperature in tank connection space	X	X		
Gas detection in duct between tank and machinery space containing gas-fuelled engines at 20% LEL	X			
Gas detection on two detectors[1)] in duct between tank and machinery space containing gas-fuelled engines at 40% LEL	X	X[2)]		
Gas detection in fuel preparation room at 20% LEL	X			
Gas detection on two detectors[1)] in fuel preparation room at 40% LEL	X	X[2)]		
Gas detection in duct inside machinery space containing gas-fuelled engines at 30% LEL	X			If double pipe fitted in machinery space containing gas-fuelled engines

Parameter	Alarm	Automatic shutdown of tank valve[6)]	Automatic shutdown of gas supply to machinery space containing gas-fuelled engines	Comments
Gas detection on two detectors[1)] in duct inside machinery space containing gas-fuelled engines at 60% LEL	X		X[3)]	If double pipe fitted in machinery space containing gas-fuelled engines
Gas detection in ESD protected machinery space containing gas-fuelled engines at 20% LEL	X			
Gas detection on two detectors[1)] in ESD protected machinery space containing gas-fuelled engines at 40% LEL	X		X	It shall also disconnect non certified safe electrical equipment in machinery space containing gas-fuelled engines
Loss of ventilation in duct between tank and machinery space containing gas-fuelled engines	X		X[2)]	
Loss of ventilation in duct inside machinery space containing gas-fuelled engines[5)]	X		X[3)]	If double pipe fitted in machinery space containing gas-fuelled engines
Loss of ventilation in ESD protected machinery space containing gas-fuelled engines	X		X	
Fire detection in machinery space containing gas-fuelled engines	X			
Abnormal gas pressure in gas supply pipe	X			
Failure of valve control actuating medium	X		X[4)]	Time delayed as found necessary
Automatic shutdown of engine (engine failure)	X		X[4)]	

Parameter	Alarm	Automatic shutdown of tank valve[6)]	Automatic shutdown of gas supply to machinery space containing gas-fuelled engines	Comments
Manually activated emergency shutdown of engine	X		X	

1) Two independent gas detectors located close to each other are required for redundancy reasons. If the gas detector is of self-monitoring type the installation of a single gas detector can be permitted.

2) If the tank is supplying gas to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected shall close.

3) If the gas is supplied to more than one engine and the different supply pipes are completely separated and fitted in separate ducts and with the master valves fitted outside of the duct and outside of the machinery space containing gas-fuelled engines, only the master valve on the supply pipe leading into the duct where gas or loss of ventilation is detected shall close.

4) Only double block and bleed valves to close.

5) If the duct is protected by inert gas (see 9.6.1.1) then loss of inert gas overpressure shall lead to the same actions as given in this table.

6) Valves referred to in 9.4.1.

ANNEX

STANDARD FOR THE USE OF LIMIT STATE METHODOLOGIES IN THE DESIGN OF FUEL CONTAINMENT SYSTEMS OF NOVEL CONFIGURATION

1 GENERAL

1.1 The purpose of this standard is to provide procedures and relevant design parameters of limit state design of fuel containment systems of a novel configuration in accordance with section 6.4.16.

1.2 Limit state design is a systematic approach where each structural element is evaluated with respect to possible failure modes related to the design conditions identified in 6.4.1.6. A limit state can be defined as a condition beyond which the structure, or part of a structure, no longer satisfies the regulations.

1.3 The limit states are divided into the three following categories:

.1 Ultimate Limit States (ULS), which correspond to the maximum load-carrying capacity or, in some cases, to the maximum applicable strain, deformation or instability in structure resulting from buckling and plastic collapse; under intact (undamaged) conditions;

.2 Fatigue Limit States (FLS), which correspond to degradation due to the effect of cyclic loading; and

.3 Accident Limit States (ALS), which concern the ability of the structure to resist accident situations.

1.4 Section 6.4.1 through to section 6.4.14 shall be complied with as applicable depending on the fuel containment system concept.

2 DESIGN FORMAT

2.1 The design format in this standard is based on a Load and Resistance Factor Design format. The fundamental principle of the Load and Resistance Factor Design format is to verify that design load effects, L_d, do not exceed design resistances, R_d, for any of the considered failure modes in any scenario:

$$L_d \leq R_d$$

A design load F_{dk} is obtained by multiplying the characteristic load by a load factor relevant for the given load category:

$$F_{dk} = \gamma_f \cdot F_k$$

where:

γ_f is load factor; and

F_k is the characteristic load as specified in section 6.4.9 through to section 6.4.12.

A design load effect L_d (e.g. stresses, strains, displacements and vibrations) is the most unfavourable combined load effect derived from the design loads, and may be expressed by:

$$L_d = q\left(F_{d1}, F_{d2}, ..., F_{dN}\right)$$

where q denotes the functional relationship between load and load effect determined by structural analyses.

The design resistance R_d is determined as follows:

$$R_d = \frac{R_k}{\gamma_R \cdot \gamma_C}$$

where:

R_k is the characteristic resistance. In case of materials covered by chapter 7, it may be, but not limited to, specified minimum yield stress, specified minimum tensile strength, plastic resistance of cross sections, and ultimate buckling strength;

γ_R is the resistance factor, defined as $\gamma_R = \gamma_m \cdot \gamma_s$;

γ_m is the partial resistance factor to take account of the probabilistic distribution of the material properties (material factor);

γ_s is the partial resistance factor to take account of the uncertainties on the capacity of the structure, such as the quality of the construction, method considered for determination of the capacity including accuracy of analysis; and

γ_C is the consequence class factor, which accounts for the potential results of failure with regard to release of fuel and possible human injury.

2.2 Fuel containment design shall take into account potential failure consequences. Consequence classes are defined in table 1, to specify the consequences of failure when the mode of failure is related to the Ultimate Limit State, the Fatigue Limit State, or the Accident Limit State.

Table 1: Consequence classes

Consequence class	Definition
Low	Failure implies minor release of the fuel.
Medium	Failure implies release of the fuel and potential for human injury.
High	Failure implies significant release of the fuel and high potential for human injury/fatality.

3 REQUIRED ANALYSES

3.1 Three-dimensional finite element analyses shall be carried out as an integrated model of the tank and the ship hull, including supports and keying system as applicable. All the failure modes shall be identified to avoid unexpected failures. Hydrodynamic analyses shall be carried out to determine the particular ship accelerations and motions in irregular waves, and the response of the ship and its fuel containment systems to these forces and motions.

3.2 Buckling strength analyses of fuel tanks subject to external pressure and other loads causing compressive stresses shall be carried out in accordance with recognized standards. The method shall adequately account for the difference in theoretical and actual buckling stress as a result of plate out of flatness, plate edge misalignment, straightness, ovality and deviation from true circular form over a specified arc or chord length, as relevant.

3.3 Fatigue and crack propagation analysis shall be carried out in accordance with paragraph 5.1 of this standard.

4 ULTIMATE LIMIT STATES

4.1 Structural resistance may be established by testing or by complete analysis taking account of both elastic and plastic material properties. Safety margins for ultimate strength shall be introduced by partial factors of safety taking account of the contribution of stochastic nature of loads and resistance (dynamic loads, pressure loads, gravity loads, material strength, and buckling capacities).

4.2 Appropriate combinations of permanent loads, functional loads and environmental loads including sloshing loads shall be considered in the analysis. At least two load combinations with partial load factors as given in table 2 shall be used for the assessment of the ultimate limit states.

Table 2: Partial load factors

Load combination	Permanent loads	Functional loads	Environmental loads
'*a*'	1.1	1.1	0.7
'*b*'	1.0	1.0	1.3

The load factors for permanent and functional loads in load combination '*a*' are relevant for the normally well-controlled and/or specified loads applicable to fuel containment systems such as vapour pressure, fuel weight, system self-weight, etc. Higher load factors may be relevant for permanent and functional loads where the inherent variability and/or uncertainties in the prediction models are higher.

4.3 For sloshing loads, depending on the reliability of the estimation method, a larger load factor may be required by the Administration.

4.4 In cases where structural failure of the fuel containment system are considered to imply high potential for human injury and significant release of fuel, the consequence class factor shall be taken as $\gamma_C = 1.2$. This value may be reduced if it is justified through risk analysis and subject to the approval by the Administration. The risk analysis shall take account of factors including, but not limited to, provision of full or partial secondary barrier to protect hull structure from the leakage and less hazards associated with intended fuel. Conversely, higher values may be fixed by the Administration, for example, for ships carrying more hazardous or higher pressure fuel. The consequence class factor shall in any case not be less than 1.0.

4.5 The load factors and the resistance factors used shall be such that the level of safety is equivalent to that of the fuel containment systems as described in sections 6.4.2.1 to 6.4.2.5. This may be carried out by calibrating the factors against known successful designs.

4.6 The material factor γ_m shall in general reflect the statistical distribution of the mechanical properties of the material, and needs to be interpreted in combination with the specified characteristic mechanical properties. For the materials defined in chapter 6, the material factor γ_m may be taken as:

1.1 when the characteristic mechanical properties specified by the Administration typically represents the lower 2.5% quantile in the statistical distribution of the mechanical properties; or

1.0 when the characteristic mechanical properties specified by the Administration represents a sufficiently small quantile such that the probability of lower mechanical properties than specified is extremely low and can be neglected.

4.7 The partial resistance factors γ_{si} shall in general be established based on the uncertainties in the capacity of the structure considering construction tolerances, quality of construction, the accuracy of the analysis method applied, etc.

4.7.1 For design against excessive plastic deformation using the limit state criteria given in paragraph 4.8 of this standard, the partial resistance factors γ_{si} shall be taken as follows:

$$\gamma_{s1} = 0.76 \cdot \frac{B}{\kappa_1}$$

$$\gamma_{s2} = 0.76 \cdot \frac{D}{\kappa_2}$$

$$\kappa_1 = Min\left(\frac{R_m}{R_e} \cdot \frac{B}{A};1.0\right)$$

$$\kappa_2 = Min\left(\frac{R_m}{R_e} \cdot \frac{D}{C};1.0\right)$$

Factors A, B, C and D are defined in 6.4.15.2.3.1. R_m and R_e are defined in 6.4.12.1.1.3.

The partial resistance factors given above are the results of calibration to conventional type B independent tanks.

4.8 Design against excessive plastic deformation

4.8.1 Stress acceptance criteria given below refer to elastic stress analyses.

4.8.2 Parts of fuel containment systems where loads are primarily carried by membrane response in the structure shall satisfy the following limit state criteria:

$$\sigma_m \leq f$$

$$\sigma_L \leq 1.5f$$

$$\sigma_b \leq 1.5F$$

$$\sigma_L + \sigma_b \leq 1.5F$$

$$\sigma_m + \sigma_b \leq 1.5F$$

$$\sigma_m + \sigma_b + \sigma_g \leq 3.0F$$

$$\sigma_L + \sigma_b + \sigma_g \leq 3.0F$$

where:

σ_m = equivalent primary general membrane stress

σ_L = equivalent primary local membrane stress

σ_b = equivalent primary bending stress

σ_g = equivalent secondary stress

$$f = \frac{R_e}{\gamma_{s1} \cdot \gamma_m \cdot \gamma_C}$$

$$F = \frac{R_e}{\gamma_{s2} \cdot \gamma_m \cdot \gamma_C}$$

Guidance Note:

The stress summation described above shall be carried out by summing up each stress component ($\sigma_x, \sigma_y, \tau_{xy}$), and subsequently the equivalent stress shall be calculated based on the resulting stress components as shown in the example below.

$$\sigma_L + \sigma_b = \sqrt{(\sigma_{Lx} + \sigma_{bx})^2 - (\sigma_{Lx} + \sigma_{bx})(\sigma_{Ly} + \sigma_{by}) + (\sigma_{Ly} + \sigma_{by})^2 + 3(\tau_{Lxy} + \tau_{bxy})^2}$$

4.8.3 Parts of fuel containment systems where loads are primarily carried by bending of girders, stiffeners and plates, shall satisfy the following limit state criteria:

$\sigma_{ms} + \sigma_{bp} \leq 1.25F$ (see notes 1, 2)

$\sigma_{ms} + \sigma_{bp} + \sigma_{bs} \leq 1.25F$ (see note 2)

$\sigma_{ms} + \sigma_{bp} + \sigma_{bs} + \sigma_{bt} + \sigma_g \leq 3.0F$

Note 1: The sum of equivalent section membrane stress and equivalent membrane stress in primary structure ($\sigma_{ms} + \sigma_{bp}$) will normally be directly available from three-dimensional finite element analyses.

Note 2: The coefficient, 1.25, may be modified by the Administration considering the design concept, configuration of the structure, and the methodology used for calculation of stresses.

where:

σ_{ms} = equivalent section membrane stress in primary structure

σ_{bp} = equivalent membrane stress in primary structure and stress in secondary and tertiary structure caused by bending of primary structure

σ_{bs} = section bending stress in secondary structure and stress in tertiary structure caused by bending of secondary structure

σ_{bt} = section bending stress in tertiary structure

σ_g = equivalent secondary stress

$$f = \frac{R_e}{\gamma_{s1} \cdot \gamma_m \cdot \gamma_C}$$

$$F = \frac{R_e}{\gamma_{s2} \cdot \gamma_m \cdot \gamma_C}$$

The stresses σ_{ms}, σ_{bp}, σ_{bs}, and σ_{bt} are defined in 4.8.4.

Guidance Note:

The stress summation described above shall be carried out by summing up each stress component ($\sigma_x, \sigma_y, \tau_{xy}$), and subsequently the equivalent stress shall be calculated based on the resulting stress components.

Skin plates shall be designed in accordance with the requirements of the Administration. When membrane stress is significant, the effect of the membrane stress on the plate bending capacity shall be appropriately considered in addition.

4.8.4 Section stress categories

Normal stress is the component of stress normal to the plane of reference.

Equivalent section membrane stress is the component of the normal stress that is uniformly distributed and equal to the average value of the stress across the cross section of the structure under consideration. If this is a simple shell section, the section membrane stress is identical to the membrane stress defined in paragraph 4.8.2 of this standard.

Section bending stress is the component of the normal stress that is linearly distributed over a structural section exposed to bending action, as illustrated in figure 1.

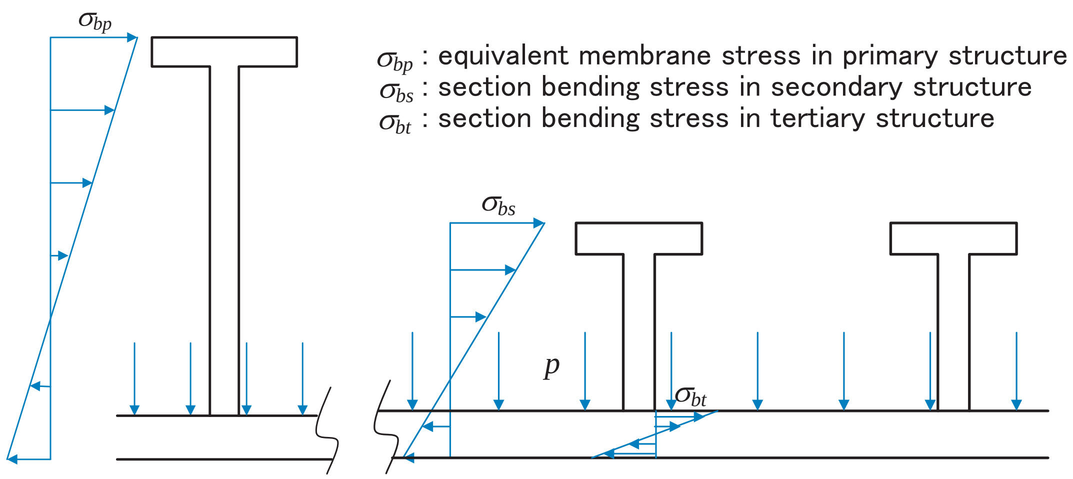

Figure 1: Definition of the three categories of section stress
(Stresses σ_{bp} and σ_{bs} are normal to the cross section shown.)

4.9 The same factors γ_C, γ_m, γ_{si} shall be used for design against buckling unless otherwise stated in the applied recognized buckling standard. In any case the overall level of safety shall not be less than given by these factors.

5 FATIGUE LIMIT STATES

5.1 Fatigue design condition as described in 6.4.12.2 shall be complied with as applicable depending on the fuel containment system concept. Fatigue analysis is required for the fuel containment system designed under 6.4.16 and this standard.

5.2 The load factors for FLS shall be taken as 1.0 for all load categories.

5.3 Consequence class factor γ_C and resistance factor γ_R shall be taken as 1.0.

5.4 Fatigue damage shall be calculated as described in 6.4.12.2.2 to 6.4.12.2.2.5. The calculated cumulative fatigue damage ratio for the fuel containment systems shall be less than or equal to the values given in table 3.

Table 3: Maximum allowable cumulative fatigue damage ratio

	Consequence class		
C_W	Low	Medium	High
	1.0	0.5	0.5*

Note*: Lower value shall be used in accordance with 6.4.12.2.7 to 6.4.12.2.9, depending on the detectability of defect or crack, etc.

5.5 Lower values may be fixed by the Administration.

5.6 Crack propagation analyses are required in accordance with 6.4.12.2.6 to 6.4.12.2.9. The analysis shall be carried out in accordance with methods laid down in a standard recognized by the Administration.

6 ACCIDENT LIMIT STATES

6.1 Accident design condition as described in 6.4.12.3 shall be complied with as applicable, depending on the fuel containment system concept.

6.2 Load and resistance factors may be relaxed compared to the ultimate limit state considering that damages and deformations can be accepted as long as this does not escalate the accident scenario.

6.3 The load factors for ALS shall be taken as 1.0 for permanent loads, functional loads and environmental loads.

6.4 Loads mentioned in 6.4.9.3.3.8 and 6.4.9.5 need not be combined with each other or with environmental loads, as defined in 6.4.9.4.

6.5 Resistance factor γ_R shall in general be taken as 1.0.

6.6 Consequence class factors γ_C shall in general be taken as defined in paragraph 4.4 of this standard, but may be relaxed considering the nature of the accident scenario.

6.7 The characteristic resistance R_k shall in general be taken as for the ultimate limit state, but may be relaxed considering the nature of the accident scenario.

6.8 Additional relevant accident scenarios shall be determined based on a risk analysis.

7 TESTING

7.1 Fuel containment systems designed according to this standard shall be tested to the same extent as described in 16.2, as applicable depending on the fuel containment system concept.

PART B-1

Fuel in the context of the regulations in this part means natural gas, either in its liquefied or gaseous state.

16 MANUFACTURE, WORKMANSHIP AND TESTING

16.1 General

16.1.1 The manufacture, testing, inspection and documentation shall be in accordance with recognized standards and the regulations given in this Code.

16.1.2 Where post-weld heat treatment is specified or required, the properties of the base material shall be determined in the heat treated condition, in accordance with the applicable tables of chapter 7, and the weld properties shall be determined in the heat treated condition in accordance with 16.3. In cases where a post-weld heat treatment is applied, the test regulations may be modified at the discretion of the Administration.

16.2 General test regulations and specifications

16.2.1 Tensile test

16.2.1.1 Tensile testing shall be carried out in accordance with recognized standards.

16.2.1.2 Tensile strength, yield stress and elongation shall be to the satisfaction of the Administration. For carbon-manganese steel and other materials with definitive yield points, consideration shall be given to the limitation of the yield to tensile ratio.

16.2.2 Toughness test

16.2.2.1 Acceptance tests for metallic materials shall include Charpy V-notch toughness tests unless otherwise specified by the Administration. The specified Charpy V-notch regulations are minimum average energy values for three full size (10 mm × 10 mm) specimens and minimum single energy values for individual specimens. Dimensions and tolerances of Charpy V-notch specimens shall be in accordance with recognized standards. The testing and regulations for specimens smaller than 5.0 mm in size shall be in accordance with recognized standards. Minimum average values for sub-sized specimens shall be:

Charpy V-notch specimen size (mm)	Minimum average energy of three specimens
10 x 10	KV
10 x 7.5	5/6 KV
10 x 5.0	2/3 KV

where:

KV = the energy values (J) specified in tables 7.1 to 7.4.

Only one individual value may be below the specified average value, provided it is not less than 70% of that value.

16.2.2.2 For base metal, the largest size Charpy V-notch specimens possible for the material thickness shall be machined with the specimens located as near as practicable to a point midway between the surface and the centre of the thickness and the length of the notch perpendicular to the surface as shown in figure 16.1.

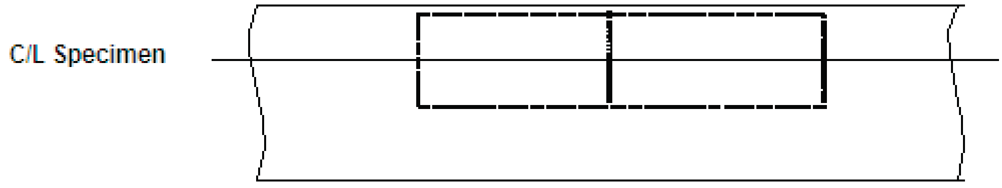

Figure 16.1 – Orientation of base metal test specimen

16.2.2.3 For a weld test specimen, the largest size Charpy V-notch specimens possible for the material thickness shall be machined, with the specimens located as near as practicable to a point midway between the surface and the centre of the thickness. In all cases the distance from the surface of the material to the edge of the specimen shall be approximately 1 mm or greater. In addition, for double-V butt welds, specimens shall be machined closer to the surface of the second welded section. The specimens shall be taken generally at each of the following locations, as shown in figure 16.2, on the centreline of the welds, the fusion line and 1 mm, 3 mm and 5 mm from the fusion line.

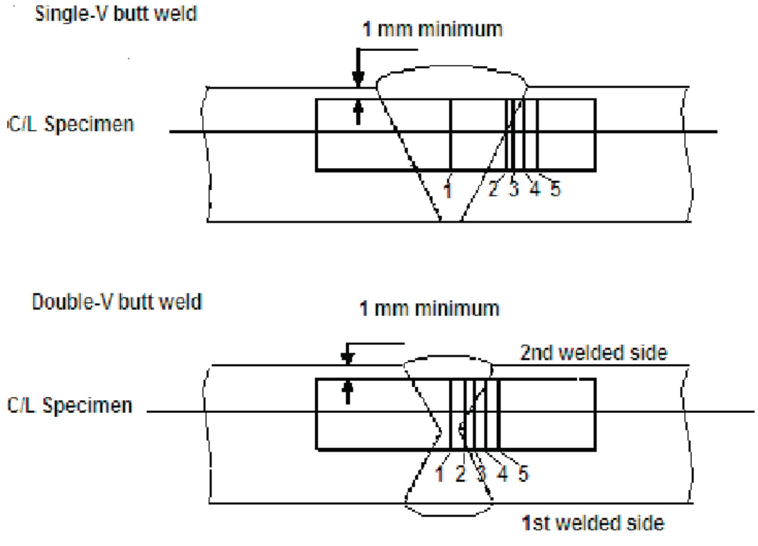

Figure 16.2 – Orientation of weld test specimen

Notch locations in figure 16.2:

.1 centreline of the weld;

.2 on fusion line;

.3 in heat-affected zone (HAZ), 1 mm from fusion line;

.4 in HAZ, 3 mm from fusion line; and

.5 in HAZ, 5 mm from fusion line.

16.2.2.4 If the average value of the three initial Charpy V-notch specimens fails to meet the stated regulations, or the value for more than one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, three additional specimens from the same material may be tested and the results combined with those previously obtained to form a new average. If this new average complies with the regulations and if no more than two individual results are lower, than the required average and no more than one result is lower than the required value for a single specimen, the piece or batch may be accepted.

16.2.3 Bend test

16.2.3.1 The bend test may be omitted as a material acceptance test, but is required for weld tests. Where a bend test is performed, this shall be done in accordance with recognized standards.

16.2.3.2 The bend tests shall be transverse bend tests, which may be face, root or side bends at the discretion of the Administration. However, longitudinal bend tests may be required in lieu of transverse bend tests in cases where the base material and weld metal have different strength levels.

16.2.4 Section observation and other testing

Macrosection, microsection observations and hardness tests may also be required by the Administration, and they shall be carried out in accordance with recognized standards, where required.

16.3 Welding of metallic materials and non-destructive testing for the fuel containment system

16.3.1 General

This section shall apply to primary and secondary barriers only, including the inner hull where this forms the secondary barrier. Acceptance testing is specified for carbon, carbon-manganese, nickel alloy and stainless steels, but these tests may be adapted for other materials. At the discretion of the Administration, impact testing of stainless steel and aluminium alloy weldments may be omitted and other tests may be specially required for any material.

16.3.2 Welding consumables

Consumables intended for welding of fuel tanks shall be in accordance with recognized standards. Deposited weld metal tests and butt weld tests shall be required for all consumables. The results obtained from tensile and Charpy V-notch impact tests shall be in accordance with recognized standards. The chemical composition of the deposited weld metal shall be recorded for information.

16.3.3 Welding procedure tests for fuel tanks and process pressure vessels

16.3.3.1 Welding procedure tests for fuel tanks and process pressure vessels are required for all butt welds.

16.3.3.2 The test assemblies shall be representative of:

.1 each base material;

.2 each type of consumable and welding process; and

.3 each welding position.

16.3.3.3 For butt welds in plates, the test assemblies shall be so prepared that the rolling direction is parallel to the direction of welding. The range of thickness qualified by each welding procedure test shall be in accordance with recognized standards. Radiographic or ultrasonic testing may be performed at the option of the fabricator.

16.3.3.4 The following welding procedure tests for fuel tanks and process pressure vessels shall be done in accordance with 16.2 with specimens made from each test assembly:

.1 cross-weld tensile tests;

.2 longitudinal all-weld testing where required by the recognized standards;

.3 transverse bend tests, which may be face, root or side bends. However, longitudinal bend tests may be required in lieu of transverse bend tests in cases where the base material and weld metal have different strength levels;

.4 one set of three Charpy V-notch impacts, generally at each of the following locations, as shown in figure 16.2:

  .1 centreline of the welds;

  .2 fusion line;

  .3 1 mm from the fusion line;

  .4 3 mm from the fusion line; and

  .5 5 mm from the fusion line;

.5 macrosection, microsection and hardness survey may also be required.

16.3.3.5 Each test shall satisfy the following:

.1 tensile tests: cross-weld tensile strength is not to be less than the specified minimum tensile strength for the appropriate parent materials. For aluminium alloys, reference shall be made to 6.4.12.1.1.3 with regard to the regulations for weld metal strength of under-matched welds (where the weld metal has a lower tensile strength than the parent metal). In every case, the position of fracture shall be recorded for information;

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

.3 Charpy V-notch impact tests: Charpy V-notch tests shall be conducted at the temperature prescribed for the base material being joined. The results of weld metal impact tests, minimum average energy (KV), shall be no less than 27 J. The weld metal regulations for sub-size specimens and single energy values shall be in accordance with 16.2.2. The results of fusion line and heat affected zone impact tests shall show a minimum average energy (KV) in accordance with the transverse or longitudinal regulations of the base material, whichever is applicable, and for sub-size specimens, the minimum average energy (KV) shall be in accordance with 16.2.2. If the material thickness does not permit machining either full-size or standard sub-size specimens, the testing procedure and acceptance standards shall be in accordance with recognized standards.

16.3.3.6 Procedure tests for fillet welding shall be in accordance with recognized standards. In such cases, consumables shall be so selected that exhibit satisfactory impact properties.

16.3.4 Welding procedure tests for piping

Welding procedure tests for piping shall be carried out and shall be similar to those detailed for fuel tanks in 16.3.3.

16.3.5 Production weld tests

16.3.5.1 For all fuel tanks and process pressure vessels except membrane tanks, production weld tests shall generally be performed for approximately each 50 m of butt-weld joints and shall be representative of each welding position. For secondary barriers, the same type production tests as required for primary tanks shall be performed, except that the number of tests may be reduced subject to agreement with the Administration. Tests, other than those specified in 16.3.5.2 to 16.3.5.5 may be required for fuel tanks or secondary barriers.

16.3.5.2 The production tests for types A and B independent tanks shall include bend tests and, where required for procedure tests, one set of three Charpy V-notch tests. The tests shall be made for each 50 m of weld. The Charpy V-notch tests shall be made with specimens having the notch alternately located in the centre of the weld and in the heat affected zone (most critical location based on procedure qualification results). For austenitic stainless steel, all notches shall be in the centre of the weld.

16.3.5.3 For type C independent tanks and process pressure vessels, transverse weld tensile tests are required in addition to the tests listed in 16.3.5.2. Tensile tests shall meet regulation 16.3.3.5.

16.3.5.4 The quality assurance/quality control (QA/QC) program shall ensure the continued conformity of the production welds as defined in the material manufacturers quality manual (QM).

16.3.5.5 The test regulations for membrane tanks are the same as the applicable test regulations listed in 16.3.3.

16.3.6 Non-destructive testing

16.3.6.1 All test procedures and acceptance standards shall be in accordance with recognized standards, unless the designer specifies a higher standard in order to meet design assumptions. Radiographic testing shall be used in principle to detect internal defects. However, an approved ultrasonic test procedure in lieu of radiographic testing may be conducted, but in addition supplementary radiographic testing at selected locations shall be carried out to verify the results. Radiographic and ultrasonic testing records shall be retained.

16.3.6.2 For type A independent tanks where the design temperature is below -20°C, and for type B independent tanks, regardless of temperature, all full penetration butt welds of the shell plating of fuel tanks shall be subjected to non-destructive testing suitable to detect internal defects over their full length. Ultrasonic testing in lieu of radiographic testing may be carried out under the same conditions as described in 16.3.6.1.

16.3.6.3 In each case the remaining tank structure, including the welding of stiffeners and other fittings and attachments, shall be examined by magnetic particle or dye penetrant methods as considered necessary.

16.3.6.4 For type C independent tanks, the extent of non-destructive testing shall be total or partial according to recognized standards, but the controls to be carried out shall not be less than the following:

.1 Total non-destructive testing referred to in 6.4.15.3.2.1.3

Radiographic testing:

.1 all butt welds over their full length.

Non-destructive testing for surface crack detection:

.2 all welds over 10% of their length;

.3 reinforcement rings around holes, nozzles, etc. over their full length.

As an alternative, ultrasonic testing, as described in 16.3.6.1, may be accepted as a partial substitute for the radiographic testing. In addition, the Administration may require total ultrasonic testing on welding of reinforcement rings around holes, nozzles, etc.

.2 Partial non-destructive testing referred to in 6.4.15.3.2.1.3:

Radiographic testing:

.1 all butt welded crossing joints and at least 10% of the full length of butt welds at selected positions uniformly distributed.

Non-destructive testing for surface crack detection:

.2 reinforcement rings around holes, nozzles, etc. over their full length.

Ultrasonic testing:

.3 as may be required by the Administration in each instance.

16.3.6.5 The quality assurance/quality control (QA/QC) program shall ensure the continued conformity of the non-destructive testing of welds, as defined in the material manufacturer's quality manual (QM).

16.3.6.6 Inspection of piping shall be carried out in accordance with the regulations of chapter 7.

16.3.6.7 The secondary barrier shall be non-destructive tested for internal defects as considered necessary. Where the outer shell of the hull is part of the secondary barrier, all sheer strake butts and the intersections of all butts and seams in the side shell shall be tested by radiographic testing.

16.4 Other regulations for construction in metallic materials

16.4.1 General

Inspection and non-destructive testing of welds shall be in accordance with regulations in 16.3.5 and 16.3.6. Where higher standards or tolerances are assumed in the design, they shall also be satisfied.

16.4.2 Independent tank

For type C tanks and type B tanks primarily constructed of bodies of revolution the tolerances relating to manufacture, such as out-of-roundness, local deviations from the true form, welded joints alignment and tapering of plates having different thicknesses, shall comply with recognized standards. The tolerances shall also be related to the buckling analysis referred to in 6.4.15.2.3.1 and 6.4.15.3.3.2.

16.4.3 Secondary barriers

During construction the regulations for testing and inspection of secondary barriers shall be approved or accepted by the Administration (see also 6.4.4.5 and 6.4.4.6).

16.4.4 Membrane tanks

The quality assurance/quality control (QA/QC) program shall ensure the continued conformity of the weld procedure qualification, design details, materials, construction, inspection and production testing of components. These standards and procedures shall be developed during the prototype testing programme.

16.5 Testing

16.5.1 Testing and inspections during construction

16.5.1.1 All liquefied gas fuel tanks and process pressure vessels shall be subjected to hydrostatic or hydro-pneumatic pressure testing in accordance with 16.5.2 to 16.5.5, as applicable for the tank type.

16.5.1.2 All tanks shall be subject to a tightness test which may be performed in combination with the pressure test referred to in 16.5.1.1.

16.5.1.3 The gas tightness of the fuel containment system with reference to 6.3.3 shall be tested.

16.5.1.4 Regulations with respect to inspection of secondary barriers shall be decided by the Administration in each case, taking into account the accessibility of the barrier (see also 6.4.4).

16.5.1.5 The Administration may require that for ships fitted with novel type B independent tanks, or tanks designed according to 6.4.16 at least one prototype tank and its support shall be instrumented with strain gauges or other suitable equipment to confirm stress levels during the testing required in 16.5.1.1. Similar instrumentation may be required for type C independent tanks, depending on their configuration and on the arrangement of their supports and attachments.

16.5.1.6 The overall performance of the fuel containment system shall be verified for compliance with the design parameters during the first LNG bunkering, when steady thermal conditions of the liquefied gas fuel are reached, in accordance with the requirements of the Administration. Records of the performance of the components and equipment, essential to verify the design parameters, shall be maintained on board and be available to the Administration.

16.5.1.7 The fuel containment system shall be inspected for cold spots during or immediately following the first LNG bunkering, when steady thermal conditions are reached. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked shall be carried out in accordance with the requirements of the Administration.

16.5.1.8 Heating arrangements, if fitted in accordance with 6.4.13.1.1.3 and 6.4.13.1.1.4, shall be tested for required heat output and heat distribution.

16.5.2 Type A independent tanks

All type A independent tanks shall be subjected to a hydrostatic or hydro-pneumatic pressure testing. This test shall be performed such that the stresses approximate, as far as practicable, the design stresses, and that the pressure at the top of the tank corresponds at least to the MARVS. When a hydropneumatic test is performed, the conditions shall simulate, as far as practicable, the design loading of the tank and of its support structure including dynamic components, while avoiding stress levels that could cause permanent deformation.

16.5.3 Type B independent tanks

Type B independent tanks shall be subjected to a hydrostatic or hydro-pneumatic pressure testing as follows:

.1 The test shall be performed as required in 16.5.2 for type A independent tanks.

.2 In addition, the maximum primary membrane stress or maximum bending stress in primary members under test conditions shall not exceed 90% of the yield strength of the material (as fabricated) at the test temperature. To ensure that this condition is satisfied, when calculations indicate that this stress exceeds 75% of the yield strength the test of the first of a series of identical tanks shall be monitored by the use of strain gauges or other suitable equipment.

16.5.4 Type C independent tanks and other pressure vessels

16.5.4.1 Each pressure vessel shall be subjected to a hydrostatic test at a pressure measured at the top of the tanks, of not less than 1.5 P_0. In no case during the pressure test shall the calculated primary membrane stress at any point exceed 90% of the yield strength of the material at the test temperature. To ensure that this condition is satisfied where calculations indicate that this stress will exceed 0.75 times the yield strength, the test of the first of a series of identical tanks shall be monitored by the use of strain gauges or other suitable equipment in pressure vessels other than simple cylindrical and spherical pressure vessels.

16.5.4.2 The temperature of the water used for the test shall be at least 30°C above the nil-ductility transition temperature of the material, as fabricated.

16.5.4.3 The pressure shall be held for 2 hours per 25 mm of thickness, but in no case less than 2 hours.

16.5.4.4 Where necessary for liquefied gas fuel pressure vessels, a hydro-pneumatic test may be carried out under the conditions prescribed in 16.5.4.1 to 16.5.4.3.

16.5.4.5 Special consideration may be given to the testing of tanks in which higher allowable stresses are used, depending on service temperature. However, regulation in 16.5.4.1 shall be fully complied with.

16.5.4.6 After completion and assembly, each pressure vessel and its related fittings shall be subjected to an adequate tightness test, which may be performed in combination with the pressure testing referred to in 16.5.4.1 or 16.5.4.4 as applicable.

16.5.4.7 Pneumatic testing of pressure vessels other than liquefied gas fuel tanks shall be considered on an individual case basis. Such testing shall only be permitted for those vessels designed or supported such that they cannot be safely filled with water, or for those vessels that cannot be dried and are to be used in a service where traces of the testing medium cannot be tolerated.

16.5.5 Membrane tanks

16.5.5.1 *Design development testing*

16.5.5.1.1 The design development testing required in 6.4.15.4.1.2 shall include a series of analytical and physical models of both the primary and secondary barriers, including corners and joints, tested to verify that they will withstand the expected combined strains due to static, dynamic and thermal loads at all filling levels. This will culminate in the construction of a prototype scaled model of the complete liquefied gas fuel containment system. Testing conditions considered in the analytical and physical model shall represent the most extreme service conditions the liquefied gas fuel containment system will be likely to encounter over its life. Proposed acceptance criteria for periodic testing of secondary barriers required in 6.4.4 may be based on the results of testing carried out on the prototype scaled model.

16.5.5.1.2 The fatigue performance of the membrane materials and representative welded or bonded joints in the membranes shall be determined by tests. The ultimate strength and fatigue performance of arrangements for securing the thermal insulation system to the hull structure shall be determined by analyses or tests.

16.5.5.2 *Testing*

.1 In ships fitted with membrane liquefied gas fuel containment systems, all tanks and other spaces that may normally contain liquid and are adjacent to the hull structure supporting the membrane, shall be hydrostatically tested.

.2 All hold structures supporting the membrane shall be tested for tightness before installation of the liquefied gas fuel containment system.

.3 Pipe tunnels and other compartments that do not normally contain liquid need not be hydrostatically tested.

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

16.6.1 General

Welding shall be carried out in accordance with 16.3.

16.6.2 Post-weld heat treatment

Post-weld heat treatment shall be required for all butt welds of pipes made with carbon, carbon-manganese and low alloy steels. The Administration may waive the regulations for thermal stress relieving of pipes with wall thickness less than 10 mm in relation to the design temperature and pressure of the piping system concerned.

16.6.3 Non-destructive testing

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

.1 100% radiographic or ultrasonic inspection of butt-welded joints for piping systems with;

  .1 design temperatures colder than minus 10°C; or

  .2 design pressure greater than 1.0 MPa; or

  .3 gas supply pipes in ESD protected machinery spaces; or

  .4 inside diameters of more than 75 mm; or

  .5 wall thicknesses greater than 10 mm.

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

.3 The radiographic or ultrasonic inspection regulation may be reduced to 10% for butt-welded joints in the outer pipe of double-walled fuel piping.

.4 For other butt-welded joints of pipes not covered by 16.6.3.1 and 16.6.3.3, spot radiographic or ultrasonic inspection or other non-destructive tests shall be carried out depending upon service, position and materials. In general, at least 10% of butt-welded joints of pipes shall be subjected to radiographic or ultrasonic inspection.

16.7 Testing regulations

16.7.1 Type testing of piping components

Valves

Each type of piping component intended to be used at a working temperature below minus 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 and temperatures, at intervals, up to the rated design pressure of the valve. Allowable leakage rates shall be to the requirements of the Administration 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.

.3 Pressurized components shall be pressure tested to at least 1.5 times the design pressure.

.4 For emergency shutdown valves, with materials having melting temperatures lower than 925°C, the type testing shall include a fire test to a standard at least equivalent to those acceptable to the Organization.[32]

16.7.2 Expansion bellows

The following type tests shall be performed on each type of expansion bellows intended for use on fuel piping outside the fuel tank as found acceptable in 7.3.6.4.3.1.3 and where required by the Administration, on those installed within the fuel tanks:

.1 Elements of the bellows, not pre-compressed, but axially restrained shall be pressure tested at not less than five times the design pressure without bursting. The duration of the test shall not be less than five minutes.

.2 A pressure test shall be performed on a type expansion joint, complete with all the accessories such as flanges, stays and articulations, at the minimum design temperature and twice the design pressure at the extreme displacement conditions recommended by the manufacturer without permanent deformation.

.3 A cyclic test (thermal movements) shall be performed on a complete expansion joint, which shall withstand at least as many cycles under the conditions of pressure, temperature, axial movement, rotational movement and transverse movement as it will encounter in actual service. Testing at ambient temperature is permitted when this testing is at least as severe as testing at the service temperature.

.4 A cyclic fatigue test (ship deformation, ship accelerations and pipe vibrations) shall be performed on a complete expansion joint, without internal pressure, by simulating the bellows movement corresponding to a compensated pipe length, for at least 2,000,000 cycles at a frequency not higher than 5 Hz. This test is only required when, due to the piping arrangement, ship deformation loads are actually experienced.

16.7.3 System testing regulations

16.7.3.1 The regulations for testing in this section apply to fuel piping inside and outside the fuel tanks. However, relaxation from these regulations for piping inside fuel tanks and open ended piping may be accepted by the Administration.

16.7.3.2 After assembly, all fuel piping shall be subjected to a strength test with a suitable fluid. The test pressure shall be at least 1.5 times the design pressure for liquid lines and 1.5 times the maximum system working pressure for vapour lines. When piping systems or parts of systems are completely manufactured and equipped with all fittings, the test may be conducted prior to installation on board the ship. Joints welded on board shall be tested to at least 1.5 times the design pressure.

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32 Refer to the recommendations by the International Organization for Standardization, in particular publications:

ISO 19921:2005, *Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Test methods*

ISO 19922:2005, *Ships and marine technology – Fire resistance of metallic pipe components with resilient and elastomeric seals – Requirements imposed on the test bench*

16.7.3.3 After assembly on board, the fuel piping system shall be subjected to a leak test using air, or other suitable medium to a pressure depending on the leak detection method applied.

16.7.3.4 In double wall fuel piping systems the outer pipe or duct shall also be pressure tested to show that it can withstand the expected maximum pressure at pipe rupture.

16.7.3.5 All piping systems, including valves, fittings and associated equipment for handling fuel or vapours, shall be tested under normal operating conditions not later than at the first bunkering operation, in accordance with the requirements of the Administration.

16.7.3.6 Emergency shutdown valves in liquefied gas piping systems shall close fully and smoothly within 30 s of actuation. 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.

16.7.3.7 The closing time of the valve referred to in 8.5.8 and 15.4.2.2 (i.e. time from shutdown signal initiation to complete valve closure) shall not be greater than:

$$\frac{3600U}{BR} \quad \textit{(second)}$$

where:

U = ullage volume at operating signal level (m^3);

BR = maximum bunkering rate agreed between ship and shore facility (m^3/h); or

5 seconds, whichever is the least.

The bunkering rate shall be adjusted to limit surge pressure on valve closure to an acceptable level, taking into account the bunkering hose or arm, the ship and the shore piping systems, where relevant.

PART C-1

Fuel in the context of the regulations in this part means natural gas, either in its liquefied or gaseous state.

17 DRILLS AND EMERGENCY EXERCISES

Drills and emergency exercises on board shall be conducted at regular intervals.

Such gas-related exercises could include for example:

.1 tabletop exercise;

.2 review of fueling procedures based in the fuel handling manual required by 18.2.3;

.3 responses to potential contingences;

.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.

Gas related exercises may be incorporated into periodical drills required by SOLAS.

The response and safety system for hazards and accident control shall 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 gas or low-flashpoint fuels minimize the risk to personnel, the ship and the environment and that are consistent with practices for a conventional oil fuelled ship whilst taking into account the nature of the liquid or gaseous fuel.

18.2 Functional requirements

This chapter relates to the functional requirements in 3.2.1 to 3.2.3, 3.2.9, 3.2.11, 3.2.15, 3.2.16 and 3.2.17. In particular the following apply:

.1 a copy of this Code, or national regulations incorporating the provisions of this Code, shall be on board every ship covered by this Code;

.2 maintenance procedures and information for all gas related installations shall be available on board;

.3 the ship shall 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 shall be provided with suitable emergency procedures.

18.3 Regulations for maintenance

18.3.1 Maintenance and repair procedures shall include considerations with respect to the tank location and adjacent spaces (see chapter 5).

18.3.2 In-service survey, maintenance and testing of the fuel containment system are to be carried out in accordance with the inspection/survey plan required by 6.4.1.8.

18.3.3 The procedures and information shall include maintenance of electrical equipment that is installed in explosion hazardous spaces and areas. The inspection and maintenance of electrical installations in explosion hazardous spaces shall be performed in accordance with a recognized standard.[33]

18.4 Regulations for bunkering operations

18.4.1 Responsibilities

18.4.1.1 Before any bunkering operation commences, the master of the receiving ship or his representative and the representative of the bunkering source (Persons In Charge, PIC) shall:

.1 agree in writing the transfer procedure, including cooling down and if necessary, gassing up; the maximum transfer rate at all stages and volume to be transferred;

.2 agree in writing action to be taken in an emergency; and

.3 complete and sign the bunker safety check-list.

18.4.1.2 Upon completion of bunkering operations the ship PIC shall receive and sign a Bunker Delivery Note for the fuel delivered, containing at least the information specified in the annex to part C-1, completed and signed by the bunkering source PIC.

18.4.2 Overview of control, automation and safety systems

18.4.2.1 The fuel handling manual required by 18.2.3 shall include but is not limited to:

.1 overall operation of the ship from dry-dock to dry-dock, including procedures for system cool down and warm up, bunker loading and, where appropriate, discharging, sampling, inerting and gas freeing;

.2 bunker temperature and pressure control, alarm and safety systems;

.3 system limitations, cool down rates and maximum fuel storage tank temperatures prior to bunkering, including minimum fuel temperatures, maximum tank pressures, transfer rates, filling limits and sloshing limitations;

.4 operation of inert gas systems;

.5 firefighting and emergency procedures: operation and maintenance of firefighting systems and use of extinguishing agents;

.6 specific fuel properties and special equipment needed for the safe handling of the particular fuel;

[33] Refer to IEC 60079 17:2007 Explosive atmospheres – part 17: Electrical installations inspection and maintenance.

.7 fixed and portable gas detection operation and maintenance of equipment;

.8 emergency shutdown and emergency release systems, where fitted; and

.9 a description of the procedural actions to take in an emergency situation, such as leakage, fire or potential fuel stratification resulting in rollover.

18.4.2.2 A fuel system schematic/piping and instrumentation diagram (P&ID) shall be reproduced and permanently mounted in the ship's bunker control station and at the bunker station.

18.4.3 Pre-bunkering verification

18.4.3.1 Prior to conducting bunkering operations, pre-bunkering verification including, but not limited to the following, shall be carried out and documented in the bunker safety checklist:

.1 all communications methods, including ship shore link (SSL), if fitted;

.2 operation of fixed gas and fire detection equipment;

.3 operation of portable gas detection equipment;

.4 operation of remote controlled valves; and

.5 inspection of hoses and couplings.

18.4.3.2 Documentation of successful verification shall be indicated by the mutually agreed and executed bunkering safety checklist signed by both PIC's.

18.4.4 Ship bunkering source communications

18.4.4.1 Communications shall be maintained between the ship PIC and the bunkering source PIC at all times during the bunkering operation. In the event that communications cannot be maintained, bunkering shall stop and not resume until communications are restored.

18.4.4.2 Communication devices used in bunkering shall comply with recognized standards for such devices acceptable to the Administration.

18.4.4.3 PIC's shall have direct and immediate communication with all personnel involved in the bunkering operation.

18.4.4.4 The ship shore link (SSL) or equivalent means to a bunkering source provided for automatic ESD communications, shall be compatible with the receiving ship and the delivering facility ESD system.[34]

18.4.5 Electrical bonding

Hoses, transfer arms, piping and fittings provided by the delivering facility used for bunkering shall be electrically continuous, suitably insulated and shall provide a level of safety compliant with recognized standards.[35]

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[34] Refer to ISO 28460, ship-shore interface and port operations.

[35] Refer to API RP 2003, ISGOTT: International Safety Guide for Oil Tankers and Terminals.

18.4.6 Conditions for transfer

18.4.6.1 Warning signs shall be posted at the access points to the bunkering area listing fire safety precautions during fuel transfer.

18.4.6.2 During the transfer operation, personnel in the bunkering manifold area shall be limited to essential staff only. All staff engaged in duties or working in the vicinity of the operations shall wear appropriate personal protective equipment (PPE). A failure to maintain the required conditions for transfer shall be cause to stop operations and transfer shall not be resumed until all required conditions are met.

18.4.6.3 Where bunkering is to take place via the installation of portable tanks, the procedure shall provide an equivalent level of safety as integrated fuel tanks and systems. Portable tanks shall be filled prior to loading on board the ship and shall be properly secured prior to connection to the fuel system.

18.4.6.4 For tanks not permanently installed in the ship, the connection of all necessary tank systems (piping, controls, safety system, relief system, etc.) to the fuel system of the ship is part of the "bunkering" process and shall be finished prior to ship departure from the bunkering source. Connecting and disconnecting of portable tanks during the sea voyage or manoeuvring is not permitted.

18.5 Regulations for enclosed space entry

18.5.1 Under normal operational circumstances, personnel shall not enter fuel tanks, fuel storage hold spaces, void spaces, tank connection spaces or other enclosed spaces where gas or flammable vapours may accumulate, unless the gas content of the atmosphere in such space is determined by means of fixed or portable equipment to ensure oxygen sufficiency and absence of an explosive atmosphere.[36]

18.5.2 Personnel entering any space designated as a hazardous area shall not introduce any potential source of ignition into the space unless it has been certified gas-free and maintained in that condition.

18.6 Regulations for inerting and purging of fuel systems

18.6.1 The primary objective in inerting and purging of fuel systems is to prevent the formation of a combustible atmosphere in, near or around fuel system piping, tanks, equipment and adjacent spaces.

18.6.2 Procedures for inerting and purging of fuel systems shall ensure that air is not introduced into piping or a tank containing gas atmospheres, and that gas is not introduced into air contained in enclosures or spaces adjacent to fuel systems.

18.7 Regulations for hot work on or near fuel systems

18.7.1 Hot work in the vicinity of fuel tanks, fuel piping and insulation systems that may be flammable, contaminated with hydrocarbons, or that may give off toxic fumes as a product of combustion shall only be undertaken after the area has been secured and proven safe for hot work and all approvals have been obtained.

[36] Refer to the *Revised recommendations for entering enclosed spaces aboard ships* (A.1050(27)).

ANNEX

LNG-BUNKER DELIVERY NOTE*
LNG AS FUEL FOR

SHIP NAME:________________________ IMO NO.:_________

Date of delivery:

1. LNG-Properties

Methane number **	--	
Lower calorific (heating) value	MJ/kg	
Higher calorific (heating) value	MJ/kg	
Wobbe Indices Ws / Wi	MJ/m³	
Density	kg/m³	
Pressure	MPa (abs)	
LNG temperature delivered	°C	
LNG temperature in storage tank(s)	°C	
Pressure in storage tank(s)	MPa (abs)	

2. LNG-Composition

Methane, CH_4	% (kg/kg)	
Ethane, C_2H_6	% (kg/kg)	
Propane, C_3H_8	% (kg/kg)	
Isobutane, i C_4H_{10}	% (kg/kg)	
N-Butane, n C_4H_{10}	% (kg/kg)	
Pentane, C_5H_{12}	% (kg/kg)	
Hexane; C_6H_{14}	% (kg/kg)	
Heptane; C_7H_{16}	% (kg/kg)	
Nitrogen, N_2	% (kg/kg)	
Sulphur, S	% (kg/kg)	
negligible<5ppm hydrogen sulphide, hydrogen, ammonia, chlorine, fluorine, water		

3. Net Total delivered: _____________t, ___________________MJ _____________m³

Net Liquid delivery:______________GJ

4. Signature(s):

Supplier Company Name, contact details:________________________

Signature:___________________Place/Port ___________ date:__________________

Receiver:_____________________________

* The LNG properties and composition allow the operator to act in accordance with the known properties of the gas and any operational limitations linked to that.

** Preferably above 70 and referring to the used methane number calculation method in DIN EN 16726. This does not necessarily reflect the methane number that goes into the engine.

PART D

19 TRAINING

19.1 Goal

The goal of this chapter is to ensure that seafarers on board ships to which this Code applies are adequately qualified, trained and experienced.

19.2 Functional requirements

Companies shall ensure that seafarers on board ships using gases or other low-flashpoint fuels shall have completed training to attain the abilities that are appropriate to the capacity to be filled and duties and responsibilities to be taken up, taking into account the provisions given in the STCW Convention and Code, as amended.

ANNEX 2

RESOLUTION MSC.392(95)
(adopted on 11 June 2015)

AMENDMENTS TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

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)(vi)(2) 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 ninety-fifth session, amendments to the Convention, proposed and circulated in accordance with article VIII(b)(i) thereof,

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 2016, 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 to the Secretary-General 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 2017 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; and

5 REQUESTS ALSO 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 CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

CHAPTER II-1
CONSTRUCTION – STRUCTURE, SUBDIVISION AND STABILITY, MACHINERY AND ELECTRICAL INSTALLATIONS

Part A
General

Regulation 2 – Definitions

1 The following new paragraphs 29 and 30 are added after the existing paragraph 28:

"29 *IGF Code* means the International Code of safety for ships using gases or other low-flashpoint fuels as adopted by the Maritime Safety Committee of the Organization by resolution MSC.391(95), as may be amended by the Organization, provided that such amendments are adopted, brought into force and take effect in accordance with the provisions of article VIII of the present Convention concerning the amendment procedures applicable to the annex other than chapter I.

30 *Low-flashpoint fuel* means gaseous or liquid fuel having a flashpoint lower than otherwise permitted under regulation II-2/4.2.1.1."

Part F
Alternative design and arrangements

Regulation 55 – Alternative design and arrangements

2 The existing paragraphs 1 to 3 are replaced with the following:

"**1 Purpose**

The purpose of this regulation is to provide a methodology for alternative design and arrangements for machinery, electrical installations and low-flashpoint fuel storage and distribution systems.

2 General

2.1 Machinery, electrical installation and low-flashpoint fuel storage and distribution systems design and arrangements may deviate from the requirements set out in parts C, D, E or G, provided that the alternative design and arrangements meet the intent of the requirements concerned and provide an equivalent level of safety to this chapter.

2.2 When alternative design or arrangements deviate from the prescriptive requirements of parts C, D, E or G, an engineering analysis, evaluation and approval of the design and arrangements shall be carried out in accordance with this regulation.

3 Engineering analysis

The engineering analysis shall be prepared and submitted to the Administration, based on the guidelines developed by the Organization* and shall include, as a minimum, the following elements:

.1 determination of the ship type, machinery, electrical installations, low-flashpoint fuel storage and distribution systems and space(s) concerned;

.2 identification of the prescriptive requirement(s) with which the machinery, electrical installations and low-flashpoint fuel storage and distribution systems will not comply;

.3 identification of the reason the proposed design will not meet the prescriptive requirements supported by compliance with other recognized engineering or industry standards;

.4 determination of the performance criteria for the ship, machinery, electrical installation, low-flashpoint fuel storage and distribution system or the space(s) concerned addressed by the relevant prescriptive requirement(s):

  .1 performance criteria shall provide a level of safety not inferior to the relevant prescriptive requirements contained in parts C, D, E or G; and

  .2 performance criteria shall be quantifiable and measurable;

.5 detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operational restrictions or conditions;

.6 technical justification demonstrating that the alternative design and arrangements meet the safety performance criteria; and

.7 risk assessment based on identification of the potential faults and hazards associated with the proposal.

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* Refer to the *Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III* (MSC.1/Circ.1212) and the *Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments* (MSC.1/Circ.1455)."

3 The new part G is added after the existing part F as follows:

"Part G
Ships using low-flashpoint fuels

Regulation 56 – Application

1 Except as provided for in paragraphs 4 and 5, this part shall apply to ships using 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 low-flashpoint fuels on or after 1 January 2017 shall be treated as a ship using low-flashpoint fuels on the date on which such conversion commenced.

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

5 This part shall not apply to ships owned or operated by a Contracting Government and used, for the time being, only in Government non-commercial service. However, ships owned or operated by a Contracting Government and used, for the time being, only in Government non-commercial service are encouraged to act in a manner consistent, so far as reasonable and practicable, with this part.

Regulation 57 – Requirements for ships using low-flashpoint fuels

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

CHAPTER II-2
CONSTRUCTION – FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION

Part B
Prevention of fire and explosion

Regulation 4 – Probability of ignition

4 In paragraph 2.1.3.4, the word "and" is deleted.

5 In paragraph 2.1, the existing subparagraph .4 is replaced with the following:

".4 in cargo ships, to which part G of chapter II-1 is not applicable, the use of oil fuel having a lower flashpoint than otherwise specified in paragraph 2.1.1, for example crude oil, may be permitted provided that such fuel is not stored in any machinery space and subject to the approval by the Administration of the complete installation; and

.5 in ships, to which part G of chapter II-1 is applicable, the use of oil fuel having a lower flashpoint than otherwise specified in paragraph 2.1.1 is permitted."

6 At the end of existing paragraph 5.3.2.2, the following sentence is added:

"For tankers constructed on or after 1 January 2017, any isolation shall also continue to permit the passage of large volumes of vapour, air or inert gas mixtures during cargo loading and ballasting, or during discharging in accordance with regulation 11.6.1.2."

Part C
Suppression of fire

Regulation 11 – Structural integrity

7 At the end of existing paragraph 6.2, the following sentence is added:

"For tankers constructed on or after 1 January 2017, the openings shall be arranged in accordance with regulation 4.5.3.4.1."

8 In paragraph 6.3.2, the following text is added between the first and the second sentences:

"In addition, for tankers constructed on or after 1 January 2017, the secondary means shall be capable of preventing over-pressure or under-pressure in the event of damage to, or inadvertent closing of, the means of isolation required in regulation 4.5.3.2.2."

Part G
Special requirements

Regulation 20 – Protection of vehicle, special category and ro-ro spaces

9 The existing paragraph 3.1.2 is replaced with the following:

"**3.1.2** ***Performance of ventilation systems***

3.1.2.1 In passenger ships, the power ventilation system shall be separate from other ventilation systems. The power ventilation system shall be operated to give at least the number of air changes required in paragraph 3.1.1 at all times when vehicles are in such spaces, except where an air quality control system in accordance with paragraph 3.1.2.4 is provided. Ventilation ducts serving such cargo spaces capable of being effectively sealed shall be separated for each such space. The system shall be capable of being controlled from a position outside such spaces.

3.1.2.2 In cargo ships, the ventilation fans shall normally be run continuously and give at least the number of air changes required in paragraph 3.1.1 whenever vehicles are on board, except where an air quality control system in accordance with paragraph 3.1.2.4 is provided. Where this is impracticable, they shall be operated for a limited period daily as weather permits and in any case for a reasonable period prior to discharge, after which period the ro-ro or vehicle space shall be proved gas-free. One or more portable combustible gas detecting instruments shall be carried for this purpose. The system shall be entirely separate from other ventilation systems. Ventilation ducts serving ro-ro or vehicle spaces shall be capable of being effectively sealed for each cargo space. The system shall be capable of being controlled from a position outside such spaces.

3.1.2.3 The ventilation system shall be such as to prevent air stratification and the formation of air pockets.

3.1.2.4 For all ships, where an air quality control system is provided based on the guidelines developed by the Organization,* the ventilation system may be operated at a decreased number of air changes and/or a decreased amount of ventilation. This relaxation does not apply to spaces to which at least ten air changes per hour is required by paragraph 3.2.2 of this regulation and spaces subject to regulations 19.3.4.1 and 20-1.

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* Refer to the *Revised design guidelines and operational recommendations for ventilation systems in ro-ro cargo spaces* (MSC/Circ.1515)."

APPENDIX

CERTIFICATES

FORM OF SAFETY CERTIFICATE FOR PASSENGER SHIPS

PASSSENGER SHIP SAFETY CERTIFICATE

10 The following new paragraph 2.2 is added after the existing paragraph 2.1:

"2.2 the ship complied with part G of chapter II-1 of the Convention using ……… as fuel/N.A.[1]"

11 The existing paragraphs 2.2 to 2.11 are renumbered accordingly.

FORM OF SAFETY CONSTRUCTION CERTIFICATE FOR CARGO SHIPS

CARGO SHIP SAFETY CONSTRUCTION CERTIFICATE

12 The existing paragraph 2 is replaced with the following:

"2. That the survey showed that:

.1 the condition of the structure, machinery and equipment as defined in the above regulation was satisfactory and the ship complied with the relevant requirements of chapters II-1 and II-2 of the Convention (other than those relating to fire safety systems and appliances and fire control plans); and

.2 the ship complied with part G of chapter II-1 of the Convention using ……. as fuel/N.A[4]."

***

ANNEX 3

RESOLUTION MSC.393(95)
(adopted on 11 June 2015)

AMENDMENTS TO THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) 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.268(85) by which it adopted the International Maritime Solid Bulk Cargoes Code (hereinafter referred to as "the IMSBC Code"), which has become mandatory under chapter VI of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended (hereinafter referred to as "the Convention"),

NOTING ALSO article VIII(b) and regulation VII/1.1 of the Convention concerning amendment procedure for amending the IMSBC Code,

HAVING CONSIDERED, at its ninety-fifth session, amendments to the IMSBC 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 IMSBC 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 2016, 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 2017 upon their acceptance in accordance with paragraph 2 above;

4 AGREES that Contracting Governments to the Convention may apply the aforementioned amendments in whole or in part on a voluntary basis as from 1 January 2016;

5 REQUESTS the Secretary-General, for the purpose 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; and

6 FURTHER 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 MARITIME SOLID BULK CARGOES (IMSBC) CODE

Contents

1 At the end, a new entry "appendix 5" is added with the following:

"**Appendix 5** Bulk Cargo Shipping Names in three languages (English, Spanish and French)"

Section 1
General provisions

1.3 Cargoes not listed in this Code

1.3.3 Format for the properties of cargoes not listed in this Code and conditions of the carriage*

2 In the footnote assigned to the title, after the words "(IMSBC) Code", insert the words "(see supplement of this Code)".

1.4 Application and implementation of this Code

3 In paragraph 1.4.2, the following entries are inserted in the corresponding order:

"Paragraph 4.2.2.2;"

"Section 14 Prevention of pollution by cargo residues from ships;".

4 In the existing paragraph 1.4.2, the line for "Appendices other than appendix 1 Individual schedules of solid bulk cargoes; and" is replaced with the following:

"Appendices other than appendix 1 (Individual schedules of solid bulk cargoes) and appendix 5 (Bulk Cargo Shipping Names in three languages (English, Spanish and French)); and"

1.6 Conventions

5 In the body of paragraph 1.6, at the end of the first sentence, the words "are reproduced in full" are replaced by the words "the relevant parts are reproduced below", and the second sentence is deleted.

Chapter VI
Carriage of cargoes

Part A
General provisions

6 The title of chapter VI is replaced by the following:

"Carriage of cargoes and oil fuels"

Regulation 1
Application

7 At the beginning of paragraph 1, the words "Unless expressly provided otherwise," are added and the existing word "This" is replaced by the word "this".

Regulation 4
The use of pesticides in ships

8 In the footnote, in subparagraph .2, the reference for "(MSC.1/Circ.1264)" is replaced by "(MSC.1/Circ.1264, as amended by MSC.1/Circ.1396)".

Regulation 5-1
Material safety data sheets

9 Regulation 5-1 is deleted.

Chapter VII
Carriage of dangerous goods

Part A-1
Carriage of dangerous goods in solid form in bulk

Regulations 7-4
Reporting of incidents involving dangerous goods

10 In the footnote assigned at the end of paragraph 1, the reference "(MSC/Circ.857)" is amended to read "(MSC/Circ.857, as contained in the supplement to the IMDG Code)".

1.7 Definitions

11 In the definition for "*Manual of Tests and Criteria*", replace the words (ST/SG/AC.10/11/Rev.5/Amendment 1) by the words "(ST/SG/AC.10/11/Rev.5/Amendment 2)".

Section 3
Safety of personnel and ship

3.1 General requirements

12 After the existing paragraph 3.1.1, insert a new paragraph 3.1.2 with the following:

"3.1.2 Routine on board operational fire safety risk assessments shall be carried out by the ship's crew for cargo handling areas on self-unloading bulk carriers featuring internally installed conveyor systems within the ship's structure. Due consideration shall be given to fire prevention and the effective operation of fire detection systems, containment and suppression under all anticipated operating conditions and cargoes. The fire safety risk assessments shall be detailed in the ship's Safety Management System (SMS) together with a recommended timing to provide regular assessments."

and the existing paragraph 3.1.2 is renumbered as 3.1.3.

3.2 Poisoning, corrosive and asphyxiation hazards

13 In paragraph 3.2.4, the corresponding footnote is amended to read as follows:

"Refer to the *Revised recommendations for entering enclosed spaces aboard ships*, adopted by the Organization by resolution A.1050(27) (see the supplement to this Code)."

3.6 Cargo under in-transit fumigation

14 In paragraph 3.6.2, the existing footnotes are amended to read as follows:

"* Refer to the Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds (MSC.1/Circ.1264), as amended by MSC.1/Circ.1396. (see the supplement to this Code)."

"† Refer to subsection 3.3.2.4 of MSC.1/Circ.1264, as amended by MSC.1/Circ.1396."

and a new footnote "‡" is added at the end of the paragraph with the following:

"‡ Refer to subsection 3.3.2.10 of MSC.1/Circ.1264, as amended by MSC.1/Circ.1396".

Section 4
Assessment of acceptability of consignments for safe shipment

4.2 Provision of information

15 The existing paragraph 4.2.2 is renumbered as "4.2.2.1" and the following new paragraph "4.2.2.2" is added:

"4.2.2.2 The cargo information should include whether or not the cargo is harmful to the marine environment*.]

* Refer to paragraphs 3.2 and 3.4 of *2012 Guidelines for the implementation of MARPOL Annex V* (MEPC.219(63)) (See paragraph 14.2 in this Code)."

16 In paragraph 4.2.3, in the "Form for cargo information for Solid Bulk Cargoes", after the row for that describes Group of the cargo, the following rows are inserted:

"

Classification relating to MARPOL Annex V ☐ harmful to the marine environment ☐ not harmful to the marine environment

"

Section 7
Cargoes that may liquefy

7.3 Provisions for cargoes that may liquefy

7.3.1 General

17 The existing paragraphs 7.3.1.1 to 7.3.1.4 are replaced by the following:

"7.3.1.1 Concentrates or other cargoes which may liquefy shall only be accepted for loading when the actual moisture content of the cargo is less than its TML. Notwithstanding this provision, cargoes having moisture content in excess of the TML may be carried on a specially constructed or fitted cargo ship for confining cargo shift specified in paragraph 7.3.2.

7.3.1.2 Notwithstanding the provisions in section 1.4 of this Code, the requirements in sections 4.2.2.9, 4.2.2.10, 4.3.2 to 4.3.5, 4.5, 4.6 and 8 of this Code need not apply to a cargo which may liquefy provided that the cargo is carried on a specially constructed or fitted cargo ship for confining cargo shift specified in paragraph 7.3.2 or on a specially constructed ship for dry powdery cargoes specified in paragraph 7.3.3.

7.3.1.3 Cargoes which contain liquids other than packaged canned goods or the like shall not be stowed in the same cargo space above or adjacent to these solid bulk cargoes.

7.3.1.4 Adequate measures shall be taken to prevent liquids entering the cargo space in which these solid bulk cargoes are stowed during the voyage.

7.3.1.5 Masters shall be cautioned about the possible danger of using water to cool these cargoes while the ship is at sea. Introducing water may bring the moisture content of these cargoes to a flow state. When necessary, due regard shall be paid to apply water in the form of spray."

7.3.2 Specially constructed or fitted cargo ships

18 The existing subsection 7.3.2 is replaced by the following:

"7.3.2 Specially constructed or fitted cargo ships for confining cargo shift

7.3.2.1 Specially constructed cargo ships for confining cargo shift shall have permanent structural boundaries, so arranged as to confine any shift of cargo to an acceptable limit. The ship concerned shall carry evidence of approval by the Administration.

7.3.2.2 Specially fitted cargo ships for confining cargo shift shall be fitted with specially designed portable divisions to confine any shift of cargo to an acceptable limit. Specially fitted cargo ships shall be in compliance with the following requirements:

.1 The design and positioning of such special arrangements shall adequately provide not only the restraint of the immense forces generated by the flow movement of high-density bulk cargoes, but also for the need to reduce to an acceptable safe level the potential heeling movements arising out of a transverse cargo flow across the cargo space. Divisions provided to meet these requirements shall not be constructed of wood.

.2 The elements of the ship's structure bounding such cargo shall be strengthened, as necessary.

.3 The plan of special arrangements and details of the stability conditions on which the design has been based shall have been approved by the Administration. The ship concerned shall carry evidence of approval by the Administration.

7.3.2.3 A submission made to an Administration for approval of such a ship shall include:

.1 relevant structural drawings, including scaled longitudinal and transverse sections;

.2 stability calculations, taking into account loading arrangements and possible cargo shift, showing the distribution of cargo and liquids in tanks, and of cargo which may become fluid; and

.3 any other information which may assist the Administration in the assessment of the submission."

19 Add the following new subsection 7.3.3:

"7.3.3 Specially constructed cargo ships for dry powdery cargoes

7.3.3.1 Specially constructed cargo ships for dry powdery cargoes shall be designed and constructed to:

.1 carry solely dry powdery cargoes; and

.2 handle cargoes by means of closed type systems using pneumatic equipment which prevent the cargo from the exposure to weather.

7.3.3.2 The ship concerned shall carry evidence of approval by the Administration."

Section 8
Test procedures for cargoes that may liquefy

8.1 General

20 In the end of paragraph "8.1", the words "unless the cargo is carried in a specially constructed or fitted ship" are deleted.

Section 9
Materials possessing chemical hazards

9.2.3. Materials hazardous only in bulk (MHB)

9.2.3.1 General

21 After the existing paragraphs 9.2.3.1.3, two new subparagraphs 9.2.3.1.4 and 9.2.3.1.5 are added with the following:

"9.2.3.1.4 Although the chemical hazards are intended to be closely defined in order to establish a uniform approach to MHB classification, where human experience or other factors indicate the need to consider other chemical hazards, these shall always be taken into account. Where deviations from the chemical hazards described in 9.2.3.2 to 9.2.3.7, have been recognized (Other hazards (OH)), they shall be properly recorded with justifications. Other hazards are to be included in the section for "Hazard" in the individual schedule.

9.2.3.1.5 A notational reference shall accompany the MHB designation in the "Class" cell of the Characteristics table for each individual schedule for cargoes classified as MHB. When a material possesses one or more of the chemical hazards as defined below, the notational reference for each hazard shall be included in the "Class" cell. A summary of the notational references is presented in the table below:

Chemical Hazard	**Notational Reference**
Combustible solids	CB
Self-heating solids	SH
Solids that evolve flammable gas when wet	WF
Solids that evolve toxic gas when wet	WT
Toxic solids	TX
Corrosive solids	CR
Other hazards	OH

"

and amend the following subsection headings under 9.2.3 as follows:

"**9.2.3.2 Combustible solids: MHB (CB)**

9.2.3.3 Self-heating solids: MHB (SH)

9.2.3.4 Solids that evolve flammable gas when wet: MHB (WF)

9.2.3.5 Solids that evolve toxic gas when wet: MHB (WT)

9.2.3.6 Toxic solids: MHB (TX)

9.2.3.7 Corrosive solids: MHB (CR)"

9.2.3.7 *Corrosive solids*

22 In paragraph 9.2.3.7.3, replace the reference "ISO 3574:199" by the reference "ISO 3574:1999".

9.3 Stowage and segregation requirements

9.3.3 Segregation between bulk materials possessing chemical hazards and dangerous goods in packaged form

23 The second paragraph of the existing paragraph 9.3.3.1, before the table, is numbered as "9.3.3.2".

Section 13
References to related information and recommendations

13.1 General

24 In paragraph 13.1, after the words "IMO Instruments", insert the words "and other international standards (such as ISO, IEC)".

13.2 Reference list

25 In paragraph 13.2, after the words "IMO Instruments", in the first sentence, insert the words "or standard"; and, in the third sentence of the paragraph, after the words "IMO Instruments", insert the words "or reference standard".

26 In the heading of the table, in column "Reference to the relevant IMO instruments (2)", add the words "or standard" after the words "IMO instruments".

13.2.3 *Fire-extinguishing arrangements*

27 Under section 13.2.3 of the table, insert a new second row with the following:

"

General Group B	FSS Code chapter 5	Fixed Gas Fire-Extinguishing Systems

"

and under section 13.2.3 of the table, in the column "Reference to the relevant IMO instruments (2)", for entry "Groups A, B and C", replace the text with "MSC/Circ.1395/Rev.2; and, in the column "Subject (3)", after the words "may be exempted", add the words "or for which a fixed gas fire-extinguishing system is ineffective".

13.2.4 *Ventilation*

28 Under section 13.2.4 of the table, at the end of the section, insert three new rows with the following:

"

General Group B	MSC.1/Circ.1434	Unified Interpretation of SOLAS II-2/19.3.4
General Group B	MSC.1/Circ.1120	Unified Interpretation of SOLAS including II-2 /19.3.2, 19.3.4 and 19.3.4.2
General Group B	IEC 60092-506	Electrical standards for equipment safe for use in an explosive atmosphere

"

13.2.6 *Gas detection*

29 Under section 13.2.6 of the table, in the column "Reference to the relevant IMO instruments (2)", the words "section 3" are replaced by "as amended by MSC.1/Circ.1396",

and, at the end of the section, insert a new row with the following:

"

General	IEC 60092-506	Electrical standards for equipment safe for use in an explosive atmosphere

"

13.2.10 ***Segregation***

30 Under section 13.2.10 of the table, at the end of the section, insert a new row with the following:

"

Group B	IEC 60092-352	Standards for electrical cable penetrations in boundaries

"

13.2.12 ***Entering enclosed spaces***

31 Under section 13.2.12 of the table, in the column "Reference to the relevant IMO instruments (2)", amend the text to read "resolution A.1050(27), 30 November 2011"; and in the column "Subject (3)", amend the title to read "Revised recommendations for entering enclosed spaces aboard ships".

13.2.13 ***Avoidance of excessive stresses***

32 Under section 13.2.13 of the table, at the end of the section, insert two new rows with the following:

"

2.1.2	Resolution A.862(20), as amended	Code of Practice for the Safe Loading and Unloading of Bulk Carriers (BLU Code)
2.1.2	MSC.1/Circ.1357	Additional Considerations for the Safe Loading of Bulk Carriers

"

33 A new "Section 14" is added with the following texts:

"Section 14
Prevention of pollution by cargo residues from ships

14.1 The provisions of this section address the management of residues of solid bulk cargoes, in relation to the *2012 Guidelines for the implementation of MARPOL Annex V* (resolution MEPC.219(63), as amended) (the Guidelines). In accordance with MARPOL Annex V, the management of the residues of solid bulk cargoes depends primarily on the classification of a solid bulk cargo as to whether it is harmful to the marine environment (HME) or non-HME. The responsibility for classifying and declaring, whether a solid bulk cargo is HME or non-HME, lies with the shipper as per section 3.4 of the Guidelines. The information in this section is provided in order to assist users of the IMSBC Code.

14.2 The Guidelines assist with the implementation of requirements in MARPOL Annex V. The text of the Guidelines, relevant to residues of solid bulk cargoes is reproduced below. The Guidelines may be amended after the adoption of this version of the IMSBC Code, and the latest version of the Guidelines should always be referred to.

"2012 GUIDELINES FOR THE IMPLEMENTATION OF MARPOL ANNEX V

PREFACE
(Not reproduced.)

1 INTRODUCTION

1.1 The revised MARPOL Annex V with an entry into force date of 1 January 2013, prohibits the discharge of all types of garbage into the sea unless explicitly permitted under the Annex. These guidelines have been developed taking into account the regulations set forth in Annex V, as amended, of the International Convention for the Prevention of Pollution from Ships, (MARPOL) (hereinafter referred to as the "Convention"). The purpose of these guidelines is to provide guidance to governments, shipowners, ship operators, ships' crews, cargo owners, port reception facility operators and equipment manufacturers. The guidelines are divided into the following six sections that provide a general framework upon which governments can formulate programmes:

- Introduction;
- Garbage management;
- Management of cargo residues of solid bulk cargoes;
- Training, education and information;
- Port reception facilities for garbage; and
- Enhancement of compliance with MARPOL Annex V.

1.2 Under the revised MARPOL Annex V, discharge of all garbage is now prohibited, except as specifically permitted in regulations 3, 4, 5 and 6 of MARPOL Annex V. MARPOL Annex V reverses the historical presumption that garbage may be discharged into the sea based on the nature of the garbage and defined distances from shore. Regulation 7 provides limited exceptions to these regulations in emergency and non-routine situations. Generally, discharge is restricted to food wastes, identified cargo residues, animal carcasses, and identified cleaning agents and additives and cargo residues entrained in wash water which are not harmful to the marine environment. It is recommended that ships use port reception facilities as the primary means of discharge for all garbage.

1.3 Recognizing that the MARPOL Annex V regulations continue to restrict the discharge of garbage into the sea, require garbage management for ships, and that garbage management technology continues to evolve, it is recommended that governments and the Organization continue to gather information and review these guidelines periodically.

1.4 (Not reproduced.)

1.5 (Not reproduced.)

1.6 Definitions
(Not reproduced.)

1.7 Application

1.7.1 This section provides clarification as to what should and should not be considered garbage under MARPOL Annex V.

1.7.2 (Not reproduced.)

1.7.3 (Not reproduced.)

1.7.4 While cleaning agents and additives contained in hold washwater, and deck and external surface washwater are considered "operational wastes" and thus "garbage" under Annex V, these cleaning agents and additives may be discharged into the sea so long as they are not harmful to the marine environment.

1.7.5 A cleaning agent or additive is considered not harmful to the marine environment if it:

.1 is not a "harmful substance" in accordance with the criteria in MARPOL Annex III; and

.2 does not contain any components which are known to be carcinogenic, mutagenic or reprotoxic (CMR).

1.7.6 The ship's record should contain evidence provided by the producer of the cleaning agent or additive that the product meets the criteria for not being harmful to the marine environment. To provide an assurance of compliance, a dated and signed statement to this effect from the product supplier would be adequate for the purposes of a ship's record. This might form part of a Safety Data Sheet or be a stand-alone document but this should be left to the discretion of the producer concerned.

1.7.7 (Not reproduced.)

1.7.8 (Not reproduced.)

2 GARBAGE MANAGEMENT

2.1 Waste Minimization

2.1.1 All shipowners and operators should minimize taking on board material that could become garbage. Ship-specific garbage minimization procedures should be included in the Garbage Management Plan. It is recommended that manufacturers, cargo owners, ports and terminals, shipowners and operators and governments consider the management of garbage associated with ships' supplies, provisions, and cargoes as needed to minimize the generation of garbage in all forms.

2.1.2 (Not reproduced.)

2.1.3 (Not reproduced.)

2.1.4 (Not reproduced.)

2.2 Fishing gear
(Not reproduced.)

2.3 Shipboard garbage handling (collection, processing, storage, discharge)

2.3.1 Regulation 3 of MARPOL Annex V provides that the discharge of garbage into the sea is prohibited, with limited exceptions, as summarized in table 1. Under certain conditions discharge into the sea of food wastes, animal carcasses, cleaning agents and additives contained in hold washwater, deck and external surface washwater and cargo residues which are not considered to be harmful to the marine environment is permitted.

TABLE 1 – SUMMARY OF RESTRICTIONS TO THE DISCHARGE OF GARBAGE INTO THE SEA UNDER REGULATIONS 4, 5 AND 6 OF MARPOL ANNEX V (Not fully reproduced)

(Note: Table 1 is intended as a summary reference. The provisions in MARPOL Annex V, not table 1, prevail.)

<table>
<tr><th rowspan="2">Garbage type[1]</th><th colspan="2">All ships except platforms[4]</th><th rowspan="2">Offshore platforms located more than 12 nm from nearest land and ships when alongside or within 500 metres of such platforms[4]
Regulation 5</th></tr>
<tr><th>Outside special areas
Regulation 4
(Distances are from the nearest land)</th><th>Within special areas
Regulation 6
(Distances are from nearest land or nearest ice-shelf)</th></tr>
<tr><td>Cargo residues[5, 6] not contained in washwater</td><td rowspan="2">≥ 12 nm, en route and as far as practicable</td><td>Discharge prohibited</td><td rowspan="2">Discharge prohibited</td></tr>
<tr><td>Cargo residues[5, 6] contained in washwater</td><td>≥ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2)</td></tr>
<tr><td>Cleaning agents and additives[6] contained in cargo hold washwater</td><td rowspan="2">Discharge permitted</td><td>≥ 12 nm, en route and as far as practicable (subject to conditions in regulation 6.1.2)</td><td rowspan="2">Discharge prohibited</td></tr>
<tr><td>Cleaning agents and additives[6] in deck and external surfaces washwater</td><td>Discharge permitted</td></tr>
</table>

[1] When garbage is mixed with or contaminated by other harmful substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.

[4] (not reproduced).

[5] Cargo residues means only those cargo residues that cannot be recovered using commonly available methods for unloading.

[6] These substances must not be harmful to the marine environment.

2.3.2 (Not reproduced.)

2.3.3 (Not reproduced.)

2.3.4 (Not reproduced.)

2.4 Collection
(Not reproduced.)

2.5 Processing
(Not reproduced.)

2.6 Storage
(Not reproduced.)

2.7 Discharge
(Not reproduced.)

2.8 Shipboard equipment for processing garbage
(Not reproduced.)

2.9 Grinding or comminution
(Not reproduced.)

2.10 Compaction
(Not reproduced.)

2.11 Incineration
(Not reproduced.)

2.12 Treatment of animal carcasses
(Not reproduced.)

2.13 Discharge of fish carried as a cargo
(Not reproduced.)

3 MANAGEMENT OF CARGO RESIDUES OF SOLID BULK CARGOES

3.1 Cargo residues are included in the definition of garbage within the meaning of MARPOL Annex V, regulation 1.9 and may be discharged in accordance with regulations 4.1.3 and 6.1.2. However, cargo material contained in the cargo hold bilge water should not be treated as cargo residues if the cargo material is not harmful to the marine environment and the bilge water is discharged from a loaded hold through the ship's fixed piping bilge drainage system.

3.2 Cargo residues are considered harmful to the marine environment and subject to regulations 4.1.3 and 6.1.2.1 of the MARPOL Annex V if they are residues of solid bulk substances which are classified according to the criteria of the United Nations Globally Harmonized System for Classification and Labelling of Chemicals (UN GHS) meeting the following parameters[1]:

.1 Acute Aquatic Toxicity Category 1; and/or

.2 Chronic Aquatic Toxicity Category 1 or 2; and/or

.3 Carcinogenicity[2] Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or

.4 Mutagenicity[2] Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or

.5 Reproductive Toxicity[2] Category 1A or 1B combined with not being rapidly degradable and having high bioaccumulation; and/or

.6 Specific Target Organ Toxicity Repeated Exposure[2] Category 1 combined with not being rapidly degradable and having high bioaccumulation; and/or

.7 Solid bulk cargoes containing or consisting of synthetic polymers, rubber, plastics, or plastic feedstock pellets (this includes materials that are shredded, milled, chopped or macerated or similar materials).

Notes:

1) The criteria are based on UN GHS, fourth revised edition (2011). For specific products (e.g. metals and inorganic metal compounds) guidance available in UN GHS, annexes 9 and 10 are essential for proper interpretation of the criteria and classification and should be followed.

2) Products that are classified for Carcinogenicity, Mutagenicity, Reproductive toxicity or Specific Target Organ Toxicity Repeated Exposure for oral and dermal hazards or without specification of the exposure route in the hazard statement.

3.3 Cargo residues that are harmful to the marine environment may require special handling not normally provided by reception facilities. Ports and terminals receiving such cargoes should have adequate reception facilities for all relevant residues, including when contained in washwater.

3.4 Solid bulk cargoes should be classified and declared by the shipper as to whether or not they are harmful to the marine environment. Such declaration should be included in the information required in section 4.2 of the IMSBC Code.

3.5 Ports, terminals and ship operators should consider cargo loading, unloading and onboard handling practices[1] in order to minimize production of cargo residues. Cargo residues are created through inefficiencies in loading, unloading, onboard handling. Options that should be considered to decrease the amount of such garbage include the following:

.1 ensuring ships are suitable to carry the intended cargo and also suitable for unloading the same cargo using conventional unloading methods;

.2 unloading cargo as efficiently as possible, utilizing all appropriate safety precautions to prevent injury or ship and equipment damage and to avoid or minimize cargo residues; and

.3 minimizing spillage of the cargo during transfer operations by carefully controlling cargo transfer operations, both on board and from dockside. This should include effective measures to enable immediate communications between relevant ship and shore-based personnel during the transfer operations and when feasible, enclosure of conveyance devices such as conveyor belts. Since this spillage typically occurs in port, it should be completely cleaned up immediately following the loading and unloading event and handled as cargo; delivering it into the intended cargo space or into the appropriate unloading holding area.

[1] Refer to the International Maritime Solid Bulk Cargoes (IMSBC) Code and supplement.

3.6 When the master, based on the information received from the relevant port authorities, determines that there are no adequate reception facilities[2] at either the port of departure or the port of destination in the case where both ports are situated within the same special area, the condition under regulation 6.1.2.3 should be considered satisfied.

3.7 MARPOL Annex V, regulation 6.1.2 also applies when the "port of departure" and the "next port of destination" is the same port. To discharge cargo hold washwater in this situation, the ship must be en route and the discharge must take place not less than 12 miles from the nearest land.

4 TRAINING, EDUCATION AND INFORMATION

(Not reproduced.)

5 PORT RECEPTION FACILITIES FOR GARBAGE

(Not reproduced.)

6 ENHANCEMENT OF COMPLIANCE WITH MARPOL ANNEX V

(Not reproduced.)]"

[2] IMO Circular MEPC.1/Circ.469/Rev.1, *Revised consolidated format for reporting alleged inadequacies of port reception facilities.*

APPENDIX 1

Individual schedules of solid bulk cargoes

Amendments to existing individual schedules

ALFALFA

34 In the individual schedule for "ALFALFA", under the section for "Loading", in the first sentence, replace the words "of the Code" by the words "of this Code".

ALUMINA HYDRATE

35 In the individual schedule for "ALUMINA HYDRATE", under the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

CLINKER ASH, WET

36 In the bulk cargo shipping name, the word "WET", is deleted. Under the section for "Description", the third sentence "Insoluble in water." is replaced by the following:

> "This cargo can be classified into wet type, which is taken out using water, and dry type, which is taken out under dry condition."

and under the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted. After the reference "7.3.2", insert the words "or a ship complying with the requirements in subsection 7.3.3".

COAL

37 In the individual schedule for "COAL", under the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted. In the appendix for the individual schedule for "COAL", in the section for "Procedures for gas monitoring of coal cargoes", the corresponding footnote in paragraph "2.7.1.4" is amended to read as follows:

> "Refer to the *Revised recommendations for entering enclosed spaces aboard ships*, adopted by the Organization by resolution A.1050(27) (see the supplement to this Code)."

COAL SLURRY

38 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

COKE BREEZE

39 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

FLUORSPAR

40 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

FLY ASH, WET

41 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

ILMENITE CLAY

42 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

ILMENITE (UPGRADED)

43 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

IRON ORE

44 Replace the existing individual schedule for "IRON ORE" by the following:

"IRON ORE

The provisions of this schedule shall apply to iron ore cargoes:

.1 containing either:

  .1 less than 10% of fine particles less than 1 mm (D_{10} > 1 mm); or

  .2 less than 50% of particles less than 10 mm (D_{50} > 10 mm); or

  .3 both; or

.2 iron ore fines where the total goethite content is 35% or more by mass, provided the master receives from the shipper a declaration of the goethite content of the cargo which has been determined according to internationally or nationally accepted standard procedures.

Description
Iron ore varies in colour from dark grey to rusty red. It varies in iron content from haematite, (high grade ore) to ironstone of the lower commercial ranges. Mineral Concentrates are different cargoes (see IRON CONCENTRATE).

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Not applicable	1,250 to 3,500	0.29 to 0.80
Size	**Class**	**Group**
Up to 250 mm	Not applicable	C

Hazard
No special hazards.
This cargo is non-combustible or has a low fire-risk.
Iron ore cargoes may affect magnetic compasses.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
No special requirement.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code. When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Loading rates of this cargo are normally very high. Due consideration shall be given to the ballasting operation to develop the loading plan required by SOLAS regulation VI/7.3. Bilge wells shall be clean, dry and protected as appropriate to prevent ingress of the cargo.

Ventilation
No special requirements.

Carriage
No special requirements.

Discharge
No special requirements.

Clean-up
No special requirements."

IRON ORE PELLETS

45 In the individual schedule for "IRON ORE PELLETS", under "Precautions", delete the words "No special requirements".

METAL SULPHIDE CONCENTRATES

46 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

MINERAL CONCENTRATES

47 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted."

NICKEL ORE

48 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

PEAT MOSS

49 In the section for "Loading", the words "specially fitted or constructed ships (see subsection 7.3.2)" are replaced by the words "a ship complying with the requirements in subsection 7.3.2 of this Code".

SAND, HEAVY MINERAL

50 In the section for "Weather precautions", in the first paragraph, the words "specially constructed or fitted cargo" are deleted.

SULPHUR (formed, solid)

51 In the individual schedule for "SULPHUR (formed, solid)", the corresponding footnote under "Clean-up" is amended to read as follows:

> "Refer to the *Revised recommendations for entering enclosed spaces aboard ships*, adopted by the Organization by resolution A.1050(27) (see the supplement to this Code)."

WOOD PELLETS

52 The existing individual schedule for "WOOD PELLETS" is deleted.

New individual schedules

53 Insert the following new individual schedules accordingly in alphabetical order:

"ALUMINIUM FLUORIDE

Description
Aluminium fluoride is a fine, white powder, odourless which presents itself dry. The cargo is not cohesive. The moisture content is less than 1%.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
32° to 35°	1,527	0.65
Size	**Class**	**Group**
Fine powder	Not applicable	A

Hazard
This cargo may liquefy if shipped at a moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code.

The cargo may be slightly irritating to eyes and mucous membranes. In contact with acids, it develops toxic vapours of hydrogen fluoride. If involved in a fire, it may develop toxic fumes of hydrogen fluoride. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in paragraph 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
The appearance of the surface of this cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
Maintain accommodation and equipment protected from dust.

Clean-up
Make sure that decks and holds are shovelled and swept clean before using water."

"AMORPHOUS SODIUM SILICATE LUMPS

This schedule shall apply only to amorphous sodium silicate lumps with molar ratio of silicon dioxide to sodium oxide (SiO_2/Na_2O) greater than 3.2.

Description
Lumps. Colorless to green glassy solid.

Characteristics

Angle of repose	Bulk density (kg/m³)	Stowage factor (m³/t)
Not applicable	1,100 to 1,500	0.67 to 0.91
Size	**Class**	**Group**
Up to 100 mm	MHB (CR)	B

Hazard
Dust may cause skin and eye irritation.

This cargo is non-combustible or has a low fire-risk. This cargo is hygroscopic and will cake if wet.

Stowage & segregation
No special requirements.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
This cargo shall be kept as dry as practicable. This cargo shall not be handled during precipitation. During handling of this cargo all non-working hatches of the cargo spaces into which this cargo is to be loaded shall be closed.

Loading
During loading, due consideration shall be given to minimize dust generation. Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

Precautions
Bilge wells shall be clean and dry and covered as appropriate to prevent ingress of the cargo.

Persons who may be exposed to the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks. Appropriate precautions shall be taken to protect machinery and accommodation spaces from the dust of the cargo.

Ventilation
The cargo spaces carrying this cargo shall not be ventilated during voyage.

Carriage
No special requirements.

Discharge
During discharge, due consideration shall be given to minimize dust generation. This cargo is hygroscopic and may cake in overhangs, impairing safety during discharge. If this cargo has hardened, it shall be trimmed to avoid the formation of overhangs, as necessary.

Clean-up
No special requirements.

Emergency procedures

Special emergency equipment to be carried
Nil
Emergency procedures Nil **Emergency action in the event of fire** Nil **Medical First Aid** Refer to the Medical First Aid Guide (MFAG), as amended

"

"BORIC ACID

Description
A white free-flowing crystalline powder. Odourless and dry with not more than 1.0% moisture. Water soluble.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	544 to 862	1.16 to 1.84
Size	**Class**	**Group**
Fine crystalline powder, dry	MHB (TX)	B

Hazard
Mild irritation effects to nose and throat may occur from inhalation. May cause irritation to skin. May cause long-term health effects. This cargo is non-combustible.
This cargo is hygroscopic and will cake if wet.

Stowage & segregation
"Separated from" metal hydrides and alkali metals.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
This cargo shall be kept as dry as practicable. This cargo shall not be handled during precipitation. During handling of this cargo, all non-working hatches of the cargo spaces into which this cargo is loaded or to be loaded shall be closed.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
No special requirements.

Discharge
No discharge operations during precipitation.
Boric acid is hygroscopic and may cake in overhangs, impairing safety during discharge. If this cargo has hardened, it shall be trimmed to avoid the formation of overhangs, as necessary.

Clean-up
Thorough dry cleaning to be carried out prior to washing all cargo spaces.

Emergency procedures

Special emergency equipment to be carried Nil.
Emergency procedures Nil. **Emergency action in the event of fire** Nil. **Medical First Aid** Refer to the *Medical First Aid Guide (MFAG)*, as amended.

"

"CHEMICAL GYPSUM

Description
Calcium sulphate hydrate generated as a product or by-product in the process of smelter and refinery, and polyaluminum chloride. White or brown powder without smell and insoluble. In use for Gypsum-Board and Cement.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	570 to 1,170	0.85 to 1.74
Size	**Class**	**Group**
40 μm to 1 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at a moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

Precautions
No special requirements.

Ventilation
No special requirements.

Carriage
The appearance of the surface of this cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
Prior to washing out the residues of this cargo, the decks and the cargo spaces shall be shovelled and swept clean, because washing out of this cargo is difficult."

"COPPER SLAG

Description
Residue generated from copper smelting process. This cargo is highly permeable and pore water of this cargo drains quickly. It is black or red-brown in colour and either granular or lump.

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Not applicable	1,500 to 2,500	0.40 to 0.67
Size	**Class**	**Group**
Up to 10 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is abrasive. This cargo is non-combustible and has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
This cargo shall be trimmed to ensure that the height difference between peaks and troughs does not exceed 5% of the ship's breadth and that the cargo slopes uniformly from the hatch boundaries to the bulkheads and no shearing faces remain to collapse during voyage.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Appropriate action shall be taken to protect machinery and accommodation spaces from the dust of the cargo. Bilge wells of the cargo spaces shall be protected from ingress of the cargo. Due consideration shall be given to protect equipment from the dust of the cargo.

Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
Bilge water shall be removed regularly during the voyage.

Discharge
No special requirements.

Clean-up
No special requirements."

"GLASS CULLET

Description
Green, brown or uncoloured glass. May have a slight sweet smell. Used to make new glass, glass wool and foam glass.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	1,060 to 1,330	0.75 to 0.94
Size	**Class**	**Group**
Up to 50 mm	Not applicable	C

Hazard
This cargo is non-combustible or has a low fire-risk.
Potential inhalation hazard and skin and eye irritation from cullet dust during handling, placement and transportation.
Potential risk for cuts or punctures during handling and placement.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
No special requirements.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

Precautions
To protect against possible cuts or penetration injuries as well as against exposure of glass dust to skin, ears and eyes, personnel working with glass cullet shall wear long sleeves, pants, gloves, work boots, hard hats, ear protection and eye protection. Shirt sleeves and pant legs can be taped for additional protection.

Personnel can also wear disposable nuisance dust masks to protect against dust inhalation.

Ventilation
No special requirements.

Carriage
No special requirements.

Discharge
No special requirements.

Clean-up
Avoid handling which creates dust.
Wet suppression is an effective measure of dust control."

"IRON AND STEEL SLAG AND ITS MIXTURE

This cargo may contain substances hazardous to human health such as cadmium, lead, hexavalent chromium, boron and fluorine. This individual schedule shall not apply to cargoes that meet the criteria specified in 9.2.2.5 and 9.2.3.6.

Description
The main component of the cargo is a slag arising from iron and steel manufacture, and a slag mixed with one of the following additives or a combination thereof: cement, granulated blast furnace slag and concrete debris.

The cargo is mostly stabilized before transportation by ageing and slaking for the volume and/or chemical stability in practical usages, and physical properties such as the grain size, etc. are controlled for the performance requirement if necessary the cargo is transported at room temperature.

This cargo does not include both slag residue and hot iron and steel slag discharged from iron and steelmaking processes.

The iron and steel slag is a vitrified or crystallized solid formed out of high temperature processes, and it is a mixture of several mineralogical phases.

This cargo may include shaped blocks made of iron and steel slag with a combination of cement and ground granulated blast furnace slag. The colour is in the range from greyish-white to dark grey, and the appearance is in the range from granulated, pebble to blocks. Examples of the application of this cargo are: road construction materials, concrete aggregate, soil improvement, civil engineering materials, raw materials of cement industry and raw materials for fertilizer.

Characteristics

Angle of repose	**Bulk density (kg/m3)**	**Stowage factor (m3/t)**
Not applicable	1,200 to 3,000	0.33 to 0.83
Size	**Class**	**Group**
Up to 100 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at a moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible and has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept at less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
The appearance of the surface of this cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

"IRON ORE FINES

The provisions of this schedule shall apply to iron ore cargoes containing both:

.1 10% or more of fine particles less than 1 mm (D_{10} ≤ 1 mm); and

.2 50% or more of particles less than 10 mm (D_{50} ≤ 10 mm).

Notwithstanding the above provision, iron ore fines where the total goethite content is 35% or more by mass may be carried in accordance with the individual schedule for "IRON ORE", provided the master receives from the shipper a declaration of the goethite content of the cargo which has been determined according to internationally or nationally accepted standard procedures.

Description
Iron ore fines vary in colour from dark grey, rusty red to yellow and contain hematite, goethite and magnetite with varying iron content.

IRON CONCENTRATE is a different cargo (see individual schedule for "Mineral Concentrates")

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Not applicable	1,500 to 3,500	0.29 to 0.67
Size	**Class**	**Group**
10% or more of fine particles less than 1 mm and 50% or more of particles less than 10 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its transportable moisture limit (TML). See sections 7 and 8 of this Code.
This cargo may affect magnetic compasses.
This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements

Hold cleanliness
No special requirements

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Loading rates of this cargo are normally very high. Due consideration shall be given to the ballasting operation in developing the loading plan required by SOLAS regulation VI/7.3. Bilge wells shall be clean, dry and protected as appropriate to prevent ingress of the cargo.

Ventilation
No special requirements

Carriage
Cargo hold bilges shall be sounded at regular intervals and pumped out, as necessary. The appearance of the surface of this cargo shall be checked regularly during voyage, as far as practicable. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

"IRON OXIDE TECHNICAL

Description
Iron oxide technical is generated as a product or by-product in the manufacture of di-iron trioxide (iron (III) oxide) for the industrial and commercial use. The material is odourless and red in colour.

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Not applicable	1,000	1.0
Size	**Class**	**Group**
Fine particles	Not applicable	A

Hazard
Dust may cause skin and eye irritation. Iron cargoes may affect magnetic compasses.

This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements

Hold cleanliness
No special requirements

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions in compliance with sections 4 and 5 of this Code.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.
Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo.

Ventilation
No special requirements

Carriage
The appearance of the surface of this cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements

Clean-up
After discharge of this cargo, the bilge wells and the scuppers of the cargo spaces shall be checked and any blockage in the bilge wells and the scuppers shall be removed."

"IRON SINTER

Description
The thermally agglomerated substance formed by heating a variable mixture of finely divided coke, iron ore, blast furnace dust, steelmaking dust, mill scale, other miscellaneous iron-bearing materials, limestone, and dolomite at 1315°C to 1482°C.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	1,800 to 2,100	0.47 to 0.56
Size	**Class**	**Group**
Up to 200 mm	Not applicable	C

Hazard
Dust of this cargo is fine and may be irritating to eye and respiratory tract. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
No special requirements.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

As the density of the cargo is extremely high, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be paid to ensure that the tank top is not overstressed during voyage and during loading by a pile of the cargo.

Precautions
Bilge wells of the cargo space shall be protected from ingress of the cargo. Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
Bilge shall be sounded and pumped out as necessary during the voyage.

Discharge
No special requirements.

Clean-up
No special requirements."

"MANGANESE COMPONENT FERROALLOY SLAG

Description
By-product generated in process of manufacturing manganese component ferroalloy. Particles or lumps of green, brownish-red or grayish-black. Moisture: 1.2% to 5.6%.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	1,480 to 1,935	0.52 to 0.68
Size	**Class**	**Group**
Up to 200 mm	Not applicable	C

Hazard
No special hazards.
This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
No special requirements.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that tank top is not overstressed during voyage and during loading by a pile of the cargo.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
No special requirements.

Discharge
No special requirements.

Clean-up
No special requirements."

"MANGANESE ORE FINES

The provisions of this schedule shall apply to manganese ore cargoes containing both:

.1 10% or more of fine particles less than 1 mm ($D_{10} \leq$ 1 mm); and

.2 50% or more of particles less than 10 mm ($D_{50} \leq$ 10 mm).

Notwithstanding the above provisions, manganese ore cargoes which do not exhibit a flow moisture point (FMP) are not liable to liquefy and shall be shipped as a Group C cargo under the provisions of the MANGANESE ORE individual schedule.

This schedule applies to manganese ore cargoes which may liquefy. For manganese ore cargoes not liable to liquefy see the MANGANESE ORE schedule.

Description
Manganese ore fines is multicoloured, and usually brown to black. Its colour and texture may vary due to variations of the manganese and gangue minerals present. It is a very heavy cargo with typical moisture content up to 15% by weight.

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Not applicable	1,450 to 3,200	0.31 to 0.69
Size	**Class**	**Group**
Typically up to 15 mm with more than 10% finer than 1 mm and more than 50% finer than 10 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code.

The dust of this cargo is irritating to the eyes and mucous membranes.

This cargo is non-combustible or has a low fire-risk. It is stable and non-reactive under normal conditions of use, storage and transport. However, this cargo may ignite in contact with incompatible materials such as acids, alkalis, oxidizing and reducing agents. It may decompose to form toxic manganese oxide particles when heated to decomposition.

Stowage & segregation
Separated from acids, alkalis, oxidizing and reducing agents.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this schedule, during handling of the cargo all non-working hatches of the cargo spaces into which the cargo is loaded, or to be loaded, shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal to or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be paid to ensure that the tank top is not overstressed during voyage and during loading by a pile of the cargo.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.
Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo. Bilge system of a cargo space to which this cargo is to be loaded shall be tested to ensure it is working. Appropriate precautions shall be taken to protect machinery and accommodation spaces from the dust of the cargo.

Ventilation
No special requirements.

Carriage
The appearance of the surface of the cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during the voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

"SCALE GENERATED FROM THE IRON AND STEEL MAKING PROCESS

Description

This cargo consists mainly of ferric oxide which is collected from various places of iron and steel making process. Mill scale, which is scale collected from water used in hot rolling process and from drainage pits with a small amount of oil which is used for rolling, is a main component of this cargo. This cargo is reused as a raw material for iron.
Shape varies from powder to lumps. Colour is gray, ash brown, ash black green, brown, burnt umber or black. Specific gravity of solids is 3 to 6.

This cargo consists mainly of moisture, oil (less than 1.2%), Wustite (FeO), Magnetite (Fe_3O_4), Hematite (Fe_2O_3), metallic iron and Fayalite (Fe_2SiO_4). It consists of main chemical elements in this cargo except for moisture and oil are in the range of the followings: Fe > 70%, Ca < 0.8%, Si < 0.7%, Al < 0.3%, Cr < 1.5%, Ni < 0.5%, Mn < 1.0%.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Not applicable	1,300 to 3,300	0.30 to 0.77
Size	**Class**	**Group**
Up to 150 mm	Not applicable	A

Hazard

This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation

No special requirements.

Hold cleanliness

No special requirements.

Weather precautions

When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during voyage and during loading by a pile of the cargo.

Precautions
Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.
As this cargo may contain oil less than 1.2%, due consideration shall be given not to discharge bilge directly from the cargo holds.

Ventilation
No special requirements.

Carriage
The appearance of the surface of this cargo shall be checked regularly during voyage. If free water above the cargo or fluid state of the cargo is observed during voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

"SPODUMENE (UPGRADED)

Description
Spodumene (upgraded) is an odourless and tasteless off-white to beige sand containing a mixture of naturally occurring silicates and quartz. It is produced by processing naturally occurring spodumene.

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
30° to 40°	1,600 to 2,000	0.50 to 0.63
Size	**Class**	**Group**
Up to 8 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
When this cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo. Bilge system of a cargo space to which this cargo is to be loaded shall be tested to ensure it is working.

Ventilation
No special requirements.

Carriage
The appearance of the surface of the cargo shall be checked regularly during the voyage. If free water above the cargo or fluid state of the cargo is observed during the voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

"**WOOD PELLETS CONTAINING ADDITIVES AND/OR BINDERS**

Description
The wood pellets covered by this schedule are those containing additives and/or binders. These wood pellets are light blond to dark brown in colour; very hard and cannot be easily squashed; have a typical specific density between 1,100 to 1,700 kg/m^3. Wood pellets are

made of sawdust, planer shavings and other wood waste such as bark coming out of the lumber manufacturing processes. The raw material is fragmented, dried and extruded into pellet form using appropriate additives and/or binders. The raw material is compressed approximately 3.5 times and the finished wood pellets typically have a moisture content of 4% to 8%. Wood pellets are used as a fuel in district heating and electrical power generation as well as a fuel for small space heaters such as stoves and fireplaces.

Wood pellets are also used as animal bedding due to the absorption characteristics. Such wood pellets typically have a moisture content of 8% to 10%.

For wood pellets not containing any additives and/or binders see separate schedule.

Characteristics

Angle of repose	**Bulk density (kg/m^3)**	**Stowage factor (m^3/t)**
Approximately 30°	600 to 750	1.33 to 1.67
Size	**Class**	**Group**
Cylindrical with Diameter: 3 mm to 12 mm Length: 10 to 20 mm	MHB (WF)	B

Hazard
Shipments are subject to oxidation leading to depletion of oxygen and increase of carbon monoxide and carbon dioxide in cargo and communicating spaces (also see Weather precautions).

Swelling if exposed to moisture. Wood pellets may ferment over time if moisture content is over 15%, leading to generation of asphyxiating and flammable gases which may cause spontaneous combustion.

Handling of wood pellets may cause dust to develop. Risk of explosion at high dust concentration.

Stowage & segregation
Segregate as for class 4.1 materials.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
This cargo shall be kept as dry as practicable. This cargo shall not be handled during precipitation. During handling of this cargo, all non-working hatches of the cargo spaces into which this cargo is loaded or to be loaded shall be closed. There is a high risk of renewed oxygen depletion and carbon monoxide formation in previously ventilated adjacent spaces after closure of the hatch covers.

Loading
Trim in accordance with the relevant provisions required under sections 4, 5 and 6 of this Code.

Precautions
Entry of personnel into cargo and adjacent confined spaces shall not be permitted until tests have been carried out and it has been established that the oxygen content and carbon monoxide levels have been restored to the following levels: oxygen 21% and carbon monoxide <100 ppm. If these conditions are not met, additional ventilation shall be applied to the cargo hold or adjacent confined spaces and re-measuring shall be conducted after a suitable interval.

An oxygen and carbon monoxide meter shall be worn and activated by all crew when entering cargo and adjacent enclosed spaces.

Ventilation
Ventilation of enclosed spaces adjacent to a cargo hold before entry may be necessary even if these spaces are apparently sealed from the cargo hold.

Carriage
No special requirements.

Discharge
No special requirements.

Clean-up
No special requirements.

Emergency procedures

Special emergency equipment to be carried Self-contained breathing apparatus and combined or individual oxygen and carbon monoxide meters should be available.
Emergency procedures Nil **Emergency action in the event of fire** Batten down; use ship's fixed fire-fighting installation, if fitted. Exclusion of air may be sufficient to control fire. Extinguish fire with carbon dioxide, foam or water. **Medical First Aid** Refer to the Medical First Aid Guide (MFAG), as amended.

"

"WOOD PELLETS NOT CONTAINING ANY ADDITIVES AND/OR BINDERS

Description

The wood pellets covered by this schedule are those not containing any additives and/or binders. These wood pellets are light blond to dark brown in colour; very hard and cannot be easily squashed; have a typical specific density between 1,100 to 1,700 kg/m^3. The wood pellets are made of sawdust, planer shavings and other wood waste such as bark coming out of the lumber manufacturing processes. The raw material is fragmented, dried and extruded into pellet form. The raw material is compressed approximately 3.5 times and the finished wood pellets typically have a moisture content of 4% to 8%. Wood pellets are used as a fuel in district heating and electrical power generation as well as a fuel for small space heaters such as stoves and fireplaces.

Wood pellets are also used as animal bedding due to the absorption characteristics. Such wood pellets typically have a moisture content of 8% to 10%.

For wood pellets containing additives and/or binders see separate schedule.

Characteristics

Angle of repose	Bulk density (kg/m^3)	Stowage factor (m^3/t)
Approximately 30°	600 to 750	1.33 to 1.67
Size	**Class**	**Group**
Cylindrical with Diameter: 3 mm to 12 mm Length: 10 to 20 mm	MHB (OH)	B

Hazard

Shipments are subject to oxidation leading to depletion of oxygen and increase of carbon monoxide and carbon dioxide in cargo and communicating spaces (also see "Weather precautions").

Swelling if exposed to moisture. Wood pellets may ferment over time if moisture content is over 15%, leading to generation of asphyxiating and flammable gases but gas concentrations do not reach flammable levels. This cargo has a low fire-risk.

Handling of wood pellets may cause dust to develop. Risk of explosion at high dust concentration.

Stowage & segregation

Segregate as for class 4.1 materials.

Hold cleanliness

Clean and dry as relevant to the hazards of the cargo.

Weather precautions

This cargo shall be kept as dry as practicable. This cargo shall not be handled during precipitation. During handling of this cargo, all non-working hatches of the cargo spaces into which this cargo is loaded or to be loaded shall be closed. There is a high risk of renewed oxygen depletion and carbon monoxide formation in previously ventilated adjacent spaces after such closure.

Loading
Trim in accordance with the relevant provisions required under sections 4, 5 and 6 of this Code.

Precautions
Entry of personnel into cargo and adjacent confined spaces shall not be permitted until tests have been carried out and it has been established that the oxygen content and carbon monoxide levels have been restored to the following levels: oxygen 21% and carbon monoxide <100 ppm. If these conditions are not met, additional ventilation shall be applied to the cargo hold or adjacent confined spaces and remeasuring shall be conducted after a suitable interval.

An oxygen and carbon monoxide meter shall be worn and activated by all crew when entering cargo and adjacent enclosed spaces.

Ventilation
Ventilation of enclosed spaces adjacent to a cargo hold before entry may be necessary even if these spaces are apparently sealed from the cargo hold.

Carriage
No special requirements.

Discharge
No special requirements.

Clean-up
No special requirements.

Emergency procedures

Special emergency equipment to be carried Self-contained breathing apparatus and combined or individual oxygen and carbon monoxide meters should be available.
Emergency procedures Nil **Emergency action in the event of fire** Batten down; use ship's fixed fire-fighting installation, if fitted. Exclusion of air may be sufficient to control fire. Extinguish fire with carbon dioxide, foam or water. **Medical First Aid** Refer to the Medical First Aid Guide (MFAG), as amended.

"

"ZINC SLAG

Description

Residue generated from zinc smelting process. This cargo is highly permeable and pore water of this cargo drains quickly. It is black or red-brown in colour and either granular or lump.

Characteristics

Angle of repose	Bulk density (kg/m³)	Stowage factor (m³/t)
Not applicable	1,500 to 2,500	0.40 to 0.67
Size	**Class**	**Group**
Up to 10 mm	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is abrasive. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
No special requirements.

Weather precautions
When a cargo is carried in a ship other than a ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this individual schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
This cargo shall be trimmed to ensure that the height difference between peaks and troughs does not exceed 5% of the ship's breadth and that the cargo slopes uniformly from the hatch boundaries to the bulkheads and no shearing faces remain to collapse during voyage.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Appropriate action shall be taken to protect machinery and accommodation spaces from the dust of the cargo. Bilge wells of the cargo spaces shall be protected from ingress of the cargo. Due consideration shall be given to protect equipment from the dust of the cargo. Persons who may be exposed to the dust of the cargo shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.

Ventilation
No special requirements.

Carriage
Bilge water shall be removed regularly during the voyage.

Discharge
No special requirements.

Clean-up
No special requirements."

"ZIRCON KYANITE CONCENTRATE

Description
Zircon kyanite concentrate is an odourless and tasteless off-white to brown mixture of the heavy mineral sand processing waste stream (concentrate) and zircon sand. It is used for upgrading mineral sand products such as zircon and kyanite. It is a very heavy cargo.

Characteristics

Angle of repose	Bulk density (kg/m³)	Stowage factor (m³/t)
Not applicable	2,400 to 3,000	0.33 to 0.42
Size	**Class**	**Group**
Fine particles	Not applicable	A

Hazard
This cargo may liquefy if shipped at moisture content in excess of its Transportable Moisture Limit (TML). See sections 7 and 8 of this Code. This cargo is non-combustible or has a low fire-risk.

Stowage & segregation
No special requirements.

Hold cleanliness
Clean and dry as relevant to the hazards of the cargo.

Weather precautions
When this cargo is carried in a ship other than a specially constructed or fitted cargo ship complying with the requirements in subsection 7.3.2 of this Code, the following provisions shall be complied with:

.1 the moisture content of the cargo shall be kept less than its TML during loading operations and the voyage;

.2 unless expressly provided otherwise in this individual schedule, the cargo shall not be handled during precipitation;

.3 unless expressly provided otherwise in this schedule, during handling of the cargo, all non-working hatches of the cargo spaces into which the cargo is loaded or to be loaded shall be closed;

.4 the cargo may be handled during precipitation under the conditions stated in the procedures required in subsection 4.3.3 of this Code; and

.5 the cargo in a cargo space may be discharged during precipitation provided that the total amount of the cargo in the cargo space is to be discharged in the port.

Loading
Trim in accordance with the relevant provisions required under sections 4 and 5 of this Code.

When the stowage factor of this cargo is equal or less than 0.56 m^3/t, the tank top may be overstressed unless the cargo is evenly spread across the tank top to equalize the weight distribution. Due consideration shall be given to ensure that the tank top is not overstressed during the voyage and during loading by a pile of the cargo.

Precautions
Bilge wells shall be clean, dry and covered as appropriate, to prevent ingress of the cargo. Bilge system of a cargo space to which this cargo is to be loaded shall be tested to ensure it is working.

Ventilation
No special requirements.

Carriage
The appearance of the surface of the cargo shall be checked regularly during the voyage. If free water above the cargo or fluid state of the cargo is observed during the voyage, the master shall take appropriate actions to prevent cargo shifting and potential capsize of the ship, and give consideration to seeking emergency entry into a place of refuge.

Discharge
No special requirements.

Clean-up
No special requirements."

APPENDIX 2

Laboratory test procedures, associated apparatus and standards

1 Test procedures for materials which may liquefy and associated apparatus

54 Add the following new "subsection 1.4":

"1.4 Modified Proctor/Fagerberg test procedure for Iron Ore Fines

1.4.1 ***Scope***

.1 The test procedure specified in this section (this test) should only be used for determining transportable moisture limit (TML) of Iron Ore Fines. See individual schedule for Iron Ore Fines.

.2 Iron Ore Fines is iron ore containing both:

.1 10% or more of fine particles less than 1 mm, and

.2 50% or more of particles less than 10 mm.

.3 The TML of Iron Ore Fines is taken as equal to the critical moisture content at 80% degree of saturation according to the modified Proctor/Fagerberg method test.

.4 The test procedure is applicable when the degree of saturation corresponding to Optimum Moisture Content (OMC) is 90% or higher.

1.4.2 ***Modified Proctor/Fagerberg test equipment***

.1 The Proctor apparatus (see figure 1.4.1) consists of a cylindrical iron mould with a removable extension piece (the compaction cylinder) and a compaction tool guided by a pipe open at its lower end (the compaction hammer).

.2 Scales and weights (see 3.2) and suitable sample containers.

.3 A drying oven with a controlled temperature interval from 100°C to maximum 105°C.

.4 A container for hand mixing. Care should be taken to ensure that the mixing process does not reduce the particle size by breakage or increase the particle size by agglomeration or consistency of the test material.

.5 A gas or water pycnometry equipment to determine the density of the solid material as per a recognized standard (e.g. ASTM D5550, AS1289, etc.)

1.4.3 ***Temperature and humidity***
(see 1.1.3)

1.4.4 ***Procedure***

.1 **Establishment of a complete compaction curve**

A representative sample according to a relevant standard (see section 4.7 of the IMSBC Code) of the test material is partially dried at a temperature of approximately 60°C or less to reduce the samples moisture to suitable starting moisture, if needed. The representative sample for this test should not be fully dried, except in case of moisture content measurement.

The total quantity of the test material should be at least three times as big as required for the complete test sequence. Compaction tests are executed for five to ten different moisture contents (five to ten separate tests). The samples are adjusted in order that partially dry to almost saturated samples are obtained. The required quantity per compaction test is about 2,000 cm^3.

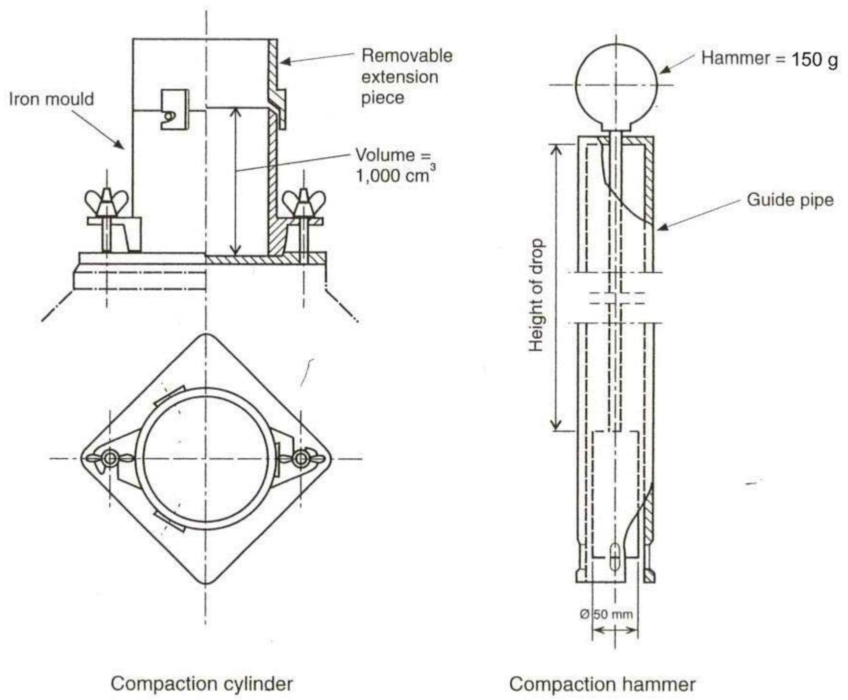

Figure 1.4.1

At each compaction test a suitable amount of water is added to the sample of the test material. The sample material is gently mixed before being allowed to rest and equilibrate. Approximately one fifth of the mixed sample is filled into the mould and levelled and then the increment is tamped uniformly over the surface of the increment. Tamping is executed by dropping a 150 g hammer 25 times through the guide pipe, 0.15 m each time. The performance is repeated for all five layers. When the last layer has been tamped, the extension piece is removed and the sample is levelled off along the brim of the mould with care, ensuring to remove any large particles that may hinder levelling of the sample, replacing them with material contained in the extension piece and re-levelling.

When the weight of the cylinder with the tamped sample has been determined, the cylinder is emptied, the sample is dried at 105ºC and the weight is determined. Reference is made to ISO 3087:2011 "Iron ores – Determination of the moisture content of a lot". The test then is repeated for the other samples with different moisture contents.

Density of solid material should be measured using a gas or water pycnometry equipment according to internationally or nationally accepted standard, e.g. ASTM D5550 and AS 1289 (see subsection 1.4.2.5).

.2 Definitions and data for calculations (see figure 1.4.2)

- empty cylinder, mass in grams: A
- cylinder with tamped sample, mass in grams: B
- wet sample, mass in grams: C

  $C = B - A$

- dry sample, mass in grams: D
- water, mass in grams (equivalent to volume in cm^3): E

  $E = C - D$

Volume of cylinder: 1000 cm^3

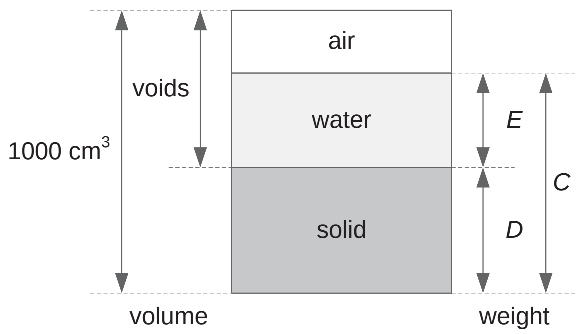

Figure 1.4.2

.3 Calculation of main characteristics

- density of solid material, g/cm^3 (t/m^3): d
- dry bulk density, g/cm^3 (t/m^3): γ

$$\gamma = \frac{D}{1000}$$

- net water content, volume %: e_v

$$e_v = \frac{E}{D} \times 100 \times d$$

- void ratio: e (volume of voids divided by volume of solids)

$$e = \frac{d}{\gamma} - 1$$

- degree of saturation, percentage by volume: S

$$S = \frac{e_v}{e}$$

- gross water content, percentage by mass: W^1

$$W^1 = \frac{E}{C} \times 100$$

- net water content, percentage by mass: W

$$W = \frac{E}{D} \times 100$$

.4 Presentation of the compaction tests

For each compaction test the calculated void ratio (e) value is plotted as the ordinate in a diagram with net water content (e_v) and degree of saturation (S) as the respective abscissa parameters.

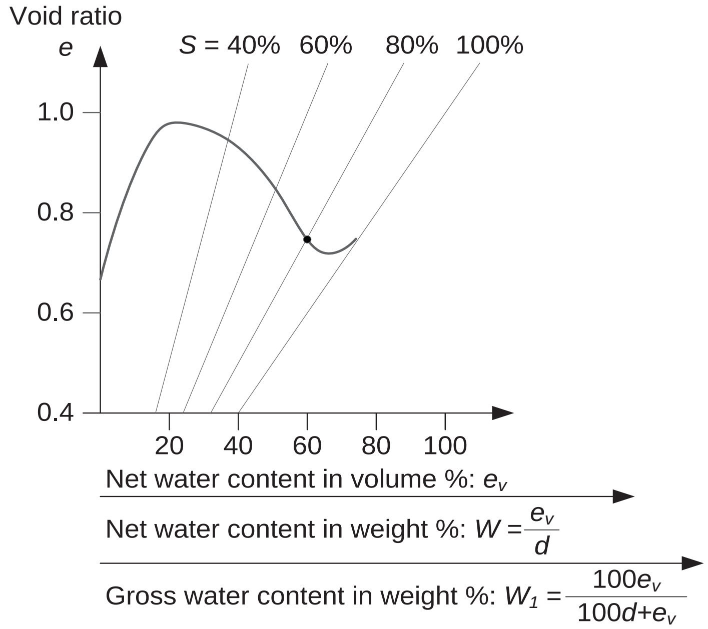

Figure 1.4.3

.5 Compaction curve

The test sequence results in a specific compaction curve (see figure 1.4.3).

The critical moisture content is indicated by the intersection of the compaction curve and the line S = 80% degree of saturation. The transportable moisture limit (TML) is the critical moisture content.

Optimum Moisture Content (OMC) is the moisture content corresponding to the maximum compaction (maximum dry density) under the specified compaction condition. To check the applicability of this test, the relationship between moisture content and dry density should be evaluated, during this test. Then the OMC and the corresponding degree of saturation should be determined. This test procedure was developed based on the finding that the degree of saturation corresponding to OMC of iron ore fines was 90 to 95%, while such degree of saturation of mineral concentrates was 70% to 75%. In the case that the degree of saturation corresponding to OMC is less than 90%, the shipper should consult with an appropriate authority, for the reason that this test may not be applicable for the material and the TML determined by this test may be too high."

APPENDIX 3

Properties of solid bulk cargoes

1 Non-cohesive cargoes

1.1 The following cargoes are non-cohesive when dry:

55 In the list, add the following new entries in alphabetical order:

"ALUMINIUM FLUORIDE"
"SPODUMENE (UPGRADED)"
"WOOD PELLETS CONTAINING ADDITIVES AND/OR BINDERS"
"WOOD PELLETS NOT CONTAINING ANY ADDITIVES AND/OR BINDERS"

and the entry for "WOOD PELLETS" is deleted.

APPENDIX 4

INDEX

56 Insert the following new entries in alphabetical order:

"

Material	Group	References
ALUMINIUM FLUORIDE	A	
AMORPHOUS SODIUM SILICATE LUMPS	B	
BORIC ACID	B	
CHEMICAL GYPSUM	A	
COPPER SLAG	A	
GLASS CULLET	C	
IRON AND STEEL SLAG AND ITS MIXTURE	A	
IRON ORE FINES	A	
IRON OXIDE TECHNICAL	A	
IRON SINTER	C	
MANGANESE COMPONENT FERROALLOY SLAG	C	
MANGANESE ORE FINES	A	
SCALE GENERATED FROM THE IRON AND STEEL MAKING PROCESS	A	
SPODUMENE (UPGRADED)	A	
WOOD PELLETS CONTAINING ADDITIVES AND/OR BINDERS	B	
WOOD PELLETS NOT CONTAINING ANY ADDITIVES AND/OR BINDERS	B	
ZINC SLAG	A	
ZIRCON KYANITE CONCENTRATE	A	

"

57 The entry for "WOOD PELLETS" is deleted.

58 In the entry for "CLINKER ASH, WET" the word "WET" is deleted.

APPENDIX 5

Bulk Cargo Shipping Names in three languages (English, Spanish and French)

59 A new appendix 5 is inserted with following:

"**Bulk Cargo Shipping Names in three languages (English, Spanish and French)**

ENGLISH	SPANISH	FRENCH
ALFALFA	ALFALFA	LUZERNE
ALUMINA	ALÚMINA	ALUMINE
ALUMINA, CALCINED	ALÚMINA CALCINADA	ALUMINE CALCINÉE
ALUMINA HYDRATE	HIDRATO DE ALÚMINA	HYDRATE D'ALUMINE
ALUMINIUM FLUORIDE	FLUORURO DE ALUMINIO	FLUORURE D'ALUMINIUM
Aluminium hydroxide	Hidróxido de aluminio	Hydroxyde d'aluminium
ALUMINA SILICA	ALÚMINA SÍLICE	ALUMINE SILICEUSE
ALUMINA SILICA, pellets	ALÚMINA SÍLICE, pellets de	ALUMINE SILICEUSE en granules
ALUMINIUM DROSS	RESIDUOS DE ALUMINIO	LAITIER D'ALUMINIUM
ALUMINIUM FERROSILICON POWDER UN 1395	ALUMINIO-FERROSILICIO EN POLVO, No ONU 1395	ALUMINO-FERRO-SILICIUM EN POUDRE UN 1395
ALUMINIUM NITRATE UN 1438	NITRATO DE ALUMINIO, No ONU 1438	NITRATE D'ALUMINIUM UN 1438
ALUMINIUM REMELTING BY-PRODUCTS UN 3170	PRODUCTOS DERIVADOS DE LA REFUNDICIÓN DEL ALUMINIO, No ONU 3170	SOUS-PRODUITS DE LA REFUSION DE L'ALUMINIUM UN 3170
Aluminium salt slags	ESCORIA DE SALES DE ALUMINIO	SCORIES SALINES D'ALUMINIUM
ALUMINIUM SMELTING / REMELTING BY-PRODUCTS, PROCESSED	PRODUCTOS DERIVADOS DE LA FUNDICIÓN DEL ALUMINIO o PRODUCTOS DERIVADOS DE LA REFUNDICIÓN DEL ALUMINIO, TRATADOS	SOUS-PRODUITS DE LA FABRICATION/REFUSION DE L'ALUMINIUM, TRAITÉS
ALUMINIUM SILICON POWDER, UNCOATED UN 1398	ALUMINIO-SILICIO EN POLVO, NO RECUBIERTO, No ONU 1398	SILICO-ALUMINIUM EN POUDRE NON ENROBÉ UN 1398
ALUMINIUM SKIMMINGS	ESPUMA DE ALUMINIO	CRASSE D'ALUMINIUM
ALUMINIUM SMELTING BY-PRODUCTS UN 3170	PRODUCTOS DERIVADOS DE LA FUNDICIÓN DEL ALUMINIO, No ONU 3170	SOUS-PRODUITS DE LA FABRICATION DE L'ALUMINIUM UN 3170
AMMONIUM NITRATE UN 1942	NITRATO AMÓNICO, No ONU 1942	NITRATE D'AMMONIUM UN 1942
AMMONIUM NITRATE BASED FERTILIZER UN 2067	ABONOS A BASE DE NITRATO AMÓNICO, No ONU 2067	ENGRAIS AU NITRATE D'AMMONIUM UN 2067

ENGLISH	SPANISH	FRENCH
AMMONIUM NITRATE BASED FERTILIZER UN 2071	ABONOS A BASE DE NITRATO AMÓNICO, No ONU 2071	ENGRAIS AU NITRATE D'AMMONIUM UN 2071
AMMONIUM NITRATE, BASED FERTILIZER (non-hazardous)	ABONOS A BASE DE NITRATO AMÓNICO (no entrañan riesgos)	ENGRAIS AU NITRATE D'AMMONIUM (non dangereux)
AMMONIUM SULPHATE	SULFATO AMÓNICO	SULFATE D'AMMONIUM
AMORPHOUS SODIUM SILICATE LUMPS	TERRONES DE SILICATO SÓDICO AMORFO	MORCEAUX DE SILICATE DE SODIUM AMORPHE
ANTIMONY ORE AND RESIDUE	ANTIMONIO, MINERAL Y RESIDUOS DE	MINERAI D'ANTIMOINE ET RÉSIDU DE MINERAI D'ANTIMOINE
Bakery materials	Materias de panadería	Produits de boulangerie
BARIUM NITRATE UN 1446	NITRATO DE BARIO, No ONU 1446	NITRATE DE BARYUM UN 1446
Barley malt pellets	Malta de cebada, pellets de	Malte d'orge en boulettes
BARYTES	BARITAS	BARYTINE
BAUXITE	BAUXITA	BAUXITE
Beet, expelled	Remolacha, prensada	Betterave, triturée
Beet, extracted	Remolacha, en extracto	Betterave, sous-produits de l'extraction
BIOSLUDGE	FANGOS BIOLÓGICOS	BOUE ACTIVÉE
Blende (zinc sulphide)	Blenda (sulfuro de cinc)	Blende (sulfure de zinc)
BORAX (PENTAHYDRATE CRUDE)	BÓRAX (CRUDO PENTAHIDRATADO)	BORAX (BRUT PENTAHYDRATÉ)
BORAX, ANHYDROUS, crude	BÓRAX ANHIDRO, crudo	BORAX ANHYDRE brut
BORAX, ANHYDROUS, refined C	BÓRAX ANHIDRO, refinado	BORAX ANHYDRE raffiné C
BORIC ACID	ÁCIDO BÓRICO	ACIDE BORIQUE
Bran pellets	Salvado, pellets de	Son en boulettes
Brewer's grain pellets	Orujo de cerveza, pellets de	Drêches de brasserie en boulettes
BROWN COAL BRIQUETTES	BRIQUETAS DE LIGNITO	CHARBON BRUN EN BRIQUETTES
Calcined clay	Arcilla calcinada	Argile calcinée
Calcined pyrites	Piritas calcinadas	Pyrites calcinées
Calcium fluoride	Fluoruro de calcio	Fluorure de calcium
CALCIUM NITRATE	NITRATO CÁLCICO, No ONU 1454	NITRATE DE CALCIUM
CALCIUM NITRATE FERTILIZER	ABONOS A BASE DE NITRATO CÁLCICO	ENGRAIS AU NITRATE DE CALCIUM
Calcium oxide	Óxido de calcio	Oxyde de calcium
Canola pellets	Píldoras de canola	Canola en boulettes
CARBORUNDUM	CARBORUNDO	CARBORUNDUM
CASTOR BEANS UN 2969	SEMILLAS DE RICINO, No ONU 2969	GRAINES DE RICIN UN 2969
CASTOR FLAKE UN 2969	ESCAMAS DE RICINO, No ONU 2969	GRAINES DE RICIN EN FLOCONS UN 2969
CASTOR MEAL UN 2969	HARINA DE RICINO, No ONU 2969	FARINES DE RICIN UN 2969
CASTOR POMACE UN 2969	PULPA DE RICINO, No ONU 2969	TOURTEAUX DE RICIN UN 2969
CEMENT	CEMENTO	CIMENT
CEMENT CLINKERS	CEMENTO, CLINKERS DE	CIMENT, CLINKERS DE
CEMENT COPPER	COBRE DE CEMENTACIÓN	CUIVRE CÉMENT
Chalcopyrite	Calcopirita	Chalcopyrite

ENGLISH	SPANISH	FRENCH
CHAMOTTE	CHAMOTA	CHAMOTTE
CHARCOAL	CARBÓN VEGETAL	CHARBON
CHEMICAL GYPSUM	YESO QUÍMICO	GYPSE DE SYNTHÈSE
CHOPPED RUBBER AND PLASTIC INSULATION	FRAGMENTOS DE REVESTIMIENTOS AISLANTES DE GOMA Y PLÁSTICO	FRAGMENTS D'ISOLANT EN PLASTIQUE ET EN CAOUTCHOUC
Chile saltpetre	Salitre de Chile	Salpêtre du Chili
Chilean natural nitrate	Nitrato natural de Chile	Nitrate naturel du Chili
Chilean natural potassic nitrate	Nitrato potásico natural de Chile	Nitrate de potassium naturel du Chili
Chrome ore	Cromo, mineral de	Minerai de chrome
CHROME PELLETS	CROMO, PELLETS DE	CHROME EN PELLETS
CHROMITE ORE	CROMITA, MINERAL DE	MINERAI DE CHROMITE
Chromium ore	Cromio, mineral de	Minerai de chromium
Citrus pulp pellets	Cítricos, pellets de pulpa de	Pulpe d'agrumes en boulettes
CLAY	ARCILLA	ARGILE
CLINKER ASH	CENIZAS DE CLÍNKER	CENDRES DE MÂCHEFER
COAL	CARBÓN	CHARBON
COAL SLURRY	FANGOS DE CARBÓN	BOUES DE CHARBON
COAL TAR PITCH	BREA DE ALQUITRÁN DE HULLA	BRAI DE GOUDRON DE HOUILLE
COARSE CHOPPED TYRES	FRAGMENTOS DE NEUMÁTICOS TRITURADOS	FRAGMENTS DE PNEUS DE GRANDES DIMENSIONS
COARSE IRON AND STEEL SLAG AND ITS MIXTURE	ESCORIA GRUESA DE HIERRO Y ACERO Y SU MEZCLA	SCORIES DE FER ET D'ACIER À GROS GRAINS ET LEUR MÉLANGE
Coconut	Coco	Noix de coco
COKE	COQUE	COKE
COKE BREEZE	CISCO DE COQUE	POUSSIER DE COKE
COLEMANITE	COLEMANITA	COLÉMANITE
COPPER CONCENTRATE	COBRE, CONCENTRADO DE	CONCENTRÉ DE CUIVRE
COPPER GRANULES	COBRE, GRÁNULOS DE	CUIVRE EN GRANULES
COPPER MATTE	COBRE, MATA DE	MATTE DE CUIVRE
Copper nickel	Cuproníquel	Nickel-cuivre
COPPER SLAG	COBRE, ESCORIA DE	SCORIES DE CUIVRE
Copper ore concentrate	Cobre, concentrado mineral de	Concentré de minerai de cuivre
COPPER CONCENTRATE	COBRE, CONCENTRADO DE	CONCENTRÉ DE CUIVRE
Copper precipitate	Cobre, precipitado de	Précipités de cuivre
CEMENT COPPER	COBRE DE CEMENTACIÓN	CUIVRE CÉMENT
COPRA (dry) UN 1363 B	COPRA (seca), No ONU 1363 B	COPRAH (sec) UN 1363
Copra, expelled	Copra, prensada	Coprah, trituré
Copra, extracted	Copra, en extracto	Coprah, sous-produit d'extraction
Corn gluten	Maíz, gluten de	Gluten de maïs
Cotton seed	Semillas de algodón	Graines de cotonnier
CRUSHED CARBON ANODES	ÁNODOS DE CARBÓN TRITURADOS	ANODES EN CARBONE CONCASSÉES

ENGLISH	SPANISH	FRENCH
CRYOLITE	CRIOLITA	CRYOLITHE
Deadburned magnesite	Magnesita calcinada a muerte	Magnésite calcinée
DIAMMONIUM PHOSPHATE	FOSFATO DIAMÓNICO	HYDROGÉNOPHOSPHATE DE DIAMMONIUM
DIRECT REDUCED IRON (A) Briquettes, hot-moulded	HIERRO OBTENIDO POR REDUCCIÓN DIRECTA (A)En forma de briquetas moldeadas en caliente	FER OBTENU PAR RÉDUCTION DIRECTE (A) Briquettes moulées à chaud
DIRECT REDUCED IRON (B) Lumps, pellets, cold-moulded briquettes	HIERRO OBTENIDO POR REDUCCIÓN DIRECTA (B) Terrones, pellets y briquetas moldeadas en frío	FER OBTENU PAR RÉDUCTION DIRECTE (B) Morceaux, pellets, briquettes moulées à froid et tournures de fer indiennes
DIRECT REDUCED IRON (C) By-product fines	HIERRO OBTENIDO POR REDUCCIÓN DIRECTA (C) (Finos obtenidos como productos derivados)	FER OBTENU PAR RÉDUCTION DIRECTE (C) (Fines en tant que sous-produit)
DISTILLERS DRIED GRAINS WITH SOLUBLES	GRANOS SECOS DE DESTILERÍA CON SOLUBLES	DISTILLATS SÉCHÉS DE GRAINS AVEC RÉSIDUS SOLUBLES
DOLOMITE	DOLOMITA	DOLOMITE
Dolomitic quicklime	Cal dolomítica	chaux vive dolomitique
D.R.I.	HRD	not applicable in French
Expellers	Tortas de presión	Expellers
FELSPAR LUMP	FELDESPATO EN TERRONES	FELDSPATH EN MORCEAUX
FERROCHROME	FERROCROMO	FERROCHROME
FERROCHROME, exothermic	FERROCROMO exotérmico	FERROCHROME, exothermique
FERROMANGANESE	FERROMANGANESO	FERROMANGANÈSE
Ferromanganese, exothermic	Ferromanganeso exotérmico	Ferromanganèse exothermique
FERRONICKEL	FERRONÍQUEL	FERRONICKEL
FERROPHOSPHORUS	FERROFÓSFORO	FERROPHOSPHORE
Ferrophosphorus briquettes	Ferrofósforo, briquetas de	Ferrophosphore en briquettes
FERROSILICON UN 1408	FERROSILICIO, No ONU 1408	FERROSILICIUM UN 1408
FERROSILICON	FERROSILICIO	FERROSILICIUM
FERROUS METAL BORINGS UN 2793	VIRUTAS DE TALADRADO DE METALES FERROSOS, No ONU 2793	ROGNURES DE MÉTAUX FERREUX UN 2793
FERROUS METAL CUTTINGS UN 2793	RECORTES DE METALES FERROSOS, No ONU 2793	ÉBARBURES DE MÉTAUX FERREUX UN 2793
FERROUS METAL SHAVINGS UN 2793	RASPADURAS DE METALES FERROSOS, No ONU 2793	COPEAUX DE MÉTAUX FERREUX UN 2793
FERROUS METAL TURNINGS UN 2793	VIRUTAS DE TORNEADO DE METALES FERROSOS, No ONU 2793	TOURNURES DE MÉTAUX FERREUX UN 2793
FERROUS SULPHATE HEPTAHYDRATE	SULFATO FERROSO HEPTAHIDRATADO	SULFATE FERREUX HEPTAHYDRATÉ
FERTILIZERS WITHOUT NITRATES	ABONOS SIN NITRATOS (no entrañan riesgos)	ENGRAIS SANS NITRATES
FISH (IN BULK)	PESCADO (A GRANEL)	POISSON (EN VRAC)
FISHMEAL, STABILIZED UN 2216	HARINA DE PESCADO ESTABILIZADA, No ONU 2216	FARINE DE POISSON STABILISÉE UN 2216
FISHSCRAP, STABILIZED UN 2216	DESECHOS DE PESCADO ESTABILIZADOS, No ONU 2216	DÉCHETS DE POISSON STABILISÉS UN 2216

ENGLISH	SPANISH	FRENCH
FLUORSPAR	ESPATOFLÚOR	SPATH FLUOR
FLY ASH, DRY	CENIZAS VOLANTES SECAS	CENDRES VOLANTES SÈCHES
FLY ASH, WET	CENIZAS VOLANTES HÚMEDAS	CENDRES VOLANTES HUMIDES
Galena (lead sulphide)	Galena (sulfuro de plomo)	Galène (sulfure de plomb)
Garbage tankage	Detritos orgánicos	Détritus organiques
GLASS CULLET	DESPERDICIOS DE VIDRIO	CALCIN DE VERRE
Gluten pellets	Gluten, pellets de	Gluten en boulettes
GRAIN SCREENING PELLETS	PELLETS DE GRANZA DE GRANO	CRIBLURES DE GRAIN EN PELLETS
GRANULAR FERROUS SULPHATE	SULFATO FERROSO GRANULAR	SULFATE FERREUX EN GRANULES
GRANULATED NICKEL MATTE (LESS THAN 2% MOISTURE CONTENT)	MATA DE NÍQUEL GRANULADA (CONTENIDO DE HUMEDAD INFERIOR A 2 %)	MATTE DE NICKEL EN GRANULES (TENEUR EN HUMIDITÉ INFÉRIEURE À 2 %)
GRANULATED SLAG	ESCORIA GRANULADA	SCORIES EN GRAINS
GRANULATED TYRE RUBBER	NEUMÁTICO GRANULADO	CAOUTCHOUC DE PNEUS EN GRANULES
Ground nuts, meal	Maní (cacahuetes), harina de	Farine d'arachide
GYPSUM	YESO	GYPSE
Hominy chop	Machacado	Hominy chop
GYPSUM GRANULATED	YESO GRANULADO	GYPSE EN GRAINS
ILMENITE CLAY	ILMENITA, ARCILLA DE	ARGILE D'ILMÉNITE
ILMENITE (ROCK)	ILMENITA (ROCA)	ILMÉNITE (ROCHE)
ILMENITE SAND	ILMENITA, ARENA DE	SABLE D'ILMÉNITE
ILMENITE (UPGRADED)	ILMENITA (ENRIQUECIDA)	ILMÉNITE VALORISÉE
IRON AND STEEL SLAG AND ITS MIXTURE	ESCORIA DE HIERRO Y ACERO Y SU MEZCLA	SCORIES DE FER ET D'ACIER ET LEUR MÉLANGE
IRON CONCENTRATE	HIERRO, CONCENTRADO DE	CONCENTRÉ DE FER
IRON CONCENTRATE (pellet feed)	HIERRO, CONCENTRADO DE (para pellets)	CONCENTRÉ DE FER (pour pellets)
IRON CONCENTRATE (sinter feed)	HIERRO, CONCENTRADO DE (para aglomerados)	CONCENTRÉ DE FER (pour agglomérés)
Iron disulphide	Disulfuro de hierro	Disulfure de fer
IRON ORE	HIERRO, MINERAL DE	MINERAI DE FER
Iron ore (concentrate, pellet feed, sinter feed)	Hierro, mineral de (concentrado, aglomerados o pellets)	Minerai de fer (concentré, pour pellets, pour agglomérés)
IRON ORE FINES	FINOS DE MINERAL DE HIERRRO	FINES DE MINERAI DE FER
IRON ORE PELLETS	HIERRO, PELLETS DE MINERAL DE	MINERAI DE FER EN PELLETS
IRON OXIDE, SPENT UN 1376	ÓXIDO DE HIERRO AGOTADO, No ONU 1376	OXYDE DE FER RÉSIDUAIRE UN 1376
IRON OXIDE TECHNICAL	ÓXIDO DE HIERRO-GRADO TÉCNICO	OXYDE DE FER DE QUALITÉ TECHNIQUE
IRON SINTER	HIERRO SINTERIZADO	AGGLOMÉRÉS DE FER
Iron swarf	Hierro, virutas de	copeaux de fer
IRON SPONGE, SPENT UN 1376	ESPONJA DE HIERRO AGOTADA, No ONU 1376	TOURNURE DE FER RÉSIDUAIRE UN 1376
IRONSTONE	ROCA FERRUGINOSA	ROCHE FERRUGINEUSE
LABRADORITE	LABRADORITA	LABRADOR

ENGLISH	SPANISH	FRENCH
LEAD AND ZINC CALCINES (mixed)	PLOMO Y CINC, CALCINADOS DE (en mezclas)	PLOMB ET ZINC CALCINÉS (en mélange)
LEAD AND ZINC MIDDLINGS	PLOMO Y CINC, MIXTOS DE	MIXTES DE PLOMB ET DE ZINC
LEAD CONCENTRATE	PLOMO, CONCENTRADO DE	CONCENTRÉ DE PLOMB
LEAD NITRATE UN 1469	NITRATO DE PLOMO, No ONU 1469	NITRATE DE PLOMB UN 1469
LEAD ORE	PLOMO, MINERAL DE	MINERAI DE PLOMB
Lead ore concentrate	Plomo, concentrado de mineral de	Concentré de minerai de plomb
LEAD ORE RESIDUE	PLOMO, RESIDUOS DE MINERAL DE	RÉSIDU DE MINERAI DE PLOMB
LEAD SILVER CONCENTRATE	PLOMO Y PLATA, CONCENTRADO DE	CONCENTRÉ DE PLOMB ARGENTIFÈRE
Lead silver ore	Plomo y plata, mineral de	Minerai de plomb argentifère
Lead sulphide	Sulfuro de plomo	Sulfure de plomb
Lead sulphide (galena)	Sulfuro de plomo (galena)	Sulfure de plomb (galène)
Lignite	Lignita	Lignite
LIME (UNSLAKED)	CAL (VIVA)	CHAUX (VIVE)
LIMESTONE	PIEDRA CALIZA	CALCAIRE
LINTED COTTON SEED	SEMILLAS DE ALGODÓN DESPEPITADO	GRAINES DE COTONNIER AVEC LINTER
Linseed, expelled	Linaza, prensada	Graines de lin, triturées
Linseed, extracted	Linaza, en extracto	Graines de lin, sous-produits de l'extraction
LOGS	TRONCOS	GRUMES
MAGNESIA (DEADBURNED)	MAGNESIA (CALCINADA A MUERTE)	MAGNÉSIE (CALCINÉE)
MAGNESIA (UNSLAKED)	MAGNESIA (VIVA)	MAGNÉSIE (VIVE)
Magnesia, clinker	Magnesia, clinker de	Magnésie en clinkers
Magnesia, electro-fused	Magnesia electrofundida	Magnésie électrofondue
Magnesia, lightburned	Magnesia quemada ligeramente	Magnésie calcinée légère
Magnesia, calcined	Magnesia calcinada	Magnésie calcinée
Magnesia, caustic calcined	Magnesia cáustica calcinada	Magnésie calcinée caustique
Magnesite, clinker	Magnesita, clinker de	Magnésite, clinkers de
MAGNESITE, natural	MAGNESITA natural	MAGNÉSITE, naturelle
Magnesium carbonate	Carbonato de magnesio	Carbonate de magnésium
MAGNESIUM NITRATE UN 1474	NITRATO DE MAGNESIO, No ONU 1474	NITRATE DE MAGNÉSIUM UN 1474
MAGNESIUM SULPHATE FERTILIZERS	ABONOS DE SULFATO DE MAGNESIO	ENGRAIS AU SULFATE DE MAGNÉSIUM
Maize, expelled	Maíz, prensado	Maïs, trituré
Maize, extracted	Maíz, en extracto	Maïs, sous-produit de l'extraction
MANGANESE COMPONENT FERROALLOY SLAG	ESCORIA DE ALEACIÓN DE HIERRO CON MANGANESO	SCORIES DE FERRO-ALLIAGES DE MANGANÈSE
MANGANESE CONCENTRATE	MANGANESO, CONCENTRADO DE	CONCENTRÉ DE MANGANÈSE
MANGANESE ORE	MANGANESO, MINERAL DE	MINERAI DE MANGANÈSE
MANGANESE ORE FINES	FINOS DE MINERAL DE MANGANESO	FINES DE MINERAI DE MANGANÈSE
M.A.P.	FMA	[not applicable in French]

ENGLISH	SPANISH	FRENCH
MARBLE CHIPS	MÁRMOL, ASTILLAS DE	ÉCLATS DE MARBRE
Meal, oily	Harina oleosa	Farines oléagineuses
METAL SULPHIDE CONCENTRATES	SULFUROS METÁLICOS, CONCENTRADOS DE	CONCENTRÉS DE SULFURES MÉTALLIQUES
Mill feed pellets	Piensos, pellets de	Sous-produits de meunerie en boulettes
Milorganite	Milorganita	Milorganite
Mineral Concentrates	Concentrados de minerales	Concentrés de minerais
MONOAMMONIUM PHOSPHATE	FOSFATO MONOAMÓNICO	MONOPHOSPHATE D'AMMONIUM
Muriate of potash	Muriato de potasa	Muriate de potasse
NEFELINE SYENITE (mineral)	SIENITA NEFELÍNICA (mineral)	SYÉNITE NÉPHÉLINIQUE (minerai)
NICKEL ORE	MINERAL DE NÍQUEL	MINERAI DE NICKEL
NICKEL CONCENTRATE	NÍQUEL, CONCENTRADO DE	CONCENTRÉ DE NICKEL
Nickel ore concentrate	Níquel, concentrado de mineral de	Concentré de minerai de nickel
Niger seed, expelled	Níger, semillas de, prensadas	Graines de niger, triturées
Niger seed, extracted	Níger, semillas de, en extracto	Graines de niger, sous-produits de l'extraction
Oil cake	Torta oleaginosa	Tourteaux oléagineux
Palm kernel, expelled	Nuez de palma, prensada	Amande de palmiste, triturée
Palm kernel, extracted	Nuez de palma, en extracto	Amande de palmiste, sous-produit de l'extraction
Peanuts, expelled	Cacahuetes (maní), prensados	Cacahuètes, triturées
Peanuts, extracted	Cacahuetes (maní), en extracto	Cacahuètes, sous-produits de l'extraction
PEANUTS (in shell)	CACAHUETES (con vaina)	CACAHUÈTES (en coques)
PEAT MOSS	TURBA FIBROSA	TOURBE HORTICOLE
PEBBLES (sea)	CANTOS RODADOS (de mar)	GALETS (de mer)
PELLETS (concentrates)	PELLETS (concentrados)	PELLETS (concentrés)
Pellets (cereal)	Cereales, pellets de	Céréales en boulettes
Pencil pitch	Brea en lápices	Brai en crayons
PENTAHYDRATE CRUDE	PENTAHIDRATO EN BRUTO	PENTAHYDRATE BRUT
PERLITE ROCK	PERLITA, ROCA DE	ROCHE PERLITE
PETROLEUM COKE (calcined)	COQUE DE PETRÓLEO (calcinado)	COKE DE PÉTROLE (calciné)
PETROLEUM COKE (uncalcined)	COQUE DE PETRÓLEO (no calcinado)	COKE DE PÉTROLE (non calciné)
PHOSPHATE ROCK (calcined)	FOSFATO EN ROCA (calcinado)	ROCHE PHOSPHATÉE (calcinée)
PHOSPHATE ROCK (uncalcined)	FOSFATO EN ROCA (no calcinado)	ROCHE PHOSPHATÉE (non calcinée)
PHOSPHATE (defluorinated)	FOSFATO (desfluorado)	PHOSPHATE (défluoré)
PIG IRON	HIERRO EN LINGOTES	FONTE EN GUEUSES
PITCH PRILL	BREA EN BOLITAS	BRAI EN GRAINS
Pollard pellets	Trasmochos, pellets de	Recoupette en boulettes
POTASH	POTASA	POTASSE
Potash muriate	Muriato de potasa	Muriate de potasse
POTASSIUM CHLORIDE	CLORURO POTÁSICO	CHLORURE DE POTASSIUM

ENGLISH	SPANISH	FRENCH
POTASSIUM NITRATE UN 1486	NITRATO POTÁSICO, No ONU 1486	NITRATE DE POTASSIUM UN 1486
Potassium nitrate/sodium nitrate (mixture)	Nitrato potásico y nitrato sódico, mezclas de	Nitrate de potassium/nitrate de sodium (en mélange)
POTASSIUM NITRATE MIXTURE	Nitrato potásico en mezcla	NITRATE DE POTASSIUM EN MÉLANGE
POTASSIUM SULPHATE	SULFATO DE POTASIO	SULFATE DE POTASSIUM
Prilled coal tar	Alquitrán de hulla en bolitas	Goudron de houille en grains
PULP WOOD	MADERA PARA PASTA PAPELERA	BOIS À PÂTE
PUMICE	PIEDRA PÓMEZ	PONCE
PYRITE (containing copper and iron)	PIRITA (contiene cobre y hierro)	PYRITE (contenant du cuivre et du fer)
PYRITES, CALCINED	PIRITAS CALCINADAS	PYRITES CALCINÉES
PYRITES	PIRITAS	PYRITES
Pyrites (cupreous, fine, flotation, or sulphur)	Piritas (cuprosas, disgregadas, flotación o azufre)	Pyrites (cuivreuses, fines, flottation, soufre)
Pyritic ash	Cenizas piríticas	Cendres pyriteuses
PYRITIC ASHES (iron)	CENIZAS PIRITOSAS (hierro)	CENDRES PYRITEUSES (fer)
PYRITIC CINDERS	ESCORIAS PIRITOSAS	CENDRES PYRITEUSES
PYROPHYLLITE	PIROFILITA	PYROPHYLLITE
QUARTZ	CUARZO BLANCO	QUARTZ
QUARTZITE	CUARCITA	QUARTZITE
Quicklime	Cal viva	chaux vive
RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I) UN 2912	MATERIALES RADIACTIVOS, DE BAJA ACTIVIDAD ESPECÍFICA (BAE-I), No ONU 2912	MATIÈRES RADIOACTIVES DE FAIBLE ACTIVITÉ SPÉCIFIQUE (LSA-I) UN 2912
RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO-I) UN 2913	MATERIALES RADIACTIVOS, OBJETOS CONTAMINADOS EN LA SUPERFICIE (OCS-I), No ONU 2913	MATIÈRES RADIOACTIVES, OBJETS CONTAMINÉS SUPERFICIELLEMENT (SCO-I) UN 2913
Rape seed, expelled	Semillas de colza, prensadas	Graines de colza, triturées
Rape seed, extracted	Semillas de colza, en extracto	Graines de colza, sous-produits de l'extraction
RASORITE (ANHYDROUS)	RASORITA (ANHIDRA)	RASORITE (ANHYDRE)
Rice bran	Arroz, salvado de	Son de riz
Rice broken	Arroz partido	Brisures de riz
Rough ammonia tankage	Amonio en bruto, desechos orgánicos de	Déchets organiques ammoniacaux
ROUNDWOOD	ROLLIZOS	RONDINS
RUTILE SAND	RUTILO, ARENA DE	SABLE DE RUTILE
Safflower seed, expelled	Cártamo, semillas de, prensadas	Graines de carthame, triturées
Safflower seed, extracted	Cártamo, semillas de, en extracto	Graines de carthame, sous-produits de l'extraction
SALT	SAL	SEL
SALT CAKE	SAL, TORTAS DE	PAIN DE SEL
SALT ROCK	SAL GEMA	ROCHE SALINE
Saltpetre	Salitre	Salpêtre

ENGLISH	SPANISH	FRENCH
SAND	ARENA	SABLE
Sand, ilmenite	Arena de ilmenita	Sable, ilménite
Sand, zircon	Arena de circonio	Sable, zircon
Spodumene	Espodumeno	Spoduméne
SAND, HEAVY MINERAL	ARENAS DE MINERALES PESADOS	SABLE, MINÉRAUX LOURDS
SAWDUST	SERRÍN	SCIURE DE BOIS
SAW LOGS	TRONCOS PARA ASERRAR	BOIS DÉBITÉ
SCALE GENERATED FROM THE IRON AND STEEL MAKING PROCESS	CASCARILLA GENERADA EN LOS PROCESOS SIDERÚRGICOS	DÉPÔTS PROVENANT DE LA FABRICATION DU FER ET DE L'ACIER
SCRAP METAL	CHATARRA	FERRAILLE
SEED CAKE, containing vegetable oil UN 1386 (a) mechanically expelled seeds, containing more than 10% of oil or more than 20% of oil and moisture content	TORTA DE SEMILLAS, con una proporción de aceite vegetal, No ONU 1386 a) residuos de semillas prensadas por medios mecánicos, con un contenido de más del 10 % de aceite o más del 20 % de aceite y humedad combinados	TOURTEAUX contenant de l'huile végétale UN 1386 a) Graines triturées par procédé mécanique contenant plus de 10 % d'huile ou plus de 20 % d'huile et d'humidité combinées
SEED CAKE, containing vegetable oil UN 1386 (b) solvent extraction and expelled seeds, containing not more than 10% of oil and when the amount of moisture is higher than 10%, not more than 20% of oil and moisture combined	TORTA DE SEMILLAS, con una proporción de aceite vegetal, No ONU 1386 b) residuos de la extracción del aceite de las semillas con disolventes o por prensado, con un contenido de no más del 10 % de aceite o, si el contenido de humedad es superior al 10 %, no más del 20 % de aceite y humedad combinados	TOURTEAUX contenant de l'huile végétale UN 1386 b) Sous-produits de l'extraction au solvant ou graines triturées contenant au maximum 10 % d'huile et, si la teneur en humidité est supérieure à 10 %, pas plus de 20 % d'huile et d'humidité combinées
SEED CAKE UN 2217	TORTA DE SEMILLAS, No ONU 2217	TOURTEAUX UN 2217
SEED CAKE (non-hazardous)	TORTA DE SEMILLAS (no entraña riesgos)	TOURTEAUX (non dangereux)
Seed expellers, oily	Semillas oleosas, torta de presión de	Expellers oléagineux
SILICOMANGANESE	SILICOMANGANESO	SILICOMANGANÈSE
SILICON SLAG	ESCORIA DE SILICIO	SCORIES DE SILICIUM
SILVER LEAD CONCENTRATE	PLATA Y PLOMO, CONCENTRADO DE	CONCENTRÉ DE PLOMB ARGENTIFÈRE
Silver lead ore concentrate	Plata y plomo, concentrado de mineral de	Concentré de minerai de plomb argentifère
Sinter	Sinterizado	Agglomérés
Slag, granulated	Escoria granulada	Scories, en grains
SLIG, iron ore	SLIG (mineral de hierro)	SLIG (minerai de fer)
SODA ASH	SOSA, CENIZA DE	SOUDE DU COMMERCE
SODIUM NITRATE UN 1498	NITRATO SÓDICO, No ONU 1498	NITRATE DE SODIUM UN 1498
SODIUM NITRATE AND POTASSIUM NITRATE MIXTURE UN 1499	NITRATO SÓDICO Y NITRATO POTÁSICO, EN MEZCLA, No ONU 1499	NITRATE DE SODIUM ET NITRATE DE POTASSIUM EN MÉLANGE UN 1499
Soyabean, expelled	Soja, prensada	Graines de soja, triturées

ENGLISH	SPANISH	FRENCH
Soyabean, extracted	Soja, en extracto	Graines de soja, sous-produits de l'extraction
SOLIDIFIED FUELS RECYCLED FROM PAPER AND PLASTICS	COMBUSTIBLES SOLIDIFICADOS RECICLADOS DE PAPELES Y PLÁSTICOS	COMBUSTIBLES SOLIDIFIÉS RECYCLÉ À PARTIR DE PAPIER ET DE PLASTIQUE
SPENT CATHODES	CÁTODOS AGOTADOS	CATHODES USÉES
SPENT POTLINER	CUBAS ELECTROLÍTICAS AGOTADAS	REVÊTEMENT USÉ DES CUVES
SPODUMENE (UPGRADED)	ESPODÚMENO (ENRIQUECIDO)	SPODUMÈNE (ENRICHI)
STAINLESS STEEL GRINDING DUST	ACERO INOXIDABLE, POLVO DEL RECTIFICADO DE	ACIER INOXYDABLE, POUSSIÈRE DE MEULAGE
Steel swarf	Acero, virutas de	Rognures d'acier
Stibnite	Estibina	Stibnite
STONE CHIPPINGS	GRAVILLA	PIERRES CONCASSÉES
Strussa pellets	Strussa, pellets de	Strussa en boulettes
SUGAR	AZÚCAR	SUCRE
SULPHATE OF POTASH AND MAGNESIUM	SULFATO DE POTASA Y MAGNESIO	SULFATE DE POTASSIUM ET DE MAGNÉSIUM
Sulphide concentrates	Sulfuros, concentrados de	Concentrés sulfurés
SULPHUR UN 1350 (crushed lump and coarse grained)	AZUFRE, No ONU 1350 (en terrones triturados o en polvo de grano grueso)	SOUFRE UN 1350 (concassé en morceaux et en poudre à gros grains)
SULPHUR (formed, solid)	AZUFRE (sólido con forma)	SOUFRE (solide, moulé)
Sunflower seed, expelled	Girasol, semillas de, prensadas	Graines de tournesol, triturées
Sunflower seed, extracted	Girasol, semillas de, en extracto	Graines de tournesol, sous-produits de l'extraction
SUPERPHOSPHATE	SUPERFOSFATO	SUPERPHOSPHATE
SUPERPHOSPHATE (triple, granular)	SUPERFOSFATO (triple granular)	SUPERPHOSPHATE (triple, granuleux)
Swarf	Virutas	Rognures
TACONITE PELLETS	TACONITA, PELLETS DE	TACONITE EN PELLETS
TALC	TALCO	TALC
TANKAGE	DESECHOS ORGÁNICOS	DÉCHETS ORGANIQUES
Tankage fertilizer	Fertilizante orgánico	Engrais à base de déchets organiques
TAPIOCA	TAPIOCA	TAPIOCA
TIMBER	MADERAJE	BILLES DE BOIS
Toasted meals	Harinas tostadas	Farines grillées
Triple superphosphate	Superfosfato triple	Superphosphate triple
UREA	UREA	URÉE
VANADIUM ORE	VANADIO, MINERAL DE	MINERAI DE VANADIUM
VERMICULITE	VERMICULITA	VERMICULITE
WHITE QUARTZ	CUARZO BLANCO	QUARTZ BLANC
WOODCHIPS	MADERA, ASTILLAS DE	COPEAUX DE BOIS
WOOD PELLETS CONTAINING ADDITIVES AND/OR BINDERS	PELLETS DE MADERA QUE CONTIENEN ADITIVOS Y/O AGLUTINANTES	GRANULÉS (PELLETS) DE BOIS CONTENANT DES ADDITIFS OU LIANTS
WOOD PELLETS NOT CONTAINING ANY ADDITIVES AND/OR BINDERS	PELLETS DE MADERA QUE NO CONTIENEN ADITIVOS NI AGLUTINANTES	GRANULÉS (PELLETS) DE BOIS NE CONTENANT AUCUN ADDITIF OU LIANT

ENGLISH	SPANISH	FRENCH
Wood Products – General	Productos generales de madera	Produits du bois – Généralités
WOOD TORREFIED	MADERA TORRADA	BOIS TORRÉFIÉ
ZINC AND LEAD CALCINES (mixed)	CINC Y PLOMO, CALCINADOS DE (en mezclas)	ZINC ET PLOMB CALCINÉS (en mélange)
ZINC AND LEAD MIDDLINGS	CINC Y PLOMO, MIXTOS DE	MIXTES DE ZINC ET DE PLOMB
ZINC ASHES UN 1435	CINC, CENIZAS DE, No ONU 1435	CENDRES DE ZINC UN 1435
ZINC CONCENTRATE	CINC, CONCENTRADO DE	CONCENTRÉ DE ZINC
Zinc, dross, residue or skimmings	Cinc (escoria de, residuos de o espuma de)	Zinc, crasses, résidus, laitier
Zinc ore, burnt	Cinc, mineral quemado de	Minerai de zinc, brûlé
Zinc ore, calamine	Cinc, mineral de, calamina	Minerai de zinc, calamine
Zinc ore, concentrates	Cinc, mineral de, concentrados	Minerai de zinc, concentrés
Zinc ore, crude	Cinc, mineral de, bruto	Minerai de zinc, brut
ZINC SINTER	CINC SINTERIZADO	AGGLOMÉRÉS DE ZINC
ZINC SLAG	CINC, ESCORIA DE	SCORIES DE ZINC
ZINC SLUDGE	CINC, FANGOS DE	BOUES DE ZINC
Zinc sulphide	Sulfuro de cinc	Sulfure de zinc
Zinc sulphide (blende)	Sulfuro de cinc (blenda)	Sulfure de zinc (blende)
ZIRCON KYANITE CONCENTRATE	CONCENTRADO DE CIANITA DE CIRCONIO	CONCENTRÉ DE KYANITE ET DE ZIRCON
ZIRCONSAND	CIRCONIO, ARENA DE	SABLE DE ZIRCON

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ANNEX 4

RESOLUTION MSC.394(95)
(adopted on 11 June 2015)

AMENDMENTS TO THE PROTOCOL OF 1978 RELATING TO 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") and article II of the Protocol of 1978 relating to the International Convention for the Safety of Life at Sea, 1974 (1978 SOLAS Protocol) concerning the amendments procedure applicable to the 1978 SOLAS Protocol,

HAVING CONSIDERED, at its ninety-fifth session, amendments to the 1978 SOLAS Protocol proposed and circulated in accordance with article VIII(b)(i) of the Convention and article II of the 1978 SOLAS Protocol,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention and article II of the 1978 SOLAS Protocol, amendments to the appendix to the annex to the 1978 SOLAS Protocol, 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 and article II of the 1978 SOLAS Protocol, that the said amendments shall be deemed to have been accepted on 1 July 2016, unless, prior to that date, more than one third of the Parties to the 1978 SOLAS Protocol or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified to the Secretary-General their objections to the amendments;

3 INVITES Parties concerned to note that, in accordance with article VIII(b)(vii)(2) of the Convention and article II of the 1978 SOLAS Protocol, the amendments shall enter into force on 1 January 2017, 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 and article II of the 1978 SOLAS Protocol, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to the 1978 SOLAS Protocol; and

5 REQUESTS ALSO the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization, which are not Parties to the 1978 SOLAS Protocol.

ANNEX

AMENDMENTS TO THE PROTOCOL OF 1978 RELATING TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, AS AMENDED

ANNEX

MODIFICATIONS AND ADDITIONS TO THE ANNEX TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

APPENDIX

FORM OF SAFETY CONSTRUCTION CERTIFICATE FOR CARGO SHIPS

CARGO SHIP SAFETY CONSTRUCTION CERTIFICATE

The existing paragraph 2 is replaced with the following:

"2 That the survey showed that:

.1 the condition of the structure, machinery and equipment as defined in the above regulation was satisfactory and the ship complied with the relevant requirements of chapters II-1 and II-2 of the Convention (other than those relating to fire safety systems and appliances and fire control plans); and

.2 the ship complied with part G of chapter II-1 of the Convention using ……… as fuel/N.A.[4]"

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ANNEX 5

RESOLUTION MSC.395(95)
(adopted on 11 June 2015)

AMENDMENTS TO THE PROTOCOL OF 1988 RELATING TO 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") and article VI of the Protocol of 1988 relating to the International Convention for the safety of Life at Sea, 1974 (1988 SOLAS Protocol) concerning the procedure for amending the 1988 SOLAS Protocol,

HAVING CONSIDERED, at its ninety-fifth session, amendments to the 1988 SOLAS Protocol proposed and circulated in accordance with article VIII(b)(i) of the Convention and article VI of the 1988 SOLAS Protocol,

1 ADOPTS, in accordance with article VIII(b)(iv) of the Convention and article VI of the 1988 SOLAS Protocol, amendments to the appendix to the annex to the 1988 SOLAS Protocol, 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 and article VI of the 1988 SOLAS Protocol, that the said amendments shall be deemed to have been accepted on 1 July 2016, unless, prior to that date, more than one third of the Parties to the 1988 SOLAS Protocol or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant fleet, have notified to the Secretary-General their objections to the amendments;

3 INVITES the Parties concerned to note that, in accordance with article VIII(b)(vii)(2) of the Convention and article VI of the 1988 SOLAS Protocol, the amendments shall enter into force on 1 January 2017, 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 and article VI of the 1988 SOLAS Protocol, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to the 1988 SOLAS Protocol; and

5 REQUESTS ALSO the Secretary-General to transmit copies of this resolution and its annex to Members of the Organization which are not Parties to the 1988 SOLAS Protocol.

ANNEX

AMENDMENTS TO THE PROTOCOL OF 1988 RELATING TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

ANNEX

MODIFICATIONS AND ADDITIONS TO THE ANNEX TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

APPENDIX

MODIFICATIONS AND ADDITIONS TO THE APPENDIX TO THE ANNEX TO THE INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974

FORM OF SAFETY CERTIFICATE FOR PASSENGER SHIPS

PASSENGER SHIP SAFETY CERTIFICATE

1 The following new paragraph 2.2 is added after the existing paragraph 2.1:

"2.2 the ship complied with part G of chapter II-1 of the Convention using ……… as fuel/N.A.[1]"

2 The existing paragraphs 2.2 to 2.11 are renumbered accordingly.

FORM OF SAFETY CONSTRUCTION CERTIFICATE FOR CARGO SHIPS

CARGO SHIP SAFETY CONSTRUCTION CERTIFICATE

3 The existing paragraph 2. is replaced with the following:

"2. That the survey showed that:

.1 the condition of the structure, machinery and equipment as defined in the above regulation was satisfactory and the ship complied with the relevant requirements of chapters II-1 and II-2 of the Convention (other than those relating to fire safety systems and appliances and fire control plans); and

.2 the ship complied with part G of chapter II-1 of the Convention using *…………* as fuel/N.A.[4]"

FORM OF SAFETY CERTIFICATE FOR CARGO SHIPS

CARGO SHIP SAFETY CERTIFICATE

4 The following new paragraph 2.2 is added after the existing paragraph 2.1:

"2.2 the ship complied with part G of chapter II-1 of the Convention using ………. as fuel/N.A.[4]"

5 The existing paragraphs 2.2 to 2.12 are renumbered accordingly.

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ANNEX 6

RESOLUTION MSC.396(95)
(adopted on 11 June 2015)

AMENDMENTS TO THE INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING FOR SEAFARERS (STCW), 1978, AS AMENDED

THE MARITIME SAFETY COMMITTEE,

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

RECALLING FURTHER article XII of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 ("the Convention"), concerning the procedures for amending the Convention,

HAVING CONSIDERED, at its ninety-fifth session, amendments to the Convention proposed and circulated in accordance with article XII(1)(a)(i) thereof,

1 ADOPTS, in accordance with article XII(1)(a)(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 XII(1)(a)(vii)(2) of the Convention, that the said amendments shall be deemed to have been accepted on 1 July 2016, unless, prior to that date more than one third of Parties or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant shipping of ships of 100 gross register tons or more, have notified to the Secretary-General of the Organization their objections to the amendments;

3 INVITES Parties to note that, in accordance with article XII(1)(a)(viii) of the Convention, that the amendments annexed hereto, shall enter into force on 1 January 2017 upon their acceptance in accordance with paragraph 2 above;

4 INVITES ALSO Parties to note that, in the absence of the ships subject to the IGF Code at the time of the entry into force of these amendments, to take into account experience gained on board ships in accordance with the Interim guidelines on safety for natural gas-fuelled engine installations in ships, as adopted by resolution MSC.285(86);

5 REQUESTS the Secretary-General, for the purposes of article XII(1)(a)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to the Convention; and

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

ANNEX

AMENDMENTS TO THE INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING FOR SEAFARERS (STCW), 1978, AS AMENDED

CHAPTER I – GENERAL PROVISIONS

Regulation I/1 – Definitions and clarifications

1 In paragraph 1, after the existing subparagraph .40, the following new definition is inserted:

".41 *The IGF Code* means the International Code of safety for ships using gases or other low-flashpoint fuels, as defined in SOLAS regulation II-1/2.29."

Regulation I/11 – Revalidation of certificates

2 Existing paragraph 1 is amended to read:

"1 Every master, officer and radio operator holding a certificate issued or recognized under any chapter of the Convention other than regulation V/3 or chapter VI, who is serving at sea or intends to return to sea after a period ashore, shall, in order to continue to qualify for seagoing service, be required, at intervals not exceeding five years, to:

.1 meet the standards of medical fitness prescribed by regulation I/9; and

.2 establish continued professional competence in accordance with section A-1/11 of the STCW Code."

CHAPTER V – SPECIAL TRAINING REQUIREMENTS FOR PERSONNEL ON CERTAIN TYPES OF SHIP

3 The following new regulation V/3 is added after existing regulation V/2:

"**Regulation V/3**

Mandatory minimum requirements for the training and qualifications of masters, officers, ratings and other personnel on ships subject to the IGF Code

1 This regulation applies to masters, officers and ratings and other personnel serving on board ships subject to the IGF Code.

2 Prior to being assigned shipboard duties on board ships subject to the IGF Code, seafarers shall have completed the training required by paragraphs 4 to 9 below in accordance with their capacity, duties and responsibilities.

3 All seafarers serving on board ships subject to the IGF Code shall, prior to being assigned shipboard duties, receive appropriate ship and equipment specific familiarization as specified in regulation I/14, paragraph 1.5.

4 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel on board ships subject to the IGF Code shall hold a certificate in basic training for service on ships subject to the IGF Code.

5 Every candidate for a certificate in basic training for service on ships subject to the IGF Code shall have completed basic training in accordance with provisions of section A-V/3, paragraph 1 of the STCW Code.

6 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel on board ships subject to the IGF Code who have been qualified and certified according to regulation V/1-2, paragraphs 2 and 5, or regulation V/1-2, paragraphs 4 and 5 on liquefied gas tankers, are to be considered as having met the requirements specified in section A-V/3, paragraph 1 for basic training for service on ships subject to the IGF Code.

7 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and fuel systems on ships subject to the IGF Code shall hold a certificate in advanced training for service on ships subject to the IGF Code.

8 Every candidate for a certificate in advanced training for service on ships subject to the IGF Code shall, while holding the Certificate of Proficiency described in paragraph 4, have:

.1 completed approved advanced training for service on ships subject to the IGF Code and meet the standard of competence as specified in section A-V/3, paragraph 2 of the STCW Code; and

.2 completed at least one month of approved seagoing service that includes a minimum of three bunkering operations on board ships subject to the IGF Code. Two of the three bunkering operations may be replaced by approved simulator training on bunkering operations as part of the training in paragraph 8.1 above.

9 Masters, engineer officers and any person with immediate responsibility for the care and use of fuels on ships subject to the IGF Code who have been qualified and certified according to the standards of competence specified in section A–V/1-2, paragraph 2 for service on liquefied gas tankers are to be considered as having met the requirements specified in section A-V/3, paragraph 2 for advanced training for ships subject to the IGF Code, provided they have also:

.1 met the requirements of paragraph 6; and

.2 met the bunkering requirements of paragraph 8.2 or have participated in conducting three cargo operations on board the liquefied gas tanker; and

.3 have completed sea going service of three months in the previous five years on board:

  .1 ships subject to the IGF Code;

  .2 tankers carrying as cargo, fuels covered by the IGF Code; or

  .3 ships using gases or low flashpoint fuel as fuel.

10 Every Party shall compare the standards of competence which it required of persons serving on gas-fuelled ships before 1 January 2017 with the standards of competence in Section A-V/3 of the STCW Code, and shall determine the need, if any, for requiring these personnel to update their qualifications.

11 Administrations shall ensure that a Certificate of Proficiency is issued to seafarers, who are qualified in accordance with paragraphs 4 or 7, as appropriate.

12 Seafarers holding Certificates of Proficiency in accordance with paragraph 4 or 7 above shall, at intervals not exceeding five years, undertake appropriate refresher training or be required to provide evidence of having achieved the required standard of competence within the previous five years."

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ANNEX 7

RESOLUTION MSC.397(95)
(adopted on 11 June 2015)

AMENDMENTS TO PART A OF THE SEAFARERS' TRAINING, CERTIFICATION AND WATCHKEEPING (STCW) CODE

THE MARITIME SAFETY COMMITTEE,

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

RECALLING FURTHER article XII and regulation I/1.2.3 of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 ("the Convention"), concerning the procedures for amending part A of the Seafarers' Training, Certification and Watchkeeping (STCW) Code,

HAVING CONSIDERED, at its ninety-fifth session, amendments to part A of the STCW Code, proposed and circulated in accordance with article XII(1)(a)(i) of the Convention,

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

2 DETERMINES, in accordance with article XII(1)(a)(vii)(2) of the Convention, that the said amendments to the STCW Code shall be deemed to have been accepted on 1 July 2016, unless, prior to that date, more than one third of Parties or Parties the combined merchant fleets of which constitute not less than 50% of the gross tonnage of the world's merchant shipping of ships of 100 gross register tons or more, have notified to the Secretary-General of the Organization their objections to the amendments;

3 INVITES Parties to note that, in accordance with article XII(1)(a)(ix) of the Convention, the annexed amendments to the STCW Code shall enter into force on 1 January 2017 upon their acceptance in accordance with paragraph 2 above;

4 REQUESTS the Secretary-General, for the purposes of article XII(1)(a)(v) of the Convention, to transmit certified copies of the present resolution and the text of the amendments contained in the annex to all Parties to the Convention; and

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

ANNEX

AMENDMENTS TO PART A OF THE SEAFARERS' TRAINING, CERTIFICATION AND WATCHKEEPING (STCW) CODE

CHAPTER V – SPECIAL TRAINING REQUIREMENTS FOR PERSONNEL ON CERTAIN TYPES OF SHIP

1 The following new section A-V/3 is added after existing section A-V/2:

"**Section A-V/3**

Mandatory minimum requirements for the training and qualification of masters, officers, ratings and other personnel on ships subject to the IGF Code

Basic training for ships subject to the IGF Code

1 Every candidate for a certificate in basic training for service on ships subject to the IGF Code shall:

.1.1 have successfully completed the approved basic training required by regulation V/3, paragraph 5, in accordance with their capacity, duties and responsibilities as set out in table A-V/3-1; and

.1.2 be required to provide evidence that the required standard of competence has been achieved in accordance with the methods and the criteria for evaluating competence tabulated in columns 3 and 4 of table A-V/3-1; or

.2 have received appropriate training and certification according to the requirements for service on liquefied gas tankers as set out in regulation V/3, paragraph 6.

Advanced training for ships subject to the IGF Code

2 Every candidate for a certificate in advanced training for service on ships subject to the IGF Code shall:

.1.1 have successfully completed the approved advanced training required by regulation V/3, paragraph 8 in accordance with their capacity, duties and responsibilities as set out in table A-V/3-2; and

.1.2 provide evidence that the required standard of competence has been achieved in accordance with the methods and the criteria for evaluating competence tabulated in columns 3 and 4 of table A-V/3-2; or

.2 have received appropriate training and certification according to the requirements for service on liquefied gas tankers as set out in regulation V/3, paragraph 9.

Exemptions

3 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.

Table A-V/3-1

Specification of minimum standard of competence in basic training for ships subject to the IGF Code

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Contribute to the safe operation of a ship subject to the IGF Code	Design and operational characteristics of ships subject to the IGF Code Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: .1 fuels addressed by the IGF Code .2 types of fuel systems subject to the IGF Code .3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code .4 general arrangement of fuel storage systems on board ships subject to the IGF Code .5 hazard zones and areas .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships subject to the IGF Code Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: .1 piping systems and valves .2 atmospheric, compressed or cryogenic storage	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Communications within the area of responsibility are clear and effective Operations related to ships subject to the IGF Code are carried out in accordance with accepted principles and procedures to ensure safety of operations

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.3 relief systems and protection screens .4 basic bunkering operations and bunkering systems .5 protection against cryogenic accidents .6 fuel leak monitoring and detection Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including: .1 properties and characteristics .2 pressure and temperature, including vapour pressure/ temperature relationship Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code		
Take precautions to prevent hazards on a ship subject to the IGF Code	Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Correctly identifies, on a Safety Data Sheet (SDS), relevant hazards to the ship and to personnel, and takes the appropriate actions in accordance with established procedures Identification and actions on becoming aware of a hazardous

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel batch differences Basic knowledge of hazard controls: .1 emptying, inerting, drying and monitoring techniques .2 anti-static measures .3 ventilation .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing .9 protection against cryogenic damages (LNG) Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)		situation conform to established procedures in line with best practice

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Apply occupational health and safety precautions and measures	Awareness of function of gas-measuring instruments and similar equipment: .1 gas testing Proper use of specialized safety equipment and protective devices, including: .1 breathing apparatus .2 protective clothing .3 resuscitators .4 rescue and escape equipment Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including: .1 precautions to be taken before entering hazardous spaces and zones .2 precautions to be taken before and during repair and maintenance work .3 safety measures for hot and cold work Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	Examination or assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Procedures and safe working practices designed to safeguard personnel and the ship are observed at all times Appropriate safety and protective equipment is correctly used First aid dos and don'ts

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Carry out firefighting operations on a ship subject to the IGF Code	Fire organization and action to be taken on ships subject to the IGF Code Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code Firefighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code Firefighting system operations	Practical exercises and instruction conducted under approved and truly realistic training conditions (e.g. Simulated shipboard conditions) and, whenever possible and practicable, in darkness	Initial actions and follow-up actions on becoming aware of an emergency conform with established practices and procedures Action taken on identifying muster signals is appropriate to the indicated emergency and complies with established procedures Clothing and equipment are appropriate to the nature of the firefighting operations The timing and sequence of individual actions are appropriate to the prevailing circumstances and conditions Extinguishment of fire is achieved using appropriate procedures techniques and firefighting agents

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Respond to emergencies	Basic knowledge of emergency procedures, including emergency shutdown	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	The type and impact of the emergency is promptly identified and the response actions conform to the emergency procedures and contingency plans
Take precautions to prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code	Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	Examination or assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Procedures designed to safeguard the environment are observed at all times

Table A-V/3-2

Specification of minimum standard of competence of advanced training for ships subject to the IGF Code

Column 1	**Column 2**	**Column 3**	**Column 4**
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code	Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code .2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .2.1 simple physical laws .2.2 states of matter .2.3 liquid and vapour densities .2.4 boil-off and weathering of cryogenic fuels .2.5 compression and expansion of gases .2.6 critical pressure and temperature of gases	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Effective use is made of information resources for identification of properties and characteristics of fuels addressed by the IGF Code and their impact on safety, environmental protection and ship operation

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.2.7 flashpoint, upper and lower flammable limits, auto-ignition temperature .2.8 saturated vapour pressure/ reference temperature .2.9 dewpoint and bubble point .2.10 hydrate formation .2.11 combustion properties: heating values .2.12 methane number/ knocking .2.13 pollutant characteristics of fuels addressed by the IGF Code .3 the properties of single liquids .4 the nature and properties of solutions .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials .8 effect of low temperature, including brittle fracture, for liquid cryogenic fuels Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code		

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on ships subject to the IGF Code	Operating principles of marine power plants Ships' auxiliary machinery Knowledge of marine engineering terms	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Plant, auxiliary machinery and equipment is operated in accordance with technical specifications and within safe operating limits at all times
Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code	Design and characteristics of ships subject to the IGF Code Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships: .4.1 fuel pumps and pumping arrangements .4.2 fuel pipelines	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Communications are clear and understood Successful ship operations using fuels addressed by the IGF Code are carried out in a safe manner, taking into account ship designs, systems and equipment Pumping operations are carried out in accordance with accepted principles and procedures and are relevant to the type of fuel Operations are planned, risk is managed and carried out in accordance with accepted principles and procedures to ensure safety of operations and to avoid pollution of the marine environment

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.4.3 expansion devices .4.4 flame screens .4.5 temperature monitoring systems .4.6 fuel tank level-gauging systems .4.7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD) Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code .1 low pressure pumps .2 high pressure pumps .3 vaporizers .4 heaters		

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.5 pressure build-up units Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including: .1 inerting .2 cooling down .3 initial loading .4 pressure control .5 heating of fuel .6 emptying systems		
Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code	General knowledge of ships subject to the IGF Code Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker- supply ship Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including:	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training .3 approved training programme .4 approved laboratory equipment training or witnessing bunker operation	Fuel quality and quantity is determined taking into account the current conditions and necessary corrective safe measures are taken Procedures for monitoring safety systems to ensure that all alarms are detected promptly and acted upon in accordance with established procedures Operations are planned and carried out in accordance with fuel transfer manuals and procedures to ensure safety of operations and avoid spill damages

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	.1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface .4 prevention of rollover Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea		and pollution of the environment Personnel are allocated duties and informed of procedures and standards of work to be followed, in a manner appropriate to the individuals concerned and in accordance with safe working procedures
Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code	Knowledge of the effects of pollution on human and environment Knowledge of measures to be taken in the event of spillage/leakage/ venting	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service .2 approved training ship experience .3 approved simulator training .4 approved training programme	Procedures designed to safeguard the environment are observed at all times

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Monitor and control compliance with legislative requirements	Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied Proficiency in the use of the IGF Code and related documents	Assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training	The handling of fuels on board ships subject to the IGF Code complies with relevant IMO instruments and established industrial standards and codes of safe working practices Operations are planned and performed in conformity with approved procedures and legislative requirements
Take precautions to prevent hazards	Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: .1 flammability .2 explosion .3 toxicity .4 reactivity .5 corrosivity .6 health hazards .7 inert gas composition .8 electrostatic hazards .9 pressurized gases .10 low temperature	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service .2 approved training ship experience .3 approved simulator training .4 approved training programme	Relevant hazards to the ship and to personnel associated with operations on board ships subject to the IGF Code are correctly identified and proper control measures are taken Use of flammable and toxic gas-detection devices are in accordance with manuals and good practice

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships subject to the IGF Code Knowledge and understanding of dangers of non-compliance with relevant rules/regulations Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code Ability to elaborate and develop safety plans and safety instructions for ships subject to the IGF Code Knowledge of hot work, enclosed spaces and tank entry including permitting procedures		
Apply occupational health and safety precautions and measures on board a ship subject to the IGF Code	Proper use of safety equipment and protective devices, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and escape equipment	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience	Appropriate safety and protective equipment is correctly used Procedures designed to safeguard personnel and the ship are observed at all times

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including: .1 precautions to be taken before, during and after repair and maintenance work on fuel systems addressed in the IGF Code .2 electrical safety (reference to IEC 600079-17) .3 ship/shore safety checklist Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code	.3 approved simulator training .4 approved training programme	Working practices are in accordance with legislative requirements, codes of practice, permits to work and environmental concerns First aid dos and don'ts
Knowledge of the prevention, control and firefighting and extinguishing systems on board ships subject to the IGF Code	Knowledge of the methods and firefighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	The type and scale of the problem is promptly identified, and initial actions conform with the emergency procedures for fuels addressed by the IGF Code Evacuation, emergency shutdown and isolation procedures are appropriate to the fuels addressed by the IGF Code

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MSC.1/Circ.1515
8 June 2015

REVISED DESIGN GUIDELINES AND OPERATIONAL RECOMMENDATIONS FOR VENTILATION SYSTEMS IN RO-RO CARGO SPACES

1 The Maritime Safety Committee, at its sixty-sixth session (28 May to 6 June 1996), approved the *Design guidelines and operational recommendations for ventilation systems in ro-ro cargo spaces* (MSC/Circ.729).

2 The Sub-Committee on Ship Systems and Equipment, at its second session (23 to 27 March 2015), revised the aforementioned guidelines, taking into account advances in technology related to air quality management for ventilation of closed vehicle spaces, closed ro-ro and special category spaces.

3 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), after having considered the above proposal by the Sub-Committee on Ship Systems and Equipment, at its second session, approved the *Revised design guidelines and operational recommendations for ventilation systems in ro-ro cargo spaces*, as set out in the annex.

4 Member Governments are invited to bring the Revised design guidelines to the attention of ship designers, shipyards, shipowners and other parties concerned. Member Governments are also invited to apply the revised design guidelines to all ships on a voluntary basis.

5 This circular supersedes MSC/Circ.729.

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ANNEX

REVISED DESIGN GUIDELINES AND OPERATIONAL RECOMMENDATIONS FOR VENTILATION SYSTEMS IN RO-RO CARGO SPACES

TABLE OF CONTENTS

PART 1

DESIGN GUIDELINES FOR VENTILATION SYSTEMS IN RO-RO CARGO SPACES

INTRODUCTION

This document provides general guidelines for the design of suitable ventilation systems for vehicle decks on ro-ro ships, car carriers and car ferries.

Exhaust gas composition

Exhaust gases from motor vehicles contain hazardous substances. Carbon monoxide (CO) from petrol engines, and nitric oxide (NO) and nitrogen dioxide (NO_2) from diesel engines are the substances whose health hazards are discussed in this document. These hazardous substances can affect people in many different ways. Certain substances have a tangible, immediate effect. Others only show injurious effects after a person has been exposed to them for some time. The effect of a substance normally depends on how long a person has been exposed to them and the quantity inhaled.

Carbon monoxide (CO) is a colourless and odourless gas which, to a lesser or greater extent inhibits the ability of the blood to absorb and transport oxygen. Inhalation of the gas can cause headaches, dizziness and nausea and in extreme cases causes weakness, rapid breathing, unconsciousness and death.

Nitric oxide (NO) and nitrogen dioxide (NO_2) are compounds of nitrogen and oxygen, together commonly referred to as oxides of nitrogen or NO_x. NO, a colourless gas is the main oxide of nitrogen formed in the combustion process. NO itself is not of great concern as regards health effects; however, a proportion of the NO formed will combine with oxygen to form NO_2, which is of concern from the point of view of human health. NO_2 is a brown gas which has a stinging, suffocating odour. It exerts a detrimental effect on the human respiratory system. Asthmatics in particular are susceptible to exposure.

Measures

Measures should be considered as follows:

A reduction in exhaust gas emissions;

Provision of an adequate ventilation system;

Limitation of exposure to the gases; and

Prevention of accumulation of hazardous and flammable gases

1 REQUIREMENTS

1.1 Definition of exposure limits and flammability limit

An exposure limit value means the highest acceptable average concentration (time-weighted mean value) of a substance or, in some cases, of a mixture of substances in the air breathed by the occupants. The concentrations are usually given in parts per million (ppm) or mg/m^3. An exposure limit value refers either to a long-term exposure level or a maximum limit value. Short-term exposure level is also used.

Long-term exposure level, means the exposure limit value for exposure during the entire working day (normally 8 hours).

Maximum exposure level means the highest concentration reached.

A short-term exposure level means the time-weighted mean exposure value over a short period of 10 or 15 minutes, dependent on the national occupational exposure standards.

Lower Explosion Limit (LEL) means concentration of flammable gas, vapour or mist in air below which an explosive gas atmosphere will not be formed. Also known as Lower flammability limit.

1.2 Pollutants of interest

The exhaust gases generated by internal combustion engines contain hundreds of chemical substances. The main part of them are nitrogen (N_2), carbon dioxide (CO_2), oxygen (O_2), carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2) aldehydes such as formaldehyde, polyaromatic hydrocarbons such as benzo(a)pyrene and organic and particulate bound lead.

Among the pollutants emitted in the exhaust gases of petrol and diesel engines, CO is generally of the most significant concern for petrol engines and NO_x for diesel engines. Lead, particulate matter (PM) and benzo(a)pyrene are also of a significant concern.

Knowledge of the effects of other pollutants to the health is at present insufficient. However, considerable research is being undertaken.

Monitoring of occupational hygiene should be planned and its results should be assessed by a qualified expert, with special training in this field. The studies should be carried out in cooperation with the monitoring staff, the management of the ship concerned and the relevant Administrations.

1.3 Rate of air change

Regulations II-2/19.3.4 and 20.3 of the 1974 SOLAS Convention, as amended, provides requirements for rate of air changes which are intended to limit maximum concentration of pollutants during loading and unloading and also to prevent a build-up of hazardous and flammable gases in the ro-ro cargo spaces when the ship is at sea with a cargo of motor vehicles. These regulations provide the minimum acceptable standards for ventilation.

2 VENTILATION

2.1 Ventilation on board ships

Ventilation systems for ro-ro cargo spaces on board ship generally operate according to the principle of dilution ventilation, whereby the supply air flow to the area is sufficient for the exhaust gases to mix thoroughly with the air and be removed.

There are two main types of dilution ventilation: exhaust air ventilation and supply air ventilation. Briefly, in exhaust air ventilation, fans remove air from a ro-ro cargo space, and this is then replaced by outdoor air entering through open ramps, doors and other openings. Exhaust air ventilation is employed when sub-atmospheric pressure is required in the ro-ro cargo space. The sub-atmospheric pressure prevents the pollution from spreading to adjacent areas.

Supply air ventilation works in the opposite way. Fans deliver outdoor air into the ro-ro cargo space and the air is then exhausted through ramps and other openings. Supply air ventilation usually creates slight pressurization of the ro-ro cargo space. If supply air ventilation is used exclusively, pollutants may mix with the supply air, be pushed up the internal ramps and contaminate other decks. However, if sufficient mixing with supply air does not occur, contaminants may remain on the deck in question. Particularly, hazardous conditions may occur on lower decks.

Ventilation systems on board ship often combine these two principles. The fans can then be reversible, so that they can either supply air into the ro-ro cargo space or exhaust air from it.

2.2 Air pollutant dispersion

Exhaust gas dispersion will depend upon air flow patterns within the vehicle deck. These will not be uniform but will be dependent upon the capacity, design and mode of operation of the ventilation system; volume and configuration of the cargo space; natural ventilation patterns and the number and location of vehicles on the vehicle deck.

Although the overall rate of air change on vehicle decks may be high, areas with low rates of air change may remain. High velocity air jets are sometimes installed in an attempt to "stir" the air so that the supply air will be evenly distributed throughout the vehicle space.

2.3 Conditions and guidelines for calculating air requirements

The function of a ventilation system in a ro-ro cargo space is to dilute and remove the vehicle exhaust gases and other hazardous gases, to protect persons working in the area from being exposed to a hazardous or disagreeable level of air pollution. The basic particulars necessary for calculating the supply air required are contained in ISO 9785:2002 or national versions of this standard. These may be used as reference in the planning of new installations or in the assessments of the capacity of existing installations.

The formula given in ISO 9785:2002 is similar to that used for calculating the supply air required for ro-ro cargo spaces in ships. However, the formula also takes into account the fact that the outdoor air supplied contains a certain amount of pollutant and also includes a dilution factor. The latter takes into account the degree of estimated or possible dilution of the pollutants in the air (see ISO 9785:2002, paragraph 5).

In addition to the supply air required to dilute and remove the exhaust gases and flammable gases, it is also important to ensure air circulation in the ro-ro cargo space.

2.4 Air flow distributions

Ventilation systems may be operated at decreased capacity when controlled by a detection system that monitors the flammable and harmful gases in the space. Air quality management is based on the measuring and controlling of CO, NO_2 and LEL values. Guidance on how to conduct air quality management is given in appendix 1.

It is not possible to draw up or recommend any universal solutions for the distribution of air flow in different types of ship. Duct runs and the location of supply air and exhaust air openings should be made to suit the design of the individual ship, the estimated vehicle handling and exhaust emissions in areas occupied by the crew and other workers.

The following generally applies:

- The air flow should reach all parts of the ro-ro cargo space. However, ventilation should be concentrated in those areas in which the emissions of exhaust gases are particularly high and which are occupied by the crew or other workers.

- Consideration should be given to the likelihood of unventilated zones being screened behind an object, and also to the fact that exhaust gases readily accumulate in low-lying spaces under the vehicles and in decks beneath the one being unloaded. Furthermore, depending on air flow patterns, it may be possible for contaminants to move into decks above the one actually being off-loaded.

- The air flow on vehicle deck should be suited to the height of the deck.

- The air flow will follow the path of least resistance, and most of the air will thus flow in open spaces, such as above the vehicles, etc.

- Polluted air from ro-ro cargo spaces should be prevented from being dispersed into adjacent spaces, for instance accommodation and engine-rooms.

- Whenever possible, places which are sheltered from the airflow should be indicated on the plan. The actual locations of such spaces on the deck should be painted in a conspicuous manner to indicate that personnel should not stand on that part of the deck, and signs should be hung on the bulkhead to provide a backup warning.

2.5 Determination of air flow requirements

To assess the number of vehicles which may be in operation at the same time in a cargo space without the occupants being exposed to a hazardous or discomforting level of pollution the guidance contained in ISO 9785:2002 for estimating the flow of outdoor air required to dilute and remove the gases exhausted by a vehicle should be followed.

Consideration should be given to the fact that the exhaust gases may not mix completely with the outdoor air supplied, that the exposure limit values should not be reached and that the outdoor air itself will contain a certain level of pollution.

This guidance applies to vehicles with a normal emission of exhaust gases, operating under normal conditions. It should be remembered that the measured or estimated air flow may deviate from the actual air flow and that the concentration of pollutants in the exhaust gases can vary widely.

The guidance specifies the supply air requirement per vehicle, to ensure that the level of pollution is kept below the exposure limit. Nevertheless, subjective (individual) symptoms of discomfort may be felt, particularly from diesel exhaust gases, with supply airflows at or above the recommended levels.

The air flow can be determined by means of direct measurement or by calculation based methodology (such as computational fluid dynamics and/or the use of established empiric formulae) to be accepted by the Administration.

3 TESTING THE VENTILATION SYSTEM

3.1 General

Testing the ventilation system when the ship is delivered is primarily aimed at confirming that the design supply air flow is obtained. The test results apply to empty vehicle deck and the weather prevailing at the time of testing.

The values recorded during testing are neither representative of nor equivalent to those that need to be applied during loading and unloading of the various types of vehicles under varying weather conditions.

To utilize the ventilation system in the ro-ro cargo spaces on a ship most effectively, knowledge should be acquired of its capacity from experience and through simple tests. It is important that guidelines, rules and routines be established for using the ventilation system in typical loading and unloading conditions. It is also important that experience gained will be documented and passed on, to provide guidance for the ship's crew.

The factors that need to be determined are the quantities of air supplied to and exhausted from the ro-ro cargo spaces and the circulation of air within the vehicle deck. Guidelines for suitable testing are contained in appendix 2.

By systematic use of visible smoke, it is possible to assess the air circulation in a ro-ro cargo space, and an anemometer can be used for determining the rate of flow of supply air. If the results are compared with detailed documentation of actual conditions, they can be used to provide a firm foundation for effective measures.

It is important that the conditions prevailing at the time of the test, which are likely to influence the results, are carefully documented since air flow patterns will vary according to loading conditions. The test results are obviously only applicable to the conditions existing at the time of the tests.

3.2 Determining the rate of air change

The rate of air change is governed by the flow of supply air admitted to the ro-ro cargo spaces through the supply air openings. The flow of air can be determined using a direct reading of anemometer or other instrument of equivalent reliability.

Since the velocity profile of the air entering the vehicle deck through supply air openings on ships is generally highly unstable and fluctuates widely, the air flow should be measured by someone experienced in such measurements. However, after some training, responsible members of the crew should also be able to make these measurements.

Even when the measurements are made by competent personnel, allowance should be made for deviations of at least 20% from the actual air flow, when readings are taken by means of anemometers.

A description of air flow measurement procedures is given in appendix 2. Note that a high air change rate does not guarantee low contaminant levels. Poor mixing within the deck could lead to high contaminant levels and potentially high exposures, even though the fans appear to be providing a large amount of air. Once the ventilation system has been fully characterized, spot checks of the system should be made during actual loading or off-loading operations to ensure that the system is operating as expected. Further guidance is provided in part 2 (Operational recommendations for minimizing air pollution in ro-ro cargo spaces).

3.3 Smoke and gas for tracing the air distribution

To improve the quality of the air at the workplace knowledge should be gained of how the pollution from the vehicles is diffused through the air in the ro-ro cargo space.

Visual tests using visible smoke do not provide any direct readings of the rate of air change or air distribution in a ro-ro cargo space, although they often provide sufficient indication of a satisfactory picture to be obtained of the air circulation, the existence of any stagnant or screened zones and the rate at which pollutants are removed by the ventilation system. Recommended methods using visible smoke or tracer gas are given in appendix 2.

The visible smoke method is simple and can readily be carried out by the officer responsible for ro-ro cargo space ventilation.

The use of tracer gas will give a more reliable picture of air changes and the air circulation in the ro-ro cargo space. However, the procedure for using tracer gas is more complicated. As the same measurement points are used, it is expedient to use tracer gas in combination with stationary monitoring of pollutant concentration in a ro-ro cargo space.

3.4 Testing of sensors used for air quality control system

On regular time intervals, such as monthly, for sample detectors and yearly for the complete system, sensors should be calibrated, maintained and tested according to the manufacturer's instructions, taking part 2 of these guidelines into account.

4 DOCUMENTATION

4.1 Operation manual

An operation manual should be supplied and should include a plan of the ventilation system, showing fans, supply air and exhaust air openings and doors, ramps, hatches, etc. The location of the control panel for the ro-ro cargo space ventilation system should also be marked.

The plan should show the various options for operation of the ventilation system. It should include details of the design air flow and of the estimated number of different types of vehicles in the different ro-ro cargo spaces under various loading and unloading conditions.

The plan should be periodically revised and/or supplemented on the basis of the experience gained from the normal vehicle loading and unloading conditions. A number of blank drawings should therefore be kept on board.

On the basis of such experience, it should also be possible to draw up guidelines for the maximum number of vehicles that should be allowed to operate simultaneously.

Whenever possible, places which are sheltered from the air flow should be indicated on the plans.

The operation manual should include guidance for the service and maintenance of the systems.

4.2 Control panels

The control panels on the ship should be installed in a convenient location.

A plan of the ship's ro-ro cargo spaces, showing the location of fans and openings, should be kept at the control panel. Each fan should be given an individual designation.

Indications as to which fans should be used for a given ro-ro cargo space under various loading conditions should also be on display at the control panel.

For safety reasons and to facilitate control of the ventilation system, the control panel should include means of indicating which fans are running.

The individual control and indicator lights should be marked with the same designation as the fans to which they relate.

As far as possible, indicator lights and controls for fans that normally operate simultaneously should be located in groups. This will help to make the function of the controls readily apparent and will therefore facilitate correct use of the controls.

Automatic control of the air quality control system should be indicated at the control panel.

Reference is made to the *Code on Alerts and Indicators, 2009* (A.1021(26)).

PART 2

OPERATIONAL RECOMMENDATIONS FOR MINIMIZING AIR POLLUTION IN RO-RO CARGO SPACES

INTRODUCTION

The operational recommendations contained in this document are primarily directed at those involved with cargo handling in cargo spaces on ro-ro ships or working in similar environments. The main purpose of the recommendations is to suggest ways in which exposure to exhaust gas emissions can be restricted, but the hazards associated with pollution from exhaust gases are also dealt with. A copy of the recommendations should be kept on board the ship.

1 TRAINING AND INFORMATION

Personnel should be properly trained, possess the necessary skills and follow established procedures.

In order to improve/monitor air quality on vehicle decks a process should be established to record and investigate complaints where persistently poor air quality is perceived by shore gang and crew.

Drivers should be given appropriate instructions for embarkation/disembarkation. These should be aimed at minimizing the air pollution generation.

Training and information should be reviewed following a significant change in the operation of the vessel.

2 INSPECTION, MAINTENANCE AND REPAIRS

Inspection, maintenance and repairs should be carried out in a professional manner. Owners should ensure that this is done and that the necessary skills, equipment and spares are available.

Annual testing of the vehicle space ventilation system should be conducted by the ship's safety delegate. Third party testing of the vehicle space ventilation system should be undertaken before entry into service of a new ship and at periodical intervals of five years thereafter.

3 TESTING THE VENTILATION SYSTEM

3.1 Effective use of the ventilation system

When optimizing the ventilation of a ro-ro cargo space, all appropriate options should be considered. Such options include: different fan speeds, fan configurations and the use of natural ventilation through hull openings. Consideration should also be given to the relative safety and environmental conditions.

3.2 Testing of the air quality

When a new ship is put in operation, the air quality should be tested by a competent qualified person with specialist training in occupational exposure. The tests should be carried out in consultation with the ship's safety delegate and any other relevant authorities.

Shipowners and operators should consider testing the air quality in conjunction with tests of the ventilation system to ensure proper maintenance and functioning of the ventilation system. Situations which indicate the necessity to conduct air quality monitoring include worker complaints (e.g. headache, dizziness, stinging of the eyes or respiratory system), indications that the ventilation system itself has deteriorated, and changes in vessel operation which are substantially different from that for which the original ventilation system was verified.

All tests results verifying the adequacy of the ventilation system should be documented and kept with the ship's records. Appendix 3 provides recommendations for conducting air quality monitoring in ro-ro cargo spaces.

4 SHIPS IN OPERATION

4.1 Loading and unloading

Even if the cargo handling on a ship is well planned and the ventilation system is well suited to the planned traffic density, this may still not be enough to ensure that acceptable air quality is maintained under all vehicle handling conditions.

It is extremely important that the ventilation system is operated in the most effective manner under the prevailing operational and weather conditions.

The personnel responsible for loading and unloading of vehicles should consult with the officer responsible for vehicle deck ventilation to familiarize himself with the ventilation system on board (the supply and exhaust air openings and the design air flow) and decide whether the ventilation is adequate in the light of the traffic density, vehicle type and other considerations on a given occasion.

It is important that the supply air has free passage to the ro-ro cargo spaces and ventilation openings should not be unnecessarily obstructed.

If auxiliary air-jet systems have been installed, vehicles should be stowed in such a way that the air jets are allowed to operate at maximum effectiveness for as long as possible.

4.2 Limitation of exhaust emission production

The most effective way of reducing exhaust emissions is to ensure that vehicles spend as little time as possible on board with their engines running. This applies not only to cargo-handling vehicle (trucks, tractors, etc.) but also to vehicles being carried as cargo (cars, coaches, long-distance trucks, etc.). The speed at which the vehicles are driven on board should also be appropriate to the prevailing conditions.

Exhaust emissions are greatly influenced by driving techniques and the temperature at which an engine is running. Smooth and steady driving of a vehicle with a warm engine will generate the lowest exhaust gas emissions. Sudden and heavy acceleration will cause a substantial and often unnecessary rise in the pollution level. This is particularly true when an engine is cold. Since slow speeds and slow acceleration produce significantly lower levels of air pollutants than high speeds and quick accelerations, vehicles should be accelerated very slowly and kept at low speeds.

The essential points to note include the following:

- condition of the engines;
- driving techniques;

- organization of the work (as few engines as possible running at the same time);

- ensuring that drivers do not start their engines sooner than necessary; and

- ensuring that the traffic flows steadily (thereby eliminating heavy acceleration and high speeds). Exhaust emission control equipment for both diesel and petrol engines may influence air quality during embarkation. However, this is likely to have little effect during disembarkation due to cold starting of engines.

4.3 Limitation of exposure

The car decks on ferries are usually equipped with exhaust air ventilation. The supply air is generally admitted through the ramp and the air is removed by exhaust air fans at the other end of the car deck.

A person carrying out heavy manual work uses up twice as much air as a person doing light work. As a result, he will inhale a correspondingly higher proportion of pollutants. Consequently, the work should be organized so that heavy physical work is avoided in areas where the pollution level is high. Nobody should be unnecessarily exposed to hazardous concentrations of exhaust gases.

4.4 Recommendations for specific ship types

4.4.1 Car ferries

During disembarkation at peak times, the highest average concentration of pollution (exhaust gases) in the vehicle deck will occur furthest away from the ramp, in the proximity of the exhaust air fans. Work on the car deck should therefore be organized to eliminate the need for personnel occupying the area of the car deck in which the pollution concentration is highest.

The embarkation and disembarkation should be organized so that no direct queues form inside the ship or in the ramp opening. The embarkation rate should be suited to the capacity of the fans and the flow of outdoor air supplied.

Embarkation should be organized so that ventilation openings, or air jets in an auxiliary system, are not unnecessarily obstructed.

Drivers should be given printed instructions for embarkation/disembarkation. A suitable leaflet could be given to drivers when the tickets are issued or notices posted for examples: Exhaust fumes constitute a health hazard. Do not start your engine before the signal is given and obey instructions.

On enclosed vehicle decks, instructions to start engines should not be given until doors leading to the ramps are open.

4.4.2 Ro-ro ships carrying heavy vehicles

Most of the cargo on ro-ro ships is handled by vehicles. Large trucks and tractors are used for cargo loading and unloading. Trucks of various sizes are used to stow the cargo in the ro-ro cargo spaces. On enclosed vehicle decks, instructions to start engines should not be given until doors leading to the ramps are open.

It is important to eliminate unnecessary exhaust emissions during cargo handling. The vehicles should be kept moving and queues should not be allowed to form. Avoid having vehicles standing with their engines idling. This applies particularly to any waiting during loading and unloading on board and to vehicles on lifts. At these times the ro-ro cargo spaces should be well ventilated.

It is also important to ensure that supply air and exhaust air openings are kept clear and are not obstructed unnecessarily. Failure to observe this can result in the ventilation system not performing effectively.

Attention should be drawn to the fact that exhaust gases can accumulate in poorly ventilated areas and in low-lying areas. A cold engine discharges twice as much pollution as a warm engine.

4.4.3 Car carriers

Owing to the general uniformity of cargo on car carriers, effective organization of embarkation/disembarkation should be possible, thereby avoiding the formation of queues and the resulting unnecessary exhaust emissions.

Drivers should be given printed instructions for driving techniques and should be informed of the importance of not running the engines more than necessary. A vehicle driven slowly and with slower acceleration will emit much less pollutant than a vehicle driven faster and with higher acceleration. Furthermore, a cold engine will often emit twice as much pollutant as a warm engine.

It is therefore recommended that engines be warmed up before the vehicles are driven on board. Vehicles with engines running should not be permitted in the vicinity of the "lashing gang".

5 PERSONAL SAFETY EQUIPMENT

The use of personal safety equipment should always be seen as a last resort, only to be adopted when all else has failed. With regard to exhaust gases, the practical possibilities are limited, since all of the pollutants contained in the emissions are difficult to filter out, which generally rules out the use of masks and the like. Consequently, if the problem is to be solved using personal safety equipment, breathing apparatus should be used. Such apparatus is inconvenient in practice because the oxygen should come either from cylinders carried or worn on the back of the user or through a hose.

APPENDIX 1

VENTILATION OF RO-RO CARGO SPACES – AIR QUALITY CONTROL AND MANAGEMENT SYSTEM

1 General

This appendix gives directions for measuring the quality of air and to regulate the air flow accordingly. This system is called air quality control.

Air quality control may be used as an instrument to regulate the air flow in closed vehicle spaces, closed ro-ro and special category spaces.

Air quality control is based on measurement of CO, NO_2 and LEL values. Based on the measured values the amount of air can be regulated by changing the number of revolutions of the supply and/or discharge ventilators.

2 Requirements

2.1 Monitoring frequency and the resulting response of the ventilation system on air quality in the ro-ro spaces should be sufficient to keep the concentration of flammable and harmful gases below limits.

2.2 Maintenance provisions should be provided by the manufacturer and indicate at least frequency of testing and adjustment of the sensors.

2.3 The system should be capable of automatic operation, with a manual override.

2.4 The power supply, sensors and control equipment should be monitored. An alarm should be generated upon failure, including the manual override.

2.5 Upon any failure in the system including power failure of the control system, the ventilators should switch to the capacity as required in SOLAS regulation II-2/20.3.1.1.

2.6 Maximum section size for sensor equipment should be one hold.

2.7 Periodic onboard test and calibration of sensors should be according to the manufacturer's instructions.

2.8 Alarms as provided in paragraph 2.4 should be sufficient and indicated in the space where the controls for the power ventilation serving the vehicle decks are located on the navigation bridge.[1]

2.9 Gas detection equipment including wiring should be fit for ro-ro cargo hold conditions and meet the relevant standards.

2.10 When CO, or NO_2, or concentration of flammable gasses (LEL) exceeds the threshold concentration, an audible and visual alarm should be given at a continuously manned location.

2.11 The control system should be continuously powered and should have an automatic changeover to a standby power supply in case of loss of normal power supply.

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1 Refer to the *Code on Alerts and Indicators, 2009* (resolution A.1021(26)).

3 Air quality control systems

3.1 Air quality control is a system to ensure flammable and hazardous gas concentrations are kept below prescribed levels.

3.2 In ro-ro cargo spaces the following gases should be monitored and managed in order to limit the concentration of harmful exhaust gases when vehicles are being loaded and unloaded, and prevent the build-up of flammable gases while the ship is at sea:

.1 for gasoline powered vehicles, carbon monoxide (CO);

.2 for diesel engines nitrogen oxide (NO_2); and

.3 the Lower Explosion Limit (LEL).

3.3 Factors to be taken into consideration when determining what type of system should be specified:

.1 Size of space to be monitored: In areas comprised of dividers, sections, corners and other barriers to free movement of air should be condensed to one sensor per 900 m^2. Lesser number of sensors may be accepted based on calculations or measurements of the response time on air quality in the holds.

.2 Sensor Placement: When installing sensors in a space, care should be taken to keep them away from areas which may have an effect on readings. These include overhead doors (entrances and exits) as well as areas close to the outside air intake or exhaust fans.

4 Minimum quantity of air based on measurements of CO, NO_2 and LEL

4.1 Ventilators should be controlled by the air quality control system in order to provide the appropriate number of air changes to restore the normal values of CO, NO_2 and LEL as soon as those levels are exceeded during 5 minutes. The ventilation regime should be continuously regulated in relation to the increase of gas concentration and to restore normal levels of CO or NO_2 as soon as possible.

4.2 Alarm should be given when the level exceeds 40 mg/m^3 CO or 4 mg/m^3 NO_2 long-term exposure according to the standard ISO 9785:2002 or when a relative concentration of the atmosphere to the LEL is higher than 10%. Other more stringent exposure limits may be used when determined by the Administration, taking national/local occupational regulations into account.

4.3 The minimum amount of ventilation should give sufficient flow for the measurement devices to operate.

5 Detection of CO, NO_2 and LEL

The installation and location of the detectors is dependent on the air flow in the holds. To assess the location and number of detectors, the flow of air in the hold should be taken into consideration. In any case, the detectors should be installed to provide the performance required in paragraph 3 and as indicated below:

.1 suitable height above deck according to the instruction of the manufacturer;

.2 such that each detector covers max 900 m^2. Lesser number of sensors may be accepted but with sufficient response time to keep the concentration of harmful gases below exposure and flammable limits; and

.3 in accordance with paragraph 3 of part 2 of this guideline and with the manufacturer's instructions concerning sensor placement.

6 Approval Test

A test on board to verify the performance of the air quality control systems according to these guidelines should be performed. Real scale tests may be replaced by model tests to the satisfaction of the Administration.

APPENDIX 2

VENTILATION OF RO-RO CARGO SPACES – AIR FLOW TESTING PROCEDURES

1 Scope and field of application

This appendix gives directions for measuring nominal air change and air distribution in connection with testing of ventilation plants in ro-ro ship's cargo spaces where running of vehicles with internal combustion engines occurs.

The nominal air change is measured by calculation of the air flow in supply air and exhaust air terminal devices. The air distribution is normally estimated visually with visible smoke, or by measuring with tracer gas.

2 Nominal air change

In order to verify that the calculated quantity of air is supplied to the ro-ro cargo spaces, the air flow rate should be measured in each supply air and, where appropriate, exhaust air terminal device.

2.1 Instruments for Measurement of Air Flow

Although alternative techniques, such as the pilot traverse method are available, anemometers are generally employed for low velocity air flow measurements. There are two general types of anemometers:

.1 The direct-reading anemometer of the electronic type which registers the air velocity almost instantaneously. This has a distinct non-uniform airflow as any instability or random changes of velocity are immediately seen and the true mean of the velocity at a point can be judged. It is also very quick to use.

.2 The mechanical type of direct reading anemometer with a rotating vane. The movement is a rotary deflection against the action of a spring.

These types of anemometer are small and compact, easy to read and use, give reasonably steady readings and any fault or inconsistency developing is usually quite apparent. Where a correction chart is supplied with an anemometer the correction factors should be applied to the measured velocities before comparing them. With a good quality instrument in proper repair used by an experienced operator, the probable error on the comparative value obtained will range from a maximum of ± 2% when comparing similar velocities to a maximum of ± 5% when comparing widely differing velocities.

2.2 Air Flow Measurement Procedure[2]

For supply or extract grilles the anemometer is used as follows:

The gross grille area is divided into 150-300 mm squares, depending upon the size of grille and variation in the velocity pattern.

[2] Abstracted from the Chartered Institute of Building Services, Commissioning Codes, Series A, Air Distribution, CIBS, London, 1971.

The anemometer is held at the centre of each square with the back of the instrument touching the louvres which should be set without deflection. The instrument will give an immediate reading of the indicated velocity at each square and this reading should be recorded. When the indicated velocities at the centre of all squares have been recorded, the average value of these velocities should be calculated; this average value should be taken as the "indicated velocity" for the whole grille.

This method will normally provide repeatable results. In practice the only inconsistency which is necessary to consider appears where the grille damper is well closed down, causing the air to strike the anemometer vanes in separate jets rather than with uniform velocity. In this case a hood may have to be used with the anemometer.

2.3 Calculations

The air flow rate at each supply-extract grille is calculated as follows:

Air flow rate (m^3/s) = "indicated velocity" (m/s) x area of supply/extract grille (m^2)

The global rate of air change per hour achieved by the vehicle deck system(s) is subsequently calculated as follows:

$$\text{Air changes per hour } = \sum \frac{\text{Air flow rates at extract grilles } (\mathrm{m}^3/\mathrm{s}) \text{ x } 60 \text{ x } 60}{\text{Volume of vehicle deck } (\mathrm{m}^3)}$$

2.4 Report

A report should be drawn up in accordance with paragraph 4 of this appendix.

3 Air distribution

3.1 Visual study with visible smoke

In order to assess air change rate the movement of air and the existence of poorly ventilated areas, visible smoke can be released into the space. With the ventilation system operating, the movement of air and the dissipation of smoke can be studied and the air change rate estimated.

3.2 Measurement with tracer gas

By use of tracer gas it is possible to estimate air change rate and air distribution in chosen points in the ro-ro cargo space.

Measurement with tracer gas involves mixing a gaseous component with the air. The atmosphere in the space is examined to determine how dilution of the tracer gas is tracked at chosen points in the ro-ro cargo space whilst the ventilation system is operational.

This method should be carried out with and without vehicles.

3.2.1 Test procedures

The placing of the measurement probes should be chosen with regard to the purpose of the measurement. The probes are not to be placed near to the supply air terminal devices or at places where a so-called ventilation shadow can be expected, such as behind pillars, webs, etc. As a rule the probes are placed at the head height and in the vicinity of persons working on the deck.

The tracer gas should be spread and mixed in the air as completely as possible. The mixing may be done by the ordinary ventilation plant or with help of external fans. In order to reach an adequate accuracy, the concentration of the tracer gas ought to reach at least 50 times the detection limit of the analytical instrumentation.

When the tracer gas concentration is adequate the ventilation plant as well as the measurement equipment should be started. Tracer gas concentration should be recorded until the detection level is reached.

3.2.2 Calculation

With a dilution ventilation system the logarithm of the concentration of tracer gas will be linear with regard to time (see figure 1 below).

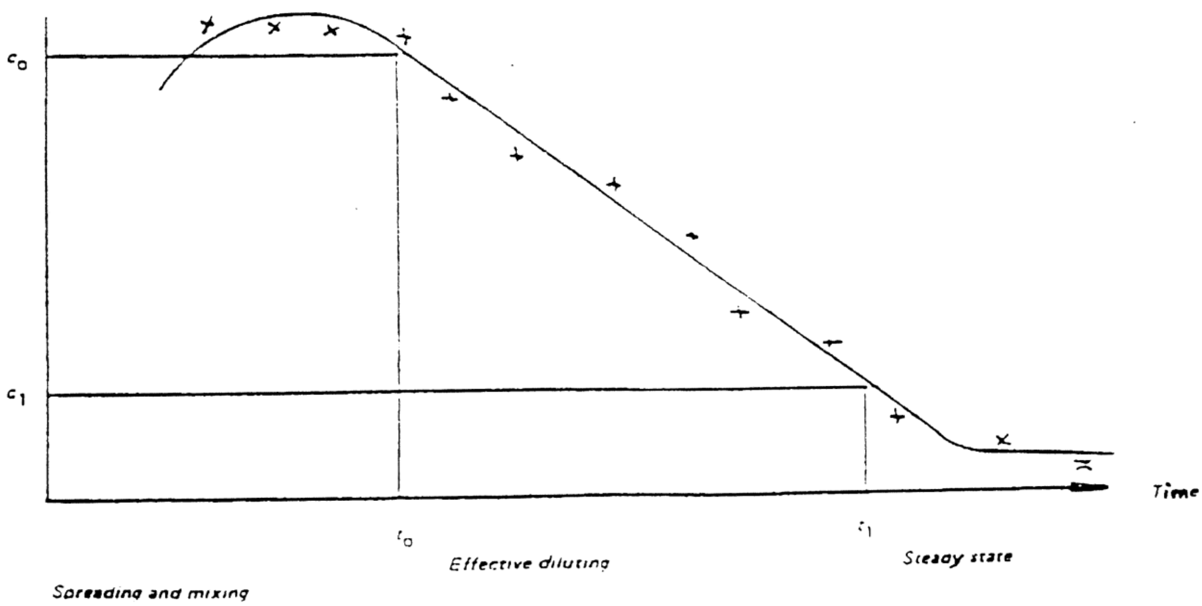

Figure 1 – The logarithm of the concentration of tracer gas

The relation between the concentration of tracer gas and time (the inclination of the graph) is a straight measure of the effect to the ventilation expressed in number of air changes according to the following formula:

$$N = \frac{ln\frac{c_0}{c_1}}{t_1 - t_0}$$

where

N = number of changes
c_0 = the concentration at the beginning of the effective dilution
c_1 = the concentration at the end of the effective dilution
t_0 = the point of time at the beginning of the effective dilution
t_1 = the point of time at the end of the effective dilution

3.3 Alternatives

As an alternative to the tests in paragraphs 3.1 and 3.2, air flow distribution in the ro-ro cargo space may be evaluated by use of an anemometer; or

The air flow can be determined by means of a calculation based methodology (such as Computational Fluid Dynamics and/or the use of established empiric formulae) to be accepted by the Administration.

4 Report

A written report should be provided containing the following information:

Ship's data	including, ship name, register, number, length, breadth, draught, GT, owner, shipyard, name of contractor carrying out the test.
Weather conditions	Wind speed and direction in general and in relation to the longitudinal of the ship during measurements.
Vehicle deck measurements	Deck length, breadth, height, and volume.
Ventilation	A plan of the deck indicating the location of supply and exhaust fans, together with information on grille surface area, design capacity and actual capacity of each unit. The use of additional air mixing equipment (e.g. dirivent) should also be noted. An indication of the status of all other openings to the deck during sampling should also be provided.
Activity	Details of loading and unloading should be included. These should comprise the time taken for each loading/unloading operation, the number of personnel working, the number and type of vehicles present.
Measurements	Time and date of the measurements Instrumentation Calibration Measurement procedure Sample locations Details of sample analysis
Results	Measurement results Calculation of occupational exposure

5 Conclusions/Recommendations

In addition to the statement of results the report should contain a plan of the ro-ro cargo space with supply air and exhaust air ducts shown. Where appropriate, the measurement points, type and number of vehicles, etc. should be indicated. Notes should be made regarding circumstances that affect the ventilation systems and/or air flow patterns on the deck.

When conducting a visual study with visible smoke, a detailed description of discharge and dissipation of the smoke as well as lapse of time should be given.

APPENDIX 3

RECOMMENDATIONS FOR THE EVALUATION OF AIR QUALITY IN RO-RO CARGO SPACES

1 General

Air quality testing should be planned and results evaluated by competent persons with specialist training in air quality evaluation and occupational exposure. Tests should be carried out in consultation with the ship's safety delegate and any other relevant authorities.

The duration of the tests will depend on the operating cycles and working practices on board the vessel. Monitoring should be carried out during several "normal" cycles, i.e. with representative vehicles, activities and ventilation practices.

Both short-term and long-term (over the working day) exposure to air pollutants should be investigated. Either static or personal samplers or ideally a combination of bath techniques should be used in order to provide the most accurate picture of contaminant concentrations and occupational exposure.

2 Air quality measurements

Air quality measurements should be representative of all exposed persons.

Pollutants

The concentrations of the following pollutants should be determined; nitric oxide (NO), nitrogen dioxide (NO_2), carbon monoxide (CO). In addition concentrations of benzene, toluene, xylene and suspended particulate matter (SPM) should also be determined whenever possible.

There are two general approaches to air quality sampling that can be adopted. Static site monitoring, typically involving continuous monitoring techniques and personal sampling which employs both passive and active methods. Static site monitoring usually includes the more accurate and sensitive techniques, but as the sampling site is fixed the measurements are not entirely representative of exposure. Personal samplers are worn by a representative sub-set of exposed individuals throughout the sampling period. Personal sampling techniques are not usually as sensitive or accurate. Ideally, personal sampling methods should be validated using more sophisticated techniques at regular intervals.

The following exemplary methods are recommended.

Static site monitoring

Pollutant:	Sampling and analysis method:
Nitrogen dioxide	Chemiluminescence, reagent tube, grab sampling/laboratory analysis
Nitric oxide	Chemiluminescence reagent tube, grab sampling/laboratory analysis
Carbon monoxide	Non-dispersive infra-red absorption, reagent tube, grab sampling/laboratory analysis

Benzene	Real time gas chromatography
Toluene	Real time gas chromatography
Xylene	Real time gas chromatography
Suspended particulates*	Dual beam radiation absorption, Tapered Element Oscillating Microbalance, gravimetric

* Suspended particulate matter can be sampled as total suspended particulate matter, PM10 respirable dust (≤ 5 μm).

Personal monitoring

Pollutant:	Sampling and analysis method:
Nitrogen dioxide	Passive (badge) sampler-ion chromatography
Nitric oxide	Electrochemical*
Carbon monoxide	Electrochemical*
Benzene	Passive badge sampler-gas chromatography/FID (Flame Ionization Detection)
Toluene	Passive badge sampler-gas chromatography/FID
Xylene	Passive badge sampler-gas chromatography/FID
Suspended particulates**	Personal sampler, gravimetric

* Electrochemical methods are susceptible to interference; therefore, it is recommended that these methods are regularly validated by intercomparison with other techniques in the test environment.

** Suspended particulate matter can be sampled as total suspended particulate matter or respirable dust (≤ 5 μm).

Supplementary measurements of local air velocity, temperature and relative humidity should also be undertaken.

3 Calculation of occupational exposure to air pollutants

Long-term Reference Period

The occupational exposure over a 24-hour period is determined by treating the cumulative exposure over 24 hours as equivalent to a single uniform exposure. This is generally converted to an 8-hour time-weighted average (TWA) exposure and is represented mathematically by:

$$\frac{C_1T_1 + C_2T_2 + \cdots. + C_nT_n}{8}$$

where C_n is the occupational exposure and T_n is the associated exposure time in hours in any 24-hour period.

Short-Term Reference Period

The short-term reference period generally relates to a period of 10 or 15 minutes, dependent upon the national occupational exposure standards. Exposure is therefore recorded as the average over a 10 or 15-minute reference period. Where the exposure period is less than 10 or 15 minutes, the measurement result is averaged over 10 or 15 minutes. Where the exposure period exceeds the short term reference period, results are averaged for the 10 or 15 minutes period during which maximum exposure occurs.

4 Report

A written report should be provided containing the following information: completed, taking into account paragraph 4 of appendix 2.

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MSC.1/Circ.1395/Rev.2
12 June 2015

LISTS OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM MAY BE EXEMPTED OR FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM IS INEFFECTIVE

1 The Maritime Safety Committee, at its sixty-fourth session (5 to 9 December 1994), agreed that there was a need to provide Administrations with guidelines regarding the provisions of SOLAS regulation II-2/10 concerning exemptions from the requirements for fire extinguishing systems.

2 Consequently, the Committee approved MSC/Circ.671 whereby it agreed to:

.1 a list of solid bulk cargoes, for which a fixed gas fire-extinguishing system may be exempted (table 1) and recommended Member Governments to take into account the information contained in table 1 when granting exemptions under the provisions of SOLAS regulation II-2/10.7.1.4; and

.2 a list of solid bulk cargoes for which a fixed gas fire-extinguishing system is ineffective (table 2), and recommended that cargo spaces in a ship engaged in the carriage of cargoes listed in table 2 be provided with a fire extinguishing system which provides equivalent protection. The Committee also agreed that Administrations should take account of the provisions of SOLAS regulation II 2/19.3.1 when determining suitable requirements for an equivalent fire-extinguishing system.

3 The Maritime Safety Committee, at its seventy-ninth session (1 to 10 December 2004), reviewed the above-mentioned tables and approved MSC.1/Circ.1146. The Committee decided that the annexed tables should be periodically reviewed and invited Member Governments to provide the Organization, when granting exemptions to ships for the carriage of cargoes not included in table 1, with data on the non-combustibility or fire risk properties of such cargoes. Member Governments were also requested to provide the Organization, when equivalent fire extinguishing systems are required for the agreed carriage of cargoes not included in table 2, with data on the inefficiency of fixed gas fire-extinguishing systems for such cargoes.

4 The Maritime Safety Committee, at its eighty-ninth session (11 to 20 May 2011), noting the mandatory status of the IMSBC Code, reviewed the aforementioned lists of solid bulk cargoes to align certain names in the lists with those in the recent version of the IMDG Code and approved MSC/Circ.1395 on Lists of solid bulk cargoes for which a fixed gas fire-extinguishing system may be exempted or for which a fixed gas fire-extinguishing system is ineffective, superseding MSC.1/Circ.1146. The Maritime Safety Committee, at its ninety-second session (12 to 21 June 2013), approved a revision to MSC.1/Circ.1395.

5 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), considering the proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its first session, approved a revision to MSC.1/Circ.1395/Rev.1, as set out in tables 1 and 2 of the annex.

6 The purpose of this circular is to provide guidance to Administrations. It should not, however, be considered as precluding Administrations from their right to grant exemptions for cargoes not included in table 1 or to impose any conditions when granting such exemptions under the provisions of SOLAS regulation II-2/10.7.1.4.

7 This circular supersedes MSC.1/Circ.1395/Rev.1.

***

ANNEX

TABLE 1

LIST OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM MAY BE EXEMPTED

1 Cargoes including, but not limited to, those listed in regulation II-2/10:

Ore
Coal (COAL and BROWN COAL BRIQUETTES)
Grain
Unseasoned timber

2 Cargoes listed in the International Maritime Solid Bulk Cargoes (IMSBC) Code, which are not combustible or constitute a low fire-risk, as follows:

.1 all cargoes not categorized into Group B in the IMSBC Code; and

.2 the following cargoes categorized into Group B in the IMSBC Code:

ALUMINA HYDRATE
ALUMINIUM SMELTING BY-PRODUCTS, UN 3170
(Both the names ALUMINIUM SMELTING BY-PRODUCTS or ALUMINIUM REMELTING BY-PRODUCTS are in use as proper shipping name)
ALUMINIUM FERROSILICON POWDER, UN 1395
ALUMINIUM SILICON POWDER, UNCOATED, UN 1398
AMORPHOUS SODIUM SILICATE LUMPS
BORIC ACID
CALCINED PYRITES (Pyritic ash)
CLINKER ASH
COAL TAR PITCH
DIRECT REDUCED IRON (A) Briquettes, hot moulded
FERROPHOSPHORUS (including briquettes)
FERROSILICON, with more than 30% but less than 90% silicon, UN 1408
FERROSILICON, with 25% to 30% silicon, or 90% or more silicon
FLUORSPAR (calcium fluoride)
GRANULATED NICKEL MATTE (LESS THAN 2% MOISTURE CONTENT)
LIME (UNSLAKED)
LOGS
MAGNESIA (UNSLAKED)
PEAT MOSS
PETROLEUM COKE*
PITCH PRILL
PULP WOOD
RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY MATERIAL (LSA-1), UN 2912 (non-fissile or fissile – excepted)
RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECT(S) (SCO-I or SCO-II), UN 2913 (non-fissile or fissile – excepted)

* When loaded and transported under the provisions of the IMSBC Code.

ROUNDWOOD
SAW LOGS
SILICOMANGANESE
SULPHUR, UN 1350
TIMBER
VANADIUM ORE
WOODCHIPS, with moisture content of 15% or more
WOOD PELLETS (NOT CONTAINING ANY ADDITIVES AND/OR BINDERS)
ZINC ASHES, UN 1435

.3 Cargoes assigned to the following generic Group B shipping schedules when they do not exhibit any self-heating, flammability, or water-reactive flammability hazards in accordance with the MHB tests and classification criteria contained in the Code:

METAL SULPHIDE CONCENTRATES

3 Solid bulk cargoes which are not listed in the IMSBC Code, provided that:

.1 they are assessed in accordance with section 1.3 of the Code;

.2 they do not present hazards of Group B as defined in the Code; and

.3 a certificate has been provided by the competent authority of the port of loading to the master in accordance with 1.3.2 of the Code.

TABLE 2

LIST OF SOLID BULK CARGOES FOR WHICH A FIXED GAS FIRE-EXTINGUISHING SYSTEM IS INEFFECTIVE AND FOR WHICH A FIRE-EXTINGUISHING SYSTEM GIVING EQUIVALENT PROTECTION SHALL BE AVAILABLE

The following cargoes categorized into Group B of the IMSBC Code:

ALUMINIUM NITRATE, UN 1438
AMMONIUM NITRATE, UN 1942 (with not more than 0.2% total combustible material, including any organic substance, calculated as carbon to the exclusion of any other added substance)
AMMONIUM NITRATE BASED FERTILIZER, UN 2067
AMMONIUM NITRATE BASED FERTILIZER, UN 2071
BARIUM NITRATE, UN 1446
CALCIUM NITRATE, UN 1454
LEAD NITRATE, UN 1469
MAGNESIUM NITRATE, UN 1474
POTASSIUM NITRATE, UN 1486
SODIUM NITRATE, UN 1498
SODIUM NITRATE AND POTASSIUM NITRATE, MIXTURE, UN 1499

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MSC.1/Circ.1453/Rev.1
12 June 2015

GUIDELINES FOR THE SUBMISSION OF INFORMATION AND COMPLETION OF THE FORMAT FOR THE PROPERTIES OF CARGOES NOT LISTED IN THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE AND THEIR CONDITIONS OF CARRIAGE

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), in adopting resolution MSC.393(95) on *Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code* and considering the proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its first session, with regard to implementation of subsection 1.3.3 of the IMSBC Code, approved a revision to MSC.1/Circ.1453 on *Guidelines for the submission of information and completion of the format for the properties of cargoes not listed in the IMSBC Code and their conditions of carriage*, as set out in the annex.

2 Member Governments are invited to bring the annexed guidelines to the attention of all concerned, taking into account the voluntary application date of 1 January 2016 for amendment 03-15 of the IMSBC Code, pending its envisaged mandatory entry-into-force date of 1 January 2017.

3 This circular supersedes MSC.1/Circ.1453.

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ANNEX

GUIDELINES FOR THE SUBMISSION OF INFORMATION AND COMPLETION OF THE FORMAT FOR THE PROPERTIES OF CARGOES NOT LISTED IN THE INTERNATIONAL MARITIME SOLID BULK CARGOES (IMSBC) CODE AND THEIR CONDITIONS OF CARRIAGE

Foreword

When a cargo which is not listed in the International Maritime Solid Bulk Cargoes (IMSBC) Code is intended to be carried in bulk, the competent authority of the port of loading should provide to the master a certificate stating the characteristics of the cargo and the required conditions for carriage and handling of that shipment. The competent authority of the port of loading should also submit an application to the Organization to incorporate this solid bulk cargo into appendix 1 of the IMSBC Code. The format of this application should be as outlined in subsection 1.3.3 of the IMSBC Code. These guidelines provide guidance on the type and structure of information which is required in the application.

General

The application should be supported as a minimum by relevant data such as may be contained in Material Safety Data Sheet (MSDS), Safety Data Sheet (SDS) or other relevant documentation. Applicants should therefore complete and submit the questionnaire in the appendix. Where applications indicate use of equipment or systems, references to relevant internationally agreed standards for such equipment or systems should be indicated.

1 Section "TENTATIVE BULK CARGO SHIPPING NAME"

This is the proposed Bulk Cargo Shipping Name (BCSN) to be identified in capital letters. When the cargo constitutes dangerous goods, the BCSN is to be supplemented with the United Nations (UN) number. Secondary names which are proposed to be indicated in appendix 4 "Index" of the IMSBC Code may also be listed in this section.

2 Section "Description"

This section should be used to specify the type of material, the manufacturing process, the raw material, the particle size and form, the colour, the composition of the material and its variability, the moisture content, properties of the cargo such as in/soluble in water, dusty, hygroscopic, and other specific characteristics.

3 Section "Characteristics"

3.1 The table specifying the characteristics of the cargo should be completed as follows:

3.2 **Angle of repose:** This box should be used to indicate the angle of repose for non-cohesive granular materials. If the evaluation of the properties of the material proved that the cargo is cohesive, the entry should be "Not applicable".

3.3 **Bulk density:** This box should be used to indicate the bulk density or the range of bulk density, as applicable, in kg/m^3.

3.4 **Stowage factor:** This box should be used to indicate the stowage factor or range of stowage factor, as applicable, in m^3/t.

3.5 **Size:** This box should be used to indicate the form and size or size-range of particles, pellets, lumps, etc., in mm and its variability, as applicable.

3.6 **Class:** This box should be used to indicate the hazard classification in accordance with section 9.2 of the IMSBC Code. If the cargo does not fall under Group B, the entry should be "Not applicable". In addition, if the cargo constitutes dangerous goods and has subsidiary risks, the subsidiary risks should be indicated. If the Class of the cargo corresponds to Materials Hazardous only in Bulk (MHB), section 9.2.3 of the Code should be also observed. (see also section for Hazardous properties in the appendix).

3.7 **Group:** This box should be used to indicate the cargo group in accordance with subsection 1.7 of the IMSBC Code (possible entries are "A and B", "A", "B" or "C").

4 Section "Hazard"

4.1 This section should be used to specify the hazard(s) of the material relevant for sea transport, such as combustibility, toxicity, corrosivity, radiotoxicity, hygroscopy, liability to oxygen depletion, decomposition, self-heating, spontaneous ignition, liquefaction, emission of flammable and/or toxic gases or vapours, reactivity with water, fuel oil or other organic materials.

4.2 If the cargo class is MHB and the existing hazard corresponding to the cargo does not meet any of the hazards identified in section 9.2.3 of the IMSBC Code, the other hazard (OH) corresponding to that cargo should be described in detail.

4.3 In case of non-hazardous cargo, write "No special hazards". If the cargo is non-combustible or constitutes a low fire-risk, write "This cargo is non-combustible or has a low fire-risk".

5 Section "Stowage and segregation"

5.1 This section should be used to specify the requirements for stowage and segregation of the cargo, such as separation from foodstuff, from wooden boundaries or from other cargoes, stowage away from sources of heat or ignition, away from fuel oil tanks, away from machinery space boundaries.

5.2 Furthermore this section should be used to stipulate requirements for fire/heat insulation for fuel oil tanks and machinery space bulkheads arranged adjacent to the cargo spaces, for resistance of cargo hold boundaries to fire and/or passage of liquids, for gas-tight machinery space bulkheads, for escaping gases away from accommodation spaces.

5.3 If no stowage and/or segregation requirements are appropriate, write "No special requirements".

6 Section "Hold cleanliness"

6.1 This section should give advice on the preparation of cargo spaces prior to loading, such as cleanliness and dryness of cargo spaces and bilge wells, washing with fresh or sea water, free from salt, provision of protective coating or lime-wash, removal of wooden dunnage.

6.2 If no requirement is necessary, write "No special requirements".

7 Section "Weather precautions"

7.1 This section should provide requirements relating to weather conditions and protective measures to be applied prior to and during loading and/or during unloading, such as moisture content of the cargo, prohibition of cargo handling during precipitation, closing of hatch covers.

7.2 If no requirement is necessary, write "No special requirements".

8 Section "Loading"

8.1 This section should be used to specify requirements and precautions during loading, such as trimming procedure, prevention of overstressing of the tank top, prevention of dust, dust control equipment, inerting of cargo spaces, gas and temperature measurement.

8.2 If no requirement is necessary, write "No special requirements".

9 Section "Precautions"

9.1 This section should be used to specify precautions to be taken prior to loading, such as protection of the ship and the crew from dust of the cargo, posting of "NO SMOKING" signs on deck, electrical equipment to be of certified safe type (explosion protection), removal of electrical links, spark arresting screens for ventilation openings, safety locking device for cargo space bilge-lines, protection of bilge wells, gas-tightness of machinery space bulkheads, pressure test of fuel tanks adjacent to the cargo hold.

9.2 Furthermore this section should be used to describe specific conditions of the cargo prior to loading, such as permissible limits of temperature in stockpile, other conditions of stockpile and test certificates to be provided prior to loading, e.g. certificate of moisture content and transportable moisture limit, weathering certificate, exemption certificate.

9.3 If no requirement is necessary, write "No special requirements".

10 Section "Ventilation"

10.1 This section should be used to specify requirements for ventilation of cargo spaces (refer to section 3.5 of the IMSBC Code) with regard to the ventilation system and the operation of ventilation during the voyage.

10.2 If no requirement is necessary, write "No special requirements".

11 Section "Carriage"

11.1 This section should be used to specify requirements and instructions to be observed during the voyage, such as procedures and equipment for gas and temperature measurement, sealing of hatches, ventilators and other openings of cargo holds in order to prevent ingress of water or leaking of inert gas, maintaining an inert atmosphere, checking the cargo surface for liquefaction and decomposition, checking of cargo spaces for condensation, testing of the acidity of bilge water and instructions for bilge pumping, ventilating of cargo holds and adjacent spaces.

11.2 If no requirement is necessary, write "No special requirements".

12 Section "Discharge"

12.1 This section should be used to specify requirements to be observed prior to and during unloading, such as precaution for entry of personnel into cargo spaces, use of personnel protection, gas measurement, restrictions for bunkering or pumping of fuel oil, trimming of hardened cargo, prevention of dust, protection of the ship.

12.2 If no requirement is necessary, write "No special requirements".

13 Section "Clean-up"

13.1 This section should be used to specify requirements for cleaning up of cargo spaces and bilge wells, such as removal of cargo residues and spillages, decontamination, use of fresh water or seawater, use of personnel protection, precautions for the use of the shipborne bilge system.

13.2 If no requirement is necessary, write "No special requirements".

14 Section "Emergency Procedures"

14.1 The table specifying the emergency procedures should be completed for materials of Group B as follows.

14.2 **Special emergency equipment to be carried:** This box should be used to specify the special emergency equipment to be carried, such as protective clothing, self-contained breathing-apparatuses, fire-fighting equipment. Otherwise, write "Nil".

14.3 **Emergency Procedures:** This box should be used to specify protective measures for entering the cargo spaces. Otherwise, write "Nil".

14.4 **Emergency action in the event of fire:** This box should be used to specify emergency action in the event of fire, such as supply or exclusion of air, use of water, CO_2 or whether a fixed gas fire-extinguishing system may be exempted, etc. Otherwise, write "Nil".

14.5 **Medical First Aid:** Reference should be made to the *Medical First Aid Guide (MFAG)*, as applicable.

APPENDIX

IMO SOLID BULK CARGO INFORMATION REPORTING QUESTIONNAIRE

It is recommended to provide the following information, in addition to the information described in subsection 1.3.3 of the IMSBC Code.

Basic background information

- Are there other synonyms or trade names in use?
- How is it manufactured, how is it made, or where does it originate?
- What is it used for?
- Where is it produced? In what countries? In what volumes?
- What experience do you have with the cargo?

Basic cargo properties

The following information may be included in the Description section of the draft individual schedule.

- What colour is it?
- Does it have an odour?
- What form is the cargo in? What particle sizes?
- How much moisture is in the cargo? How much oil is in the cargo?
- How is it stored? Outside? Under cover?
- Does the cargo cake when wet?
- Is it a cohesive cargo or a free-flowing cargo?

Hazardous properties

For this section of the questionnaire, each answer should be supported by test data on multiple samples from difference sources. If a question is not applicable, a detailed explanation of why it is not applicable should be made.

- Does it meet the definition of dangerous goods (Hazard Classes 1-9)? Which hazard classes?
- Is the cargo easily ignitable, combustible or flammable?
- Can the cargo contribute to fire or accelerate a fire?
- Does the cargo self-heat? What causes the self-heating? Fungal or bacterial growth? Oxidation?
- Does the cargo react with water causing toxic or flammable gases to be released? Which gases? How toxic or flammable are the gases? What is the rate of evolution?
- Is the cargo toxic? Toxic by inhalation? Toxic by skin contact or ingestion? How toxic? Acute or chronic toxicity?
- Does the cargo exhibit any long-term health effects, such as carcinogenic, mutagenic or reprotoxic properties?
- Is the cargo a respiratory sensitizer?
- Does the cargo contain known pathogens?
- Does the cargo react with water reaction causing corrosion? Corrosion to eyes, skin, or metal? What is the rate of corrosion?
- Is the cargo corrosive without water? Corrosion to eyes, skin, or metal? What is the rate of corrosion?
- Is the cargo hazardous to the environment?
- Is the dust flammable or explosive?

- Can the cargo deplete oxygen in cargo spaces and adjacent spaces? By how much?
- Is the cargo incompatible with other cargoes or chemicals? Which cargoes or chemicals?
- Can the cargo liquefy during a voyage? What is the Transportable Moisture Limit (TML) of the cargo?
- If the cargo is MHB, indicate on the following notational list the identified cargo related hazards:

Chemical Hazard	**Notational Reference**	**Yes/No**
Combustible solids	CB	
Self-heating solids	SH	
Solids that evolve flammable gas when wet	WF	
Solids that evolve toxic gas when wet	WT	
Toxic solids	TX	
Corrosive solids	CR	
Other hazards	OH	

If your answer is "OH", please provide a description:____________________"

Operational questions

- How is the cargo loaded? Conveyor? Clam shell?
- Does the cargo need to be trimmed?
- What type of ship will be used? Bulk carrier? OBO? Self-unloading vessel? General cargo ship? Barge?
- What experience do you have carrying the cargo in bulk by vessel? By road and rail?
- Have there been any incidents when transporting the cargo as a result of the cargo properties or hazards?
- Are there any recommendations for tank or hold cleaning?

Emergency response questions

- In the event of a fire can the cargo be extinguished with water? CO_2?
- In the event of personal exposure what procedures should be followed?
- What happens in the event of an accidental release to water during transport?

Testing questions

- Which hazards have been assessed?
- Which tests were conducted?
- What were the results of these tests?
- What was the actual data from the tests?
- How many tests were conducted?
- What samples were tested? Are the samples representative of the cargo to be shipped?

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MSC.1/Circ.1454/Rev.1
15 June 2015

GUIDELINES FOR DEVELOPING AND APPROVING PROCEDURES FOR SAMPLING, TESTING AND CONTROLLING THE MOISTURE CONTENT FOR SOLID BULK CARGOES WHICH MAY LIQUEFY

1 The Maritime Safety Committee, at its at its ninety-fifth session (3 to 12 June 2015), in adopting resolution MSC.393(95) on *Amendments to the International Maritime Solid Bulk Cargoes (IMSBC) Code* and considering the proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its first session, with regard to implementation of section 8 of the IMSBC Code, approved a revision to MSC.1/Circ.1454 on *Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy*, as set out in the annex.

2 Member Governments are invited to bring the annexed guidelines to the attention of all concerned, taking into account the voluntary application date of 1 January 2016 for amendment 03-15 of the IMSBC Code, pending its envisaged mandatory entry-into-force date of 1 January 2017.

3 This circular supersedes MSC.1/Circ.1454.

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ANNEX

GUIDELINES FOR DEVELOPING AND APPROVING PROCEDURES FOR SAMPLING, TESTING AND CONTROLLING THE MOISTURE CONTENT FOR SOLID BULK CARGOES WHICH MAY LIQUEFY

Foreword

These guidelines, prepared by the Maritime Safety Committee of the International Maritime Organization (IMO) contain guidance on the preparation, approval and implementation of procedures for sampling, testing and controlling moisture content for solid bulk cargoes which may liquefy. These guidelines were developed as part of the work to ensure safe transport of such cargoes and to complement the provisions of the International Maritime Solid Bulk Cargoes (IMSBC) Code related to the assessment of acceptability of consignments (see section 4 of the IMSBC Code).

The main objectives of the guidelines are:

- to assist shippers in preparing procedures for sampling, testing and controlling moisture content as required by paragraph 4.3.3 of the IMSBC Code; and

- to assist competent authorities of ports of loading when approving and checking the implementation of such procedures in accordance with paragraph 4.3.3 of the IMSBC Code.

1 Introduction

1.1 The IMSBC Code establishes international provisions for the safe loading, trimming, carriage and discharge of solid bulk cargoes when transported by sea, ensuring compliance with the provisions of the SOLAS Convention and identifies the risks associated with such cargoes with the aim of taking measures to minimize and to control them.

1.2 One of the risks identified is the risk associated with liquefaction of certain cargoes which may contain sufficient moisture to become fluid under the stimulus of compaction and the vibration which occurs during a voyage. Such cargoes are identified as Group A cargoes in the IMSBC Code.

1.3 Liquefaction may occur when the moisture content of the cargo exceeds the Transportable Moisture Limit (TML). Therefore, except for ships complying with the requirements in subsection 7.3.2 of the IMSBC Code, it is particularly important to ensure that the moisture content is less than the TML of the cargo and to control its moisture content until it is on board the ship.

1.4 For this purpose, it is required by the IMSBC Code to determine by a test the acceptability of consignments for safe shipment. Considering that the determination of the acceptability is fundamental to avoid liquefaction during transport, the shipper should establish procedures for sampling, testing and controlling moisture content. These procedures should be approved and their implementation checked by the competent authority of the port of loading.

1.5 Sections 2, 3 and 4 of these guidelines contain guidance to develop such procedures for sampling, testing and the control of moisture content respectively.

2 Development of sampling procedures

2.1 The shipper should establish a sampling procedure to ensure that test samples used to determine the acceptability of consignments for safe shipment are representative of the consignments to be transported. Methods of sampling may vary since the character of the cargo and the form in which it is available will affect the method to be used. It is, therefore, of the utmost importance to describe accurately the sampling procedures.

2.2 The procedures should take into account the appropriate provisions of subsections 4.4 to 4.7 of the IMSBC Code.

2.3 The procedure should, at least, include provisions:

- to identify the consignment to be sampled;
- to identify the material (type, particle size distribution, composition) and to ensure that the consignment corresponds to the description of the material;
- to identify the appropriate time, frequency and place to take samples;
- to describe the method of sampling, including:
    - the number of subsamples or increments which are required;
    - the quantity of material to be taken (subsample or increment size);
    - the location where the subsamples or increments have to be taken in the consignment;
    - the method of combining the subsamples or increments to arrive at a representative sample;
    - the method to ensure that the moisture content of the representative sample will not be subject to variation; and
    - the method to ensure the traceability of the subsamples or increments and of the representative samples;
- on the equipment used for sampling and procedures for its maintenance, when necessary;
- to identify persons responsible for sampling and the description of their training to fulfil their responsibilities; and
- to identify a technical supervisor responsible for the implementation of the sampling procedures and the description of its training commensurate with its role and responsibilities.

2.4 Records of the following activities addressed in the procedure for testing should be kept and made available to the competent authority of the port of loading upon request:

- training;
- internal review to ensure that the procedure is applied correctly;

- forms where the traceability of the subsample and representative sample is ensured;

- maintenance of equipment for sampling, when necessary; and

- any modification to the procedure for testing.

Records should be kept for a period of time established by the competent authority of the port of loading in the working language of the shipper. If the language or languages used are not English, French or Spanish, a translation into one of these languages should be included.

3 Development of testing procedures

3.1 The shipper should establish a test procedure to determine the acceptability of its consignments for safe shipment.

3.2 The procedure should, at least, include:

- the description of the test method for determining the moisture content.

  Recognized international and national methods for determining moisture content for various materials are referred to in paragraph 1.1.4.4 of appendix 2 of the IMSBC Code;

- the description of the test method for determining the acceptability of consignments.

  Recommended methods for determining transportable moisture limit (TML) are given in appendix 2 of the IMSBC Code. However, it is recognized that, in some instances and taking into account the scope of each of the methods, they may not be suitable for the cargo to be transported.

  If the recommended methods are not suitable for the material in question, any alternative method for this material should be approved by the competent authority of the port of loading. When approving such method, the competent authority should make sure that this method gives reliable results data in order to characterize the risk of liquefaction of the cargo on board the ship. It should also be established that:

  - the method can easily be carried out and is reproducible;

  - the method gives compatible results at the ship level;

  - the method is consistent with feedback;

  - the method is capable of providing a safety margin with respect to the risk of liquefaction;

  - the method and its related transportability criteria to ensure that the moisture content of the consignment is less than the TML;

- the protocol to implement the test method:

  The protocol should be written in the working language of the persons responsible for testing. If the language or languages used is not English, French or Spanish, a translation into one of these languages should be included.

The protocol should also include a periodic internal control procedure to ensure that the protocol is applied correctly:

- an example of the form where the consignment has to be identified and where the results to the test have to be reported;

- the list of the equipment to conduct the tests, the procedure to ensure the accurate calibration and maintenance of the equipment and the location(s) where the test is conducted;

- the list of persons responsible for testing and the description of their training to fulfil their responsibilities; and

- the name of the technical supervisor designated to be responsible for the implementation of the test procedure and the description of its training commensurate with its role and responsibilities.

3.3 Records of the following activities addressed in the procedure for testing should be kept and made available to the competent authority of the port of loading upon request:

- training;

- internal review to ensure that the protocol is applied correctly;

- forms where the consignments and results are reported;

- maintenance, calibration and testing of any testing equipment; and

- any modification of the procedure for testing.

Records should be kept for a period of time established by the competent authority of the port of loading in the working language of the shipper. If the language or languages used are not English, French or Spanish, a translation into one of these languages should be included.

4 Development of procedures for controlling moisture content

4.1 The shipper should establish a procedure for controlling moisture content to ensure that the moisture content is less than the TML when it is on board the ship. Once the moisture content has been measured, it is important to ensure that the moisture content remains below the TML. This procedure should be based on an analysis of all factors that may influence the moisture content between the production/extraction area and the ship.

4.2 The procedure should, at least, include:

- a description of the geographic configuration of the production/extraction area;

- a description of the location of the stockpiling/storage area, when applicable;

- a description of the method(s) to transport the consignment from the production/extraction area to the stockpiling/storage area or to the ship and, when applicable, from the stockpiling area to the ship and a description of the precautions taken during these transport operations to control moisture content of the consignment (such as: use of closed vehicles, suspension of certain operations and conveyor belts sloped and covered during rainfall);

- a description of the stockpiling/storage method(s), when applicable and of the precautions taken during stockpiling/storage (such as configuration of the pile to allow rain to run off) to control moisture content of the consignment;

- a description of the method(s) to load the cargo from shore to ship and precautions to protect the cargo from precipitation and water ingress (see paragraph 4.3.4 when loaded from barges);

- a description of the sampling operations between the production/extraction area and the ship to measure and report moisture content at different stages before being on board the ship (such as during stockpiling, conveyor transport, loading);

- a description of the conditions when the cargo is not authorized to be loaded and when the loading should be suspended on board the ship (moisture content greater than the TML, weather conditions);

- a description of the periodic internal control procedures to ensure that the procedure for controlling moisture content is applied; and

- a description of the human and material resources and of the awareness and training activities of the personnel involved to implement the procedure.

4.3 Records of the following activities addressed in the procedure for controlling moisture content should be kept and made available to the competent authority of the port of loading upon request:

- training;

- internal review to ensure that the procedure for controlling moisture content is applied correctly;

- weather conditions during which the procedure is applied; and

- any modification of the procedure for testing.

Records should be kept for a period of time established by the competent authority of the port of loading in the working language of the shipper. If the language or languages used are not English, French or Spanish, a translation into one of these languages should be included.

5 Approval of the procedures by the competent authority

5.1 According to paragraph 4.3.3 of the IMSBC Code, the procedures for sampling, testing and controlling moisture content should be approved and their implementation checked by the competent authority of the port of loading.

5.2 Before any transport of Group A cargoes, the shipper should establish the required procedures as described in sections 2 to 4 of these guidelines and should provide them well in advance to the competent authority of the port of loading for approval.

5.3 As defined in section 1.7 of the IMSBC Code, the competent authority means any national regulatory body or authority designated or otherwise recognized as such for any purpose in connection with the IMSBC Code. Contracting Governments are invited to inform the organization of the name and address of competent authorities in their country authorized to approve the procedures for dissemination through the GISIS database.

5.4 The procedures are subject to:

.1 an initial verification by the competent authority of the port of loading before the document required in paragraph 4.3.3 of the IMSBC Code is issued. This verification should ensure that the procedures comply with the provisions of the IMSBC Code and of these guidelines, the personnel involved have received appropriate training and the required equipment is available and in conformity with the description in the procedures;

.2 a renewal verification at intervals specified by the competent authority of the port of loading, but not exceeding five years. This verification should ensure that the approved procedures still comply with the applicable provisions of the IMSBC Code in force at the time of the renewal verification and are implemented by the shipper; and

.3 at least one intermediate verification. If only one intermediate verification is carried out, it should take place before the first anniversary date of the document required in paragraph 4.3.3 of the IMSBC Code. The intermediate verification should ensure that the procedures are implemented by the shipper.

5.5 The competent authority of the port of loading should determine which changes to approved procedures should not be implemented unless the relevant changes are approved.

5.6 A document should be issued after the initial and renewal verification in accordance with the provisions of paragraph 4.3.3 of the IMSBC Code by the competent authority of the port of loading. It should be issued for a period specified by the competent authority of the port of loading, which should not exceed five years.

5.7 The document should clearly identify the procedures involved and should include a statement to the effect that the competent authority has approved the procedures. It should be drawn up in a form corresponding to the model given in the appendix to these guidelines.

5.8 A copy of the document should be provided to the master or his representative in accordance with paragraph 4.3.3 of the IMSBC Code.

APPENDIX

(Identification of the competent authority) (State)

Approval Number:

Approval issued under the provisions of paragraph 4.3.3 of the
International Maritime Solid Bulk Cargoes (IMSBC) Code

Name and address of the shipper: ....

Port of loading: ....

Bulk cargo shipping name: ....

Reference of the procedure for sampling: ....

Reference of the procedure for testing: ....

Reference of the procedure for controlling moisture content: ....

Date of initial/renewal verification on which this approval is based: ....

This is to approve the procedures mentioned above and that they have been verified in accordance with MSC.1/Circ.1454/Rev.1 on *Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy*

Specific remarks: ....

This approval is valid until ....… subject to verifications in accordance with MSC.1/Circ.1454/Rev.1 on *Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy*

Issued at: ....

Date of issue: ....

(Signature of the competent authority issuing the approval)

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INTERNATIONAL MARITIME ORGANIZATION

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MSC.1/Circ.1501
23 June 2015

UNIFIED INTERPRETATION OF SOLAS REGULATION II-2/16.3.3 FOR PRODUCTS REQUIRING OXYGEN-DEPENDENT INHIBITORS

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), approved a unified interpretation of SOLAS regulation II-2/16.3.3, prepared by the Sub-Committee on Pollution Prevention and Response, at its second session (19 to 23 January 2015), as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretation as guidance when applying the relevant requirements of the SOLAS Convention and to bring it to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATION OF SOLAS REGULATION II-2/16.3.3 FOR PRODUCTS REQUIRING OXYGEN-DEPENDENT INHIBITORS

SOLAS regulations II-2/16.3.3.2 and 16.3.3.3 (Operation of inert gas system)[1]

When a product containing an oxygen-dependent inhibitor is carried on a ship for which inerting is required under SOLAS chapter II-2, the inert gas system shall be operated as required to maintain the oxygen level in the vapour space of the tank at or above the minimum level of oxygen required under paragraph 15.13 of the IBC Code and as specified in the Certificate of Protection.

[1] Expected entry into force 1 January 2016.

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MSC-MEPC.5/Circ.10
23 June 2015

UNIFIED INTERPRETATION OF PARAGRAPH 15.13.5 OF THE IBC CODE FOR PRODUCTS REQUIRING OXYGEN-DEPENDENT INHIBITORS

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), and the Marine Environment Protection Committee, at its sixty-eighth session (11 to 15 May 2015), approved a unified interpretation of paragraph 15.13.5 of the IBC Code for products requiring oxygen-dependent inhibitors, prepared by the Sub-Committee on Pollution Prevention and Response, at its second session (19 to 23 January 2015), as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretation as guidance when applying the relevant requirements of the IBC Code and to bring it to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATION OF PARAGRAPH 15.13.5 OF THE IBC CODE FOR PRODUCTS REQUIRING OXYGEN-DEPENDENT INHIBITORS

IBC Code, paragraph 15.13.5[1] – When a product containing an oxygen-dependent inhibitor is to be carried

When a product containing an oxygen-dependent inhibitor is carried on a ship for which inerting is required under SOLAS chapter II-2, the inert gas system shall be operated as required to maintain the oxygen level in the vapour space of the tank at or above the minimum level of oxygen required under paragraph 15.13 of the IBC Code and as specified in the Certificate of Protection.

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1 Expected entry into force: 1 January 2016.

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MSC.1/Circ.1502
11 June 2015

GUIDANCE ON PRESSURE TESTING OF BOUNDARIES OF CARGO OIL TANKS UNDER DIRECTION OF THE MASTER

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to facilitate the global and consistent implementation of testing of cargo oil tanks when this is undertaken under direction of the master, in accordance with the International Code on the Enhanced Programme of Inspections during Surveys of Bulk Carriers and Oil Tankers, 2011 (2011 ESP Code), approved the *Guidance on pressure testing of boundaries of cargo oil tanks under direction of the master*, as set out in the annex.

2 Member Governments are invited to bring this circular to the attention of all parties concerned.

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ANNEX

GUIDANCE ON PRESSURE TESTING OF BOUNDARIES OF CARGO OIL TANKS UNDER DIRECTION OF THE MASTER

1 Introduction

1.1 The *International Code on the Enhanced Programme of Inspections during Surveys of Bulk Carriers and Oil Tankers, 2011 (2011 ESP Code)* was adopted on 30 November 2011 by resolution A.1049(27) and subsequently made mandatory through amendments to SOLAS regulation XI-1/2 (resolution MSC.325(90)) which entered into force on 1 January 2014. This regulation requires that bulk carriers and oil tankers as defined in the 1974 SOLAS Convention, as amended, shall be subject to an enhanced programme of inspections in accordance with the 2011 ESP Code. The enhanced survey programme shall be carried out during the surveys prescribed by SOLAS regulation I/10.

1.2 This guidance gives information and advice on technical and formal matters related to the required testing of cargo oil tanks when this is undertaken under direction of the master according to the 2011 ESP Code.

1.3 Where the ship is in a shipyard or is under attendance of the Administration/Recognized Organization (RO) surveyor(s) the testing of cargo tanks is to be carried out under the direction, and in the presence, of the Administration/RO surveyor(s). It should be noted that all ballast tanks adjacent to cargo tanks are to be tested by the Administration/RO surveyors.

2 Objective and applicability

2.1 This guidance is prepared as a reference for Administrations/ROs, companies, masters and crews in order to facilitate a common understanding of the procedures for testing of cargo oil tanks when this is undertaken under the direction of the master.

2.2 This procedure applies to all oil tankers to which the 2011 ESP Code is applicable.

3 Testing of cargo oil tanks

3.1 The minimum requirements for cargo tank testing at renewal survey are given in the 2011 ESP Code, annex B, parts A and B, paragraph 2.6.4 and annex 3.

3.2 Tests of the cargo oil tanks carried out under this procedure are to be to the satisfaction of the master.

3.3 Boundaries of cargo tanks are to be tested with liquid to the highest point that the liquid will rise under service conditions. The minimum scope of bulkheads to be tested is to be in accordance with the requirements in the 2011 ESP Code, annex B, parts A and B, annex 3.

3.4 Testing of the boundaries of cargo tanks carried out by the ship's crew under the direction of the master may be accepted by the surveyor provided the following conditions are complied with:

.1 a tank testing procedure specifying fill heights, tanks being filled and boundaries being tested has been submitted by the owner and reviewed by the Administration or RO prior to the testing being carried out;

.2 there is no record of leakage, distortion or substantial corrosion that would affect the structural integrity of the tank;

.3 the tank testing has been satisfactorily carried out within the renewal survey window not more than three months prior to the date of the survey on which the overall or close-up survey is completed;

.4 the satisfactory results of the testing are recorded in the ship's logbook; and

.5 the internal and external condition of the tanks boundaries and associated structure are found satisfactory by the surveyor at the time of the overall and close-up survey.

3.5 "Failed test": where the outcome of tank testing reveals structural damage or leakage, the Flag Administration/RO should be advised with immediate effect, and attendance on board by (an) Administration/RO surveyor(s) arranged.

4 Procedure for testing of cargo oil tanks

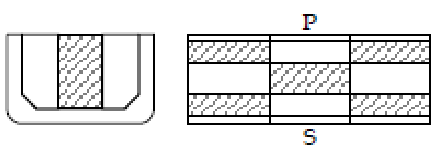
4.1 In order to comply with the cargo oil pressure testing requirements, section 4.2 or 4.3 below has to be completed.

4.2 *Strength testing using cargo oil*

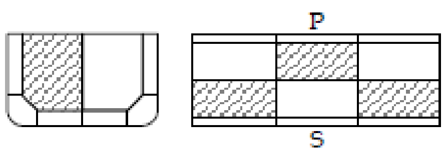
4.2.1 The required pressure testing condition is to be in accordance with the tank testing procedure reviewed by the Administration/RO (2011 ESP Code, annex B, parts A and B, paragraph 2.6.1.1) but not less than the minimum as stated in section 3.3 above.

4.2.2 In order to test the relevant boundaries, the ship may be loaded in a checker board pattern (figure 1), so that each cargo tank internal bulkhead is subjected to a fully loaded head of pressure provided that the intended loading and stability condition are checked and confirmed by the master.

4.2.3 The ship's logbook is to confirm that paragraph 4.2.2 and section 4.3 below, have been successfully carried out and that it is to be signed by the master.



Tankers with two oil-tight longitudinal bulkheads



Tankers with one centreline oil-tight longitudinal bulkhead

Figure 1 – "Stagger test" – checker board pattern

4.3 *Combined strength and tightness testing using ballast water*

If practical with respect to the operation of the ship, it is acceptable to carry out combined strength and tightness testing using ballast water provided the relevant requirements in section 4.2 above are complied with and that the relevant tank boundaries are accessible for inspection. The boundaries and associated welds between the tank under test and adjacent cargo oil tanks are to be fully inspected to ensure there is no indication of water leakage across the boundaries.

4.4 *General*

Water ballast tanks inclusive boundaries facing the cargo tanks, shall be tested in accordance with the 2011 ESP Code. These tests are to be witnessed and all boundaries are to be examined by the Administration/RO attending surveyor.

4.5 *Safety*

Careful consideration should be given to the *Revised recommendations for entering enclosed spaces aboard ships* (resolution A.1050(27)).

5 Master's inspections, assessment and reporting

5.1 *General*

The following paragraphs describe the operations that are required of the master when carrying out the inspections of the boundaries of the tank which are to be submitted to a hydrostatic test. All safety precautions and facilities (lighting, ventilation, etc.) should be provided according to the ship's Safety Management System (SMS) documentation and the cargo oil tank testing procedure as approved by the Administration/RO.

5.2 *Places to be inspected*

5.2.1 All boundaries of the cargo oil tank under testing are to be examined from positions outside of the cargo tank boundaries. Boundaries of commonly shaped tanks are constituted by:

- .1 a transverse aft bulkhead and associated structure;
- .2 a transverse fore bulkhead and associated structure;
- .3 two longitudinal bulkheads and relevant associated structure; and
- .4 an inner bottom plating and associate structure.

5.2.2 Each of these boundaries is the common division between the cargo oil tank under testing and another:

- .1 cargo oil tank, or
- .2 ballast tank/double bottom, or
- .3 fuel oil tank, or
- .4 void space, or pump-room.

5.2.3 The inspection is to verify that:

.1 the plating and structures of each boundary are not affected by evident geometrical defects, such as deflection/distortion of the structures supporting the plating of the boundaries, when hydrostatically loaded; and

.2 the tightness of each boundary is not impaired, i.e. no leakages are to appear anywhere on surface of each boundary, especially at the welded joints connecting the plates which constitute the boundary itself.

5.2.4 Each boundary should be closely inspected, noting any defective items from the two categories above.

5.3 *Reporting*

5.3.1 Following the inspection of all boundaries surrounding the cargo oil tank under test, the master is required to report, in a simple manner, the results of the inspection. The report is to be recorded in the ship's logbook and include all data relevant to:

.1 identification of the tank subjected to testing;

.2 identification of the compartments surrounding the cargo tank subject to testing;

.3 date, time and place of testing;

.4 ship's loading condition during the testing, including ship trim; and

.5 outcome of the inspections carried out during the testing.

The report is to be retained on board for the attention of the attending Administration/RO surveyor(s).

5.3.2 Where no deficiencies have been found or noted, the testing of the cargo oil tank can be considered as having a satisfactory outcome.

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MSC.1/Circ.1504
5 June 2015

UNIFIED INTERPRETATION OF THE GUIDELINES FOR SAFE ACCESS TO TANKER BOWS (RESOLUTION MSC.62(67))

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on the fire resistance requirements for Fibre Reinforce Plastic (FRP) gratings used for safe access to tanker bows, approved a unified interpretation of the *Guidelines for safe access to tanker bows* (resolution MSC.62(67)), prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretation as guidance when applying resolution MSC.62(67) to approve arrangements using FRP gratings for safe access to tanker bows on or after 5 June 2015 and to bring the unified interpretation to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATION OF THE GUIDELINES FOR SAFE ACCESS TO TANKER BOWS (RESOLUTION MSC.62(67))

Paragraph 1.3 – Gangway and access

Fibre Reinforced Plastic (FRP) gratings used in lieu of steel gratings for safe access to tanker bows should possess:

.1 low-flame spread characteristics and should not generate excessive quantities of smoke and toxic products as per the International Code for Application of Fire Test Procedures, 2010 (2010 FTP Code); and

.2 adequate structural fire integrity as per recognized standards* after undergoing tests in accordance with the above standards.

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* For example, the Standard Specification for Fibre Reinforced Polymer (FRP) Gratings Used in Marine Construction and Shipbuilding (ASTM F3059-14).

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MSC.1/Circ.1505
5 June 2015

UNIFIED INTERPRETATION OF SOLAS REGULATION II-2/13.6

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on means of escape from ro-ro spaces, approved a unified interpretation of SOLAS regulation II-2/13.6, prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to use the annexed Unified interpretation as guidance when applying SOLAS regulation II-2/13.6 on or after 5 June 2015 and to bring the unified interpretation to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATION OF SOLAS REGULATION II-2/13.6

Regulation 13.6 – *Means of escape from ro-ro spaces*

1 A place where the crew are present to carry out their routine work duties, e.g. during the loading and unloading of a ro-ro deck, or during their ro-ro deck inspections whilst the ship is underway, is considered normally employed.

2 Ro-ro deck inspections could for instance include: fire patrols, inspection of the cargo, check of bilge wells and their alarms, sounding of tanks, cargo deck cleaning, different types of maintenance work (removing of rust, painting, greasing, etc.).

3 Ro-ro spaces should be fitted with at least two means of escape, one located at the fore end and the other at the aft end of the space, from which access is provided to the lifeboat and liferaft embarkation decks. One of the means of escape should be a stairway, the second escape may be a trunk or a stairway

4 The fore and aft ends of the ro-ro space are considered as the areas being within the distance equal to the breadth of the ro-ro space, measured at its widest point, from its forward most and aftmost point.

5 Suitable signs and markings should be provided to indicate the route to the means of escape.

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MSC.1/Circ.1507
5 June 2015

AMENDMENTS TO THE UNIFIED INTERPRETATIONS OF THE PROVISIONS OF SOLAS CHAPTERS II-1 AND XII, OF THE TECHNICAL PROVISIONS FOR MEANS OF ACCESS FOR INSPECTIONS (RESOLUTION MSC.158(78)) AND OF THE PERFORMANCE STANDARDS FOR WATER LEVEL DETECTORS ON BULK CARRIERS AND SINGLE HOLD CARGO SHIPS OTHER THAN BULK CARRIERS (RESOLUTION MSC.188(79)) (MSC.1/CIRC.1464/REV.1)

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on the application of SOLAS regulation II-1/3-6.3.1, as amended, and the revised Technical Provisions for means of access for inspections (resolution MSC.158(78)), approved amendments to the *Unified interpretations of the provisions of SOLAS chapters II-1 and XII, of the Technical provisions for means of access for inspections (resolution MSC.158(78)) and of the Performance standards for water level detectors on bulk carriers and single hold cargo ships other than bulk carriers (resolution MSC.188(79))* (MSC.1/Circ.1464/Rev.1), as prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to use the annexed amendments to MSC.1/Circ.1464/Rev.1 and to bring them to the attention of all parties concerned.

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ANNEX

AMENDMENTS TO THE UNIFIED INTERPRETATIONS OF THE PROVISIONS OF SOLAS CHAPTERS II-1 AND XII, OF THE TECHNICAL PROVISIONS FOR MEANS OF ACCESS FOR INSPECTIONS (RESOLUTION MSC.158(78)) AND OF THE PERFORMANCE STANDARDS FOR WATER LEVEL DETECTORS ON BULK CARRIERS AND SINGLE HOLD CARGO SHIPS OTHER THAN BULK CARRIERS (RESOLUTION MSC.188(79)) (MSC.1/CIRC.1464/REV.1)

Paragraph 1.1

1 Replace the reference to "resolution A.744(18)" with the reference "the 2011 ESP Code".

Paragraph 1.5

2 Renumber the existing paragraph as "paragraph 1" and insert the following new paragraph 2:

> "2 The wording "not intended for the carriage of oil or hazardous cargoes" applies only to "similar compartments", i.e. safe access can be through a pump-room, deep cofferdam, pipe tunnel, cargo hold or double-hull space."

Paragraph 2.10

3 Renumber the existing paragraph as "paragraph 1" and insert the following new paragraph 2:

> "2 Deck is defined as "weather deck"."

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MSC.1/Circ.1508
5 June 2015

UNIFIED INTERPRETATIONS OF REGULATION 36(6) OF THE PROTOCOL OF 1988 RELATING TO THE INTERNATIONAL CONVENTION ON LOAD LINES, 1966

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on the application of regulation 36(6) of the 1988 LL Protocol, approved a unified interpretation of regulation 36(6) of the Protocol of 1988 relating to the International Convention on Load Lines, 1966, as prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretations as guidance when applying regulation 36(6) of the 1988 LL Protocol and to bring the unified interpretations to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATIONS OF REGULATION 36(6) OF THE PROTOCOL OF 1988 RELATING TO THE INTERNATIONAL CONVENTION ON LOAD LINES, 1966

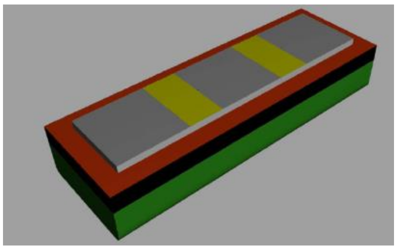
Regulation 36(6) – Continuous hatchways

Generally two types of "continuous hatchways" can be distinguished:

.1 In case of a **single** hatchway, the hatchway may be regarded as a "continuous hatchway".

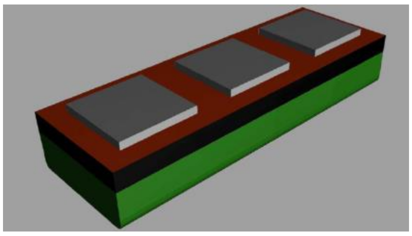
.2 In case **more than one** hatchway is fitted, the following arrangement may be considered as a "continuous hatchway", too:

Detached hatchways linked by weathertight decked steel structures in between. The hatchways are connected by longitudinal coamings connected transversally by decked steel structures. In this case, the equivalent "continuous hatchway" is the entire enclosed volume of the single hatchways and the weathertight spaces between them.

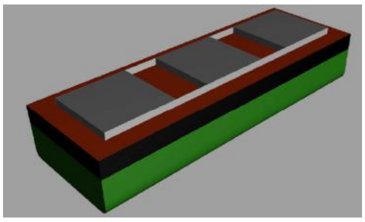


.3 In case more than one hatchway is fitted, the following arrangements should **not** be regarded as "continuous hatchways":

(1) Detached hatchways: Each hatchway is to be considered as a "separated detached trunk", thus each hatchway may be treated separately as a trunk in the freeboard computation.



(2) Detached hatchways connected by longitudinal coamings: All hatchways may be treated in the same manner as (1).



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5 June 2015

UNIFIED INTERPRETATIONS OF THE CODE ON NOISE LEVELS ON BOARD SHIPS (RESOLUTION MSC.337(91))

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), in order to facilitate its global and consistent implementation of the *Code on noise levels on board ships*, as adopted by resolution MSC.337(91), approved unified interpretations of *Code on noise levels on board ships* (resolution MSC.337(91)), as prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretations as guidance when applying Code on noise levels on board ships and to bring the unified interpretations to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATIONS OF THE CODE ON NOISE LEVELS ON BOARD SHIPS (RESOLUTION MSC.337(91))

CHAPTER 1 – GENERAL

Paragraph 1.3.8

Passenger spaces where they are also occupied by crew such as recreation rooms and open recreation areas should be considered as "other passenger spaces", and therefore are not subject to the Code. However, bulkhead and decks of crew cabins and hospitals adjacent to such rooms/areas should have the weighted sound reduction index (Rw) in compliance with paragraph 6.2 of chapter 6.

Paragraph 1.4.21

Navigating bridge wings include enclosed navigating bridge spaces.

CHAPTER 3 – MEASUREMENT

Paragraph 3.3.5

Air conditioning vents should be kept open during the taking of noise measurements on board, unless they are designed to be kept closed in the normal operating condition.

Paragraph 3.3.6

Closing devices of ventilation grilles/louvres of cabin doors should be kept open during the taking of noise measurements on board, unless they are designed to be kept closed in the normal operating condition.

Paragraph 3.3.9

The wording "40% of maximum thruster power" means exactly "40% of maximum" and does not mean "40% of 80% as required by paragraph 3.3.2 of the Code".

Paragraph 3.9

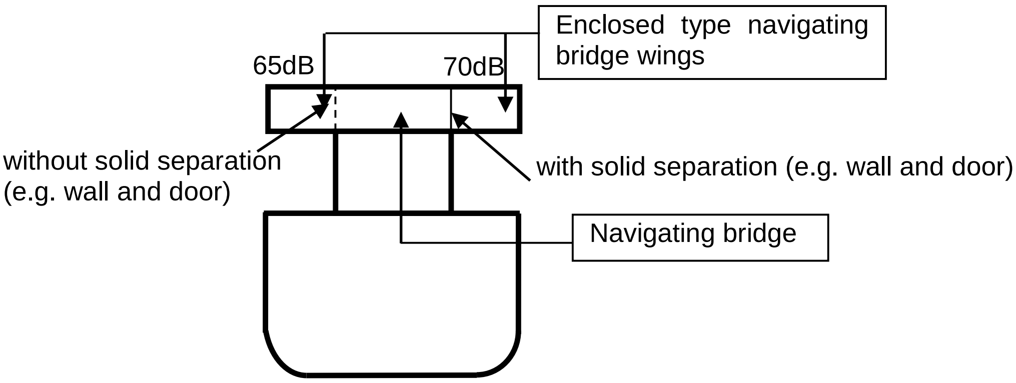
This provision only "acknowledges" the uncertainty; it does not represent any "allowance".

CHAPTER 4 – MAXIMUM ACCEPTABLE SOUND PRESSURE LEVELS

Paragraph 4.2

1 A navigating bridge provided with radio equipment should be regarded as a "navigating bridge" (65dB(A))."Radio rooms" mean separate rooms dedicated for sending/receiving radio messages.

2



3 If a cabin is completely separated by more than one bulkhead from the airborne sound source, those bulkheads are not required to have the airborne sound insulation properties as required in chapter 6. For this purpose, bathroom/toilet/lavatory is not regarded as a cabin but regarded as the origin of airborne sound to another cabin.

4 A room consisting of day-room and bedroom should be regarded as a single "cabin" (60dB(A)/55dB(A)) in cases where the room is for single occupancy. For this purpose, partitions (panel and door) between day-room and bedroom need not have the airborne sound insulation properties as required in chapter 6.

CHAPTER 6 – ACOUSTIC INSULATION BETWEEN ACCOMMODATION SPACES

Paragraph 6.2.1

1 The requirements regarding airborne sound insulation properties for bulkheads also apply to components installed in bulkheads (e.g. corridors to cabin doors).

2 In applying this requirement to bulkheads including components as mentioned in the above, the following may apply:

.1 In cases of bulkheads consisting of acoustic insulation panels and doors, this requirement is considered satisfactory where each component forming the surface of bulkheads (acoustic insulation panels and doors, etc.) has at least the required Rw.

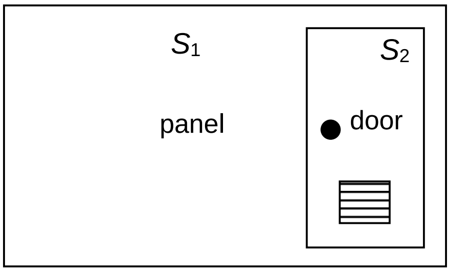
.2 In cases where either acoustic insulation panels or doors forming part of bulkheads have weighted sound reduction index inferior to that required by section 6.2.1 of the Code, this requirement is considered satisfactory provided that the Rw of bulkheads is not inferior to the required value, i.e. the Rw of bulkhead calculated using both the airborne sound insulation properties of the doors and those of the panels is not inferior to the required value. As guidance on evaluation of the Rw of bulkheads, the following formulae can be used:

$$\overline{R} = 10\log_{10}\left[S / \sum_{i=1}^{n}\left(S_i \cdot 10^{-R_i/10}\right)\right]$$

where S: the area of the concerned bulkhead
n: the number of components forming the concerned bulkhead
R_i: the sound reduction index of the component number i
S_i: the area of single component

Note: R_i has frequency elements in frequency range from 100 to 5000 [Hz]

Example: bulkhead consisting of acoustic insulation panels and doors:



$n = 2$
S_1: the area of the panel
S_2: the area of the door
S: the area of concerned bulkhead ($S = S_1 + S_2$)
R_1: the sound reduction index of the panel
R_2: the sound reduction index of the door

3 The requirements regarding airborne sound insulation properties for decks should also apply to decks together with coverings and should, therefore, be tested in laboratory as in the onboard arrangement. However, they need not apply to ceiling panels.

Paragraph 6.2.2

1 Closing devices of ventilation grilles/louvres of cabin doors should be kept open during laboratory tests.

2 Doors should be tested together with the associated door frame. In cases where there is no sill being part of the door frame, the doors should be tested with the gap specified by manufacturers and with sealing materials, if fitted.

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MSC.1/Circ.1510
5 June 2015

AMENDMENT TO THE UNIFIED INTERPRETATIONS OF SOLAS CHAPTER II-2, THE FSS CODE, THE FTP CODE AND RELATED FIRE TEST PROCEDURES (MSC/CIRC.1120)

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on the application of the Unified interpretations of SOLAS chapter II-2, the FSS Code, the FTP Code and related fire test procedures (MSC/Circ.1120), approved an amendment to the appendix to the annex to MSC/Circ.1120, as prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to apply the amendment to the appendix of the annex to MSC/Circ.1120 and to bring the amendment to the attention of all parties concerned.

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ANNEX

AMENDMENT TO THE UNIFIED INTERPRETATIONS OF SOLAS CHAPTER II-2, THE FSS CODE, THE FTP CODE AND RELATED FIRE TEST PROCEDURES (MSC/CIRC.1120)

Appendix, figure 3

Figure 3 in the appendix of the Unified interpretations for typical arrangements for prevention of heat transmission at intersections and terminal points of insulation of decks and/or bulkheads, is amended as follows.

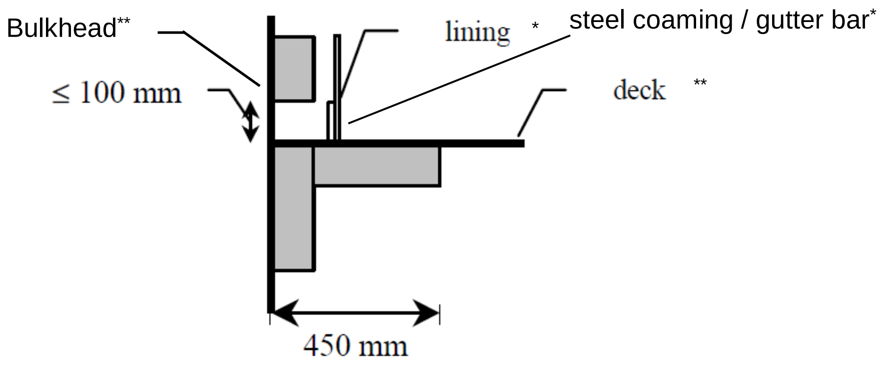

Figure 3

***Note:**
d = Depth of stiffener on girder.

* Lining and steel coaming/gutter bar are for accommodation spaces only.
** For the purpose of figure 3, bulkhead and deck are of steel construction only.

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MSC.1/Circ.1511
5 June 2015

UNIFIED INTERPRETATIONS OF SOLAS REGULATIONS II-2/9 AND II-2/13

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), with a view to providing more specific guidance on the application of SOLAS regulations II-2/9 and II-2/13, approved Unified interpretations of SOLAS regulations II-2/9 and II-2/13, as prepared by the Sub-Committee on Ship Design and Construction, at its second session (16 to 20 February 2015), as set out in the annex.

2 Member Governments are invited to apply the Unified interpretations of SOLAS regulations II-2/9 and II-2/13 and to bring them to the attention of all parties concerned.

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ANNEX

UNIFIED INTERPRETATIONS OF SOLAS REGULATIONS II-2/9 AND II-2/13

REGULATION II-2/9 – CONTAINMENT OF FIRE

Tables 9.5 and 9.6:

1 Decks and bulkheads

Decks and bulkheads to be insulated to "A-30" fire integrity are those boundaries of single spaces protected by their own fire-extinguishing system.

2 Hatches

Class "A" fire integrity respectively does not apply to hatches fitted on open deck adjacent to ro-ro/vehicle spaces and on decks separating ro-ro/vehicle spaces, provided that such hatches are constructed of steel.

3 Access doors

"A-0" fire integrity does not apply to access doors to ro-ro/vehicle spaces fitted on open decks, provided that such access doors are constructed of steel.

4 Movable ramps

Movable ramps installed on decks referred to in Interpretation1 above which form boundaries of "A-30" fire integrity shall be constructed of steel and shall be insulated to "A-30" fire integrity, except for the "working parts" of such movable ramps (e.g. hydraulic cylinders, associated pipes/accessories) and members supporting such fittings which do not contribute to the structural strength of the boundary. Such movable ramps need not be subject to fire test. This is applicable to non-watertight doors used for loading/unloading of vehicles.

5 Ventilation ducts

Where ducts for a ro-ro/vehicle spaces pass through other ro-ro/vehicle spaces without serving those spaces, each duct shall be insulated all along itself to "A-30" fire integrity in ways of other ro-ro/vehicle spaces unless the sleeves and fire dampers in compliance with SOLAS regulation II-2/9.7.3.1 in order to prevent spread of fire through the ducts are fitted.

6 Ventilators

"A-0" fire integrity does not apply to ventilators constructed of steel fitted on open decks adjacent to ro-ro/vehicle spaces.

REGULATION II-2/13 – MEANS OF ESCAPE

Regulations 13.3.3.2 and 13.3.3.3

The "Lowest open deck" should be a category (10) "Open deck" (as defined in SOLAS chapter II-2, regulations 9.2.3.3.2.2 and 9.2.4.2.2.2) at the lowest height from baseline in way of accommodation spaces.

Regulations 13.4.1.4, 13.4.1.6, 13.4.2.5 and 13.4.2.6

1 Main workshop

A "main workshop" means a compartment enclosed on at least three sides by bulkheads or gratings, usually containing welding equipment, metal working machinery and workbenches.

2 Machinery control rooms

A "machinery control room" means a space which serves for control and/or monitoring of machinery used for ship's main propulsion.

3 Continuous fire shelter

A "continuous fire shelter" means a route from a main workshop, or from a machinery control room, which allows safe escape, without entering the machinery space, to a location outside the machinery space. Such a continuous fire shelter need not be a protected enclosure as envisaged by SOLAS regulation II-2/13.4.1.1 or II-2/13.4.2.1.1. The boundaries of the continuous fire shelter shall be at least "A-0" class divisions and be protected by self-closing "A-0" class doors. The continuous fire shelter shall have minimum internal dimensions of at least 800 mm x 800 mm for vertical trunks and 600 mm in width for horizontal trunks, and shall have emergency lighting provisions. The figures below represent typical arrangements of the continuous fire shelters through trunks or through spaces/rooms to a location outside the machinery space, which should be considered as effective.

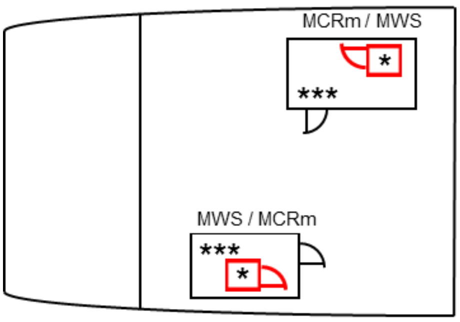


Figure 1 – Single room escape via trunk

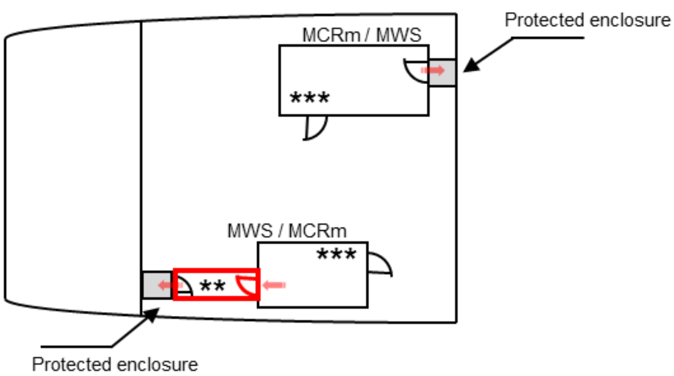


Figure 2 – Single room escape via protected enclosure

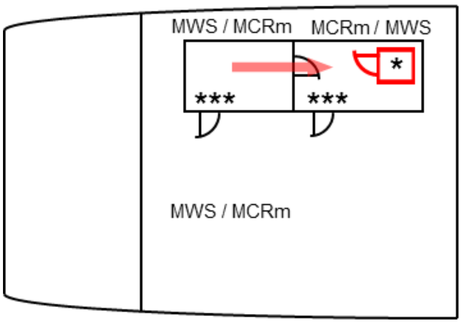


Figure 3 – Room to room escape via trunk

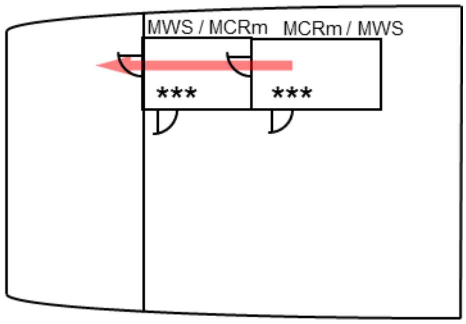


Figure 4 – Room to room direct escape

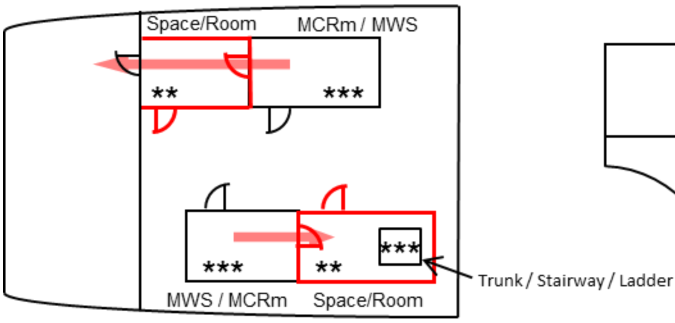


Figure 5 – Room to room escape via other space/room

MCRm: Machinery Control Room
MWS: Main Workshop

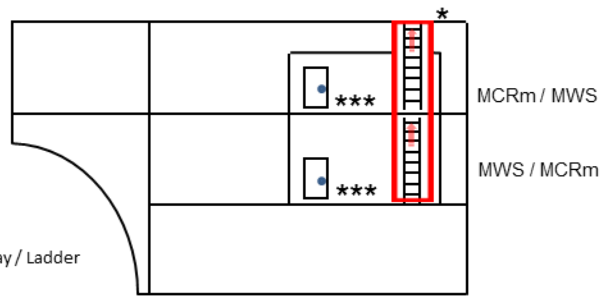


Figure 6 – Room to room escape via trunk (different decks)

* Vertical trunk (minimum dimensions: 800 mm x 800 mm) enclosing ladders or stairways to be at least "A-0" class divisions and to be protected by self-closing "A-0" class doors

** Horizontal trunk (minimum width: 600 mm) to be at least "A-0" class divisions and to be protected by self-closing "A-0" class doors

*** Fire integrity not required

Regulation 13.4.1

1 A "safe position" can be any space, excluding lockers and storerooms irrespective of their area, cargo spaces and spaces where flammable liquids are stowed, but including special category spaces and ro-ro spaces, from which access is provided and maintained clear of obstacles to the embarkation decks (regulations II-2/13.4.1.1.1 and 13.4.1.4).

2 Inclined ladders/stairways in machinery spaces being part of, or providing access to, escape routes but not located within a protected enclosure should not have an inclination greater than 60° and should not be less than 600 mm in clear width. Such requirement need not be applied to ladders/stairways not forming part of an escape route, only provided for access to equipment or components, or similar areas, from one of the main platforms or deck levels within such spaces (regulation II-2/13.4.1).

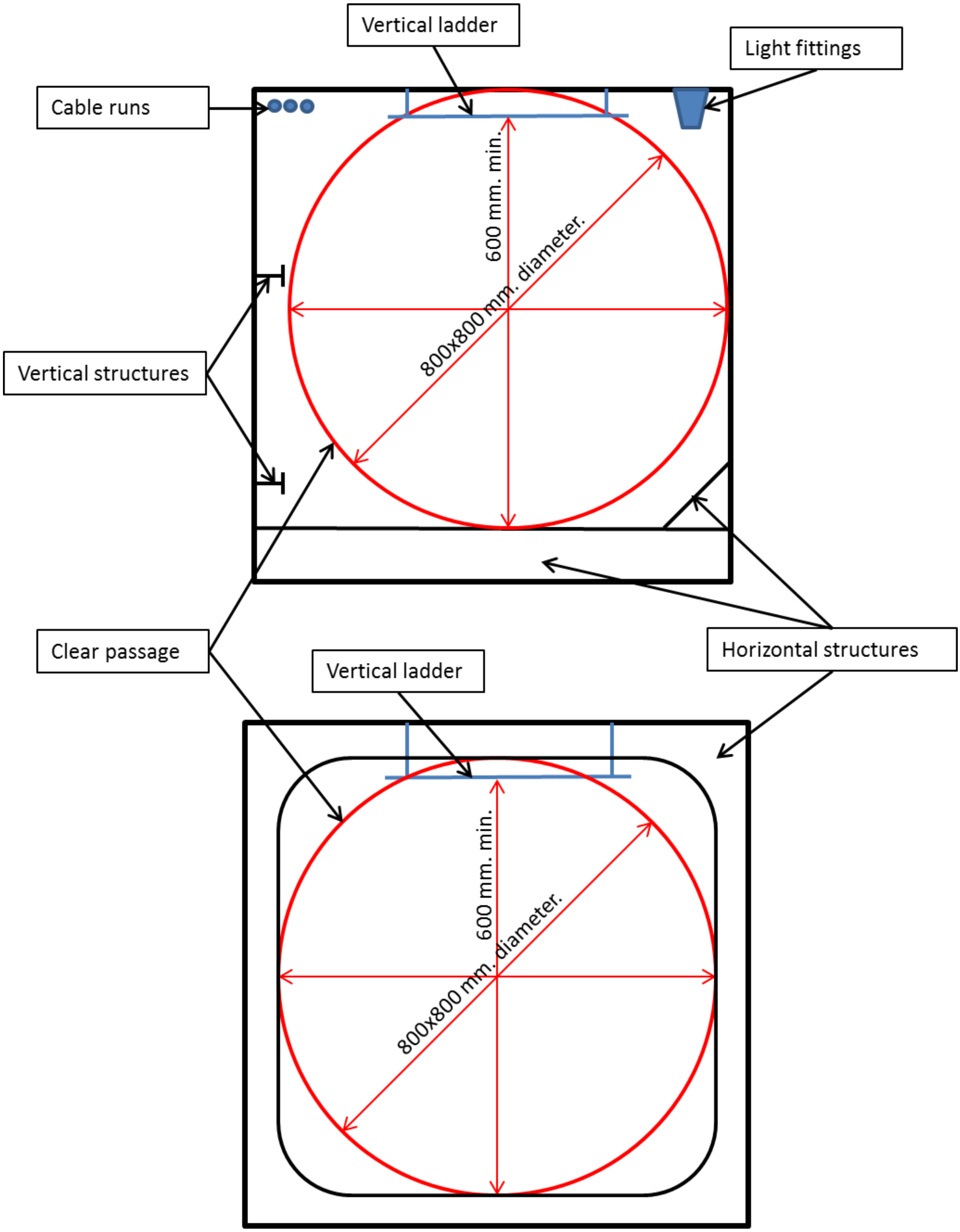
3 Machinery spaces may include working platforms and passageways, or intermediate decks at more than one deck level. In such case, the lower part of the space should be regarded as the lowest deck level, platform or passageway within the space. At deck levels, other than the lowest one, where only one means of escape other than the protected enclosure is provided, self-closing fire doors should be fitted in the protected enclosure at that deck level.

Smaller working platforms in-between deck levels, or only for access to equipment or components, need not be provided with two means of escape (regulation II-2/13.4.1.1).

4 A protected enclosure providing escape from machinery spaces to an open deck may be fitted with a hatch as means of egress from the enclosure to the open deck. The hatch should have minimum internal dimensions of 800 mm x 800 mm (regulation II-2/13.4.1.1.1).

5 Internal dimensions should be interpreted as clear width, so that a passage having diameter of 800 mm is available throughout the vertical enclosure, as shown in figure 7, clear of ship's structure, with insulation and equipment, if any. The ladder within the enclosure can be included in the internal dimensions of the enclosure. When protected enclosures include horizontal portions their clear width should not be less than 600 mm. Figure 7 is given as example of some possible arrangements which may be in line with the above interpretation (regulation II-2/13.4.1.1.1).

Figure 7


Vertical ladder
Light fittings
Cable runs
600 mm. min.
800x800 mm. diameter.
Vertical structures
Clear passage
Horizontal structures
Vertical ladder
600 mm. min.
800x800 mm. diameter.

Regulation 13.4.2

1 A "safe position" can be any space, excluding cargo spaces, lockers and storerooms irrespective of their area, cargo pump-rooms and spaces where flammable liquids are stowed, but including vehicle and ro-ro spaces, from which access is provided and maintained clear of obstacles to the open deck (regulation II-2/13.4.2.1.1).

2 Inclined ladders/stairways in machinery spaces being part of, or providing access to, escape routes, but not located within a protected enclosure should not have an inclination greater than 60° and should not be less than 600 mm in clear width. Such requirement need not be applied to ladders/stairways not forming part of an escape route, only provided for access to equipment or components, or similar areas, from one of the main platforms or deck levels within such spaces (regulation II-2/13.4.2.1).

3 Machinery spaces of category A may include working platforms and passageways, or intermediate decks at more than one deck level. In such case, the lower part of the space should be regarded as the lowest deck level, platform or passageway within the space.

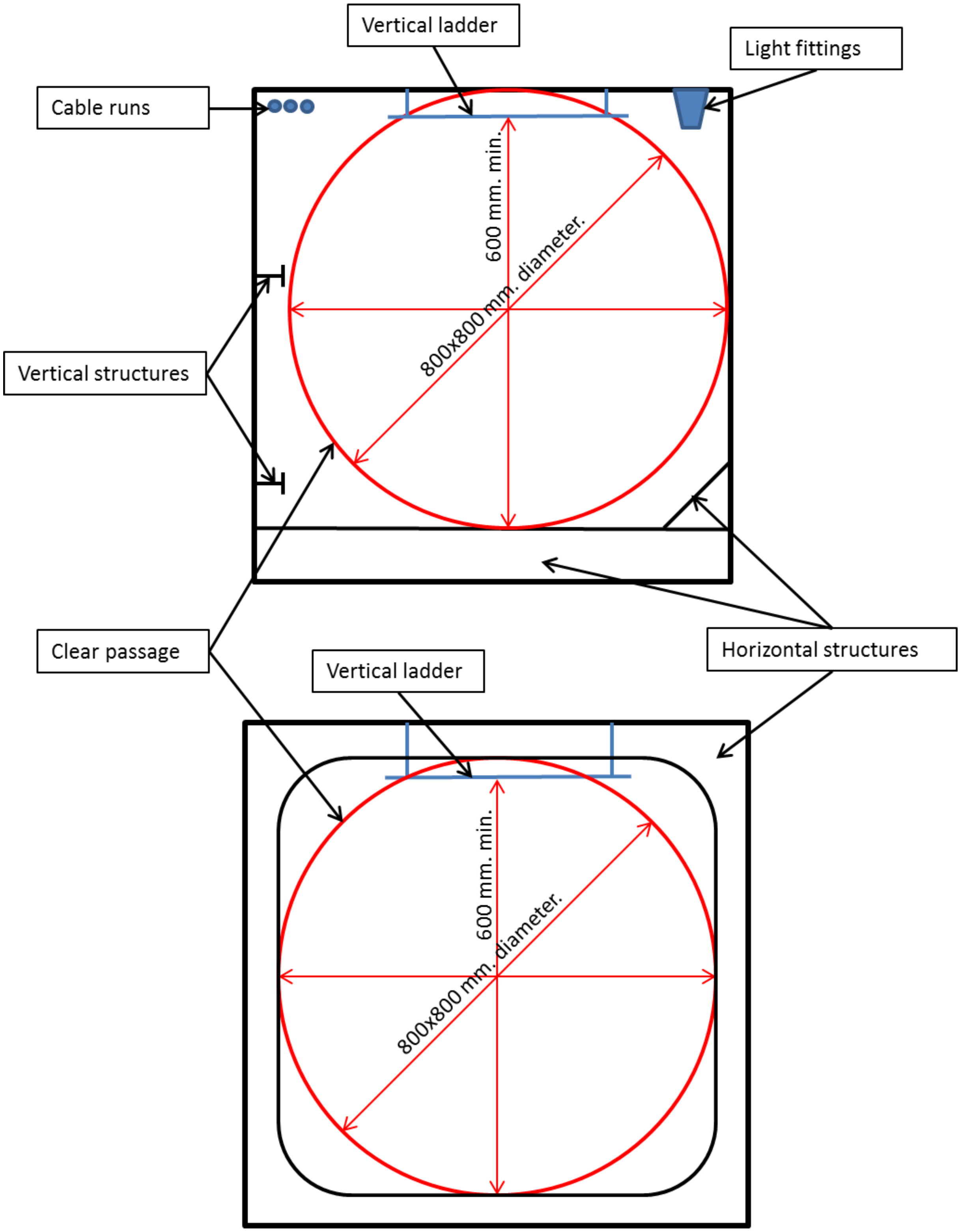
At deck levels, other than the lowest one, where only one means of escape other than the protected enclosure is provided, self-closing fire doors should be fitted in the protected enclosure at that deck level. Smaller working platforms in-between deck levels, or only for access to equipment or components, need not be provided with two means of escape (regulation II-2/13.4.2.1).

4 A protected enclosure providing escape from machinery spaces of category A to an open deck may be fitted with a hatch as means of egress from the enclosure to the open deck. The hatch should have minimum internal dimensions of 800 mm x 800 mm (regulation II-2/13.4.2.1.1).

5 Internal dimensions should be interpreted as clear width, so that a passage having diameter of 800 mm is available throughout the vertical enclosure, as shown in figure 8, clear of ship's structure, with insulation and equipment, if any. The ladder within the enclosure can be included in the internal dimensions of the enclosure. When protected enclosures include horizontal portions their clear width should not be less than 600 mm. Figure 8 is given as example of some possible arrangements which may be in line with the above interpretation (regulation II-2/13.4.2.1.1).

6 In Machinery spaces other than those of category A, which are not entered only occasionally, the travel distance should be measured from any point normally accessible to the crew, taking into account machinery and equipment within the space (regulation II-2/13.4.2.3).

Figure 8


Vertical ladder
Light fittings
Cable runs
600 mm. min.
800x800 mm. diameter.
Vertical structures
Clear passage
Horizontal structures
Vertical ladder
600 mm. min.
800x800 mm. diameter.

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MSC.1/Circ.1514
8 June 2015

PERFORMANCE STANDARD, FUNCTIONAL REQUIREMENTS AND SYSTEM REQUIREMENTS FOR THE ASSESSMENT OF SMOKE MANAGEMENT SYSTEMS

1 The Maritime Safety Committee, at its ninety-fifth session (3 to 12 June 2015), recognizing the need to provide guidance on smoke management systems installed on new passenger ships and having considered a proposal by the Sub-Committee on Ship Systems and Equipment, at its second session (23 to 27 March 2015), approved the performance standard, functional requirements and system requirements for the assessment of smoke management systems, as set out in the annex.

2 Member Governments are invited to bring the annexed performance standard, functional requirements and system requirements for the assessment of smoke management systems to the attention of ship designers, shipyards, passenger shipowners and other parties concerned.

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ANNEX

PERFORMANCE STANDARD, FUNCTIONAL REQUIREMENTS AND SYSTEM REQUIREMENTS FOR THE ASSESSMENT OF SMOKE MANAGEMENT SYSTEMS

1 Purpose

The purpose of this annex is to provide performance standard and functional as well as system requirements applicable to smoke management systems if installed on new passenger ships.

2 Definition

For the purposes of this performance standard, the following definitions apply:

2.1 *Smoke management system* is an engineered system including all methods that can be used singly or in combination to handle smoke movement ensuring a safe evacuation of persons in case of fire by preventing the contamination of smoke into escape routes. The life-safety performance criteria for safe evacuation should be acceptable to the Administration.

2.2 *Smoke extraction system,* which may form part of a smoke management system, is intended to extract smoke from escape routes by means such as exhaust fans.

3 Functional requirements

3.1 The systems should be designed as to maintain sufficiently smoke free escape routes in case of fire.

3.2 The systems may be either independent systems or part of or combined with the general air conditioning and ventilation systems.

3.3 The systems should be provided with an alternative source of power in order to remain operational when the initial source of power is lost.

3.4 After fire or smoke has been detected, activation of the systems should be in a controlled manner, either automatic or manual from the continuously manned central control station and/or the safety centre.

3.5 The system should remain operational or available for the duration required.

4 Principal system requirements

4.1 The system should be arranged for manual operation. Automatic operation with manual override may be accepted by the Administration.

4.2 The system should be arranged in sections such that the smoke will be retained in the space of origin by using smoke barriers made of non-combustible material and/or pressure differentials, whereby any section should not serve more than one main vertical zone.

4.3 The system covering large volume spaces like atrium or other multi-deck spaces should be designed based on respective fire scenarios.

4.4 The system should be capable to maintain the stairway enclosure with a positive pressure compared to the adjacent areas in order to prevent the ingress of smoke. This may be achieved by supplying more air then extracting from the stairway or respective active pressurization system.

4.5 The minimum pressure differential for each section should prevent smoke spread across the smoke control boundary, as applicable, considering the most demanding ventilation arrangement. The pressure difference should not cause any constraint of opening doors in escape routes.

4.6 The system should be designed to be fully operational within 2 minutes after activation, regardless of manual or automatic.

4.7 The system should be provided with at least two independent power sources.

4.8 All ducts used for smoke extraction should be made of steel or equivalent and insulated depending on the type of spaces passing through.

4.9 System components of smoke management systems in contact with smoke should be made of materials able to withstand temperatures expected during operation.

4.10 The system should be so arranged that extracted smoke will not affect external means of escape and the embarkation deck.

4.11 Consideration should be given to the requirement for the automatic fire dampers in SOLAS regulation II-2/9.7. Measures should be implemented to ensure that fire integrity of the ventilation duct is not impaired.

5 Commissioning and operation

5.1 The system should be tested during commissioning using theatrical hot smoke, or other means, that are sufficient to overcome any stratification effects, if applicable, as acceptable to the Administration.

5.2 A design, installation, operation and maintenance manual should be provided on board.

5.3 The smoke management system should be included in the ship's maintenance plan as required by SOLAS regulation II-2/14.2.2.

5.4 An operational strategy as when and how to use a smoke management system should be prepared and included in crew's training plan as well as the regular fire drills.

6 Performance standard

The systems should be tested, approved and maintained, as acceptable to the Administration.

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ANNEX 13

DRAFT MSC RESOLUTION MSC.399(95)
(adopted on 5 June 2015)

AMENDMENTS TO THE GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS (RESOLUTION A.753(18)), AS AMENDED BY RESOLUTION MSC.313(88)

THE MARITIME SAFETY COMMITTEE,

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

RECALLING ALSO resolution A.753(18), by which the Assembly, at its eighteenth session, adopted Guidelines for the application of plastic pipes on ships, to assist maritime Administrations to determine, in a rational and uniform manner, the permitted applications of such materials,

NOTING that the Assembly requested the Committee to keep the guidelines under review and amend them as necessary,

RECALLING FURTHER resolution MSC.313(88), by which the Committee adopted amendments to the *Guidelines for the application of plastic pipes on ships* (resolution A.753(18)).

RECOGNIZING that the continual development of plastic materials for use on ships and improvement of marine safety standards since the adoption of resolutions A.753(18) and MSC.313(88) necessitates the periodic revision of the provisions of the *Guidelines for the application of plastic pipes on ships* in order to take into account technological developments and maintain the highest practical level of safety,

HAVING CONSIDERED, at its [ninety-fifth session (3 to 12 June 2015)], amendments to the *Guidelines for the application of plastic pipes on ships*, proposed by the Sub-Committee on Ship Design and Construction, at its second session,

1 ADOPTS amendments to the guidelines for the application of plastic pipes on ships (resolution A.753(18)), as amended by MSC.313(88), the text of which is set out in the annex to the present resolution; and

2 INVITES Governments to apply the annexed amendments when considering the use of plastic piping on board ships flying the flag of their State.

ANNEX

AMENDMENTS TO THE GUIDELINES FOR THE APPLICATION OF PLASTIC PIPES ON SHIPS (RESOLUTION A.753(18)), AS AMENDED BY MSC.313(88)

1 In the table of contents, the entry for "2.2.3 Smoke generation" is replaced by the following:

"2.2.3 Smoke generation, containment and toxicity"

2 In the table of contents, the entry for "2.2.4 Toxicity" is deleted and the ensuing entries are renumbered accordingly.

3 In the table of contents, the entry for "4.6 Penetrations of fire divisions" is deleted and the ensuing entries are renumbered accordingly.

4 In the table of contents, the entry for "Appendix 3 – Test method for flame spread of plastic piping" is replaced by the following:

"Appendix 3 – Test methods and criteria for flame spread, smoke generation and toxicity of plastic piping"

5 In paragraph 2.1.1.4, the following text is added at the end of the last sentence:

"(e.g. pipes for vacuum and pressure systems)".

6 In paragraph 2.1.8.2, the following sentence is added at the end:

"This may require additional support of the piping systems."

7 In paragraph 2.2.1.2, between the words "outflow of flammable liquids" and "and worsen the fire situation" the words "or spread of fire through duct piping" are added.

8 In paragraph 2.2.2.1, between the words "piped tunnels and ducts," and "should have low flame spread" the words "if separated from accommodation, permanent manned areas and escape ways by means of an A class bulkhead," are added.

9 In paragraph 2.2.2.1, the reference "resolution A.653(16) as modified for pipes" is replaced by the reference "appendix 3".

10 In paragraph 2.2.2.2, the reference "resolution A.653(16)" in the first sentence is replaced by the reference "appendix 3".

11 In paragraph 2.2.2.2, the reference "resolution A.653(16)" in the second sentence are replaced by the reference "the 2010 FTP Code, annex 1, part 5".

12 In paragraph 2.2.2.2, between the words "modifications are" and "listed in appendix 3" in the last sentence, the word "also" is added.

13 In paragraph 2.2.2.3, the reference "IMO resolution A.653(16) (surface flammability criteria of bulkhead, wall and ceiling linings)" is replaced by the reference "appendix 3".

14 The title of section 2.2.3 is replaced by the following:

"**2.2.3 Smoke generation, containment and toxicity**"

15 In paragraph 2.2.3.1, the reference "SOLAS regulations II-2/34.7 and 49.2 are" is replaced by the reference "SOLAS regulation II-2/6 is".

16 Paragraph 2.2.3.2 is replaced by the following:

"2.2.3.2 Piping materials shall fulfil the requirements of the 2010 FTP Code, annex 1, part 2, on smoke and toxicity test. Procedure modifications are necessary due to the curvilinear pipe surfaces. These procedure modifications are listed in appendix 3".

17 Section 2.2.4 and paragraph 2.2.4.1 are deleted and the ensuing sections and paragraphs of part 2 are renumbered accordingly.

18 Section 4.6 and paragraphs 4.6.1 and 4.6.2 are deleted and the ensuing sections and paragraphs of part 4 are renumbered accordingly.

19 In appendix 1, note 2 to paragraph 1, the words "as set out in paragraphs 7.1, 7.2 and 7.3 of the annex to Assembly resolution A.754(18)" are replaced by the words " as set out in paragraphs 7.1 to 7.4 of part 3 of annex 1 to the 2010 FTP Code".

20 In appendix 1, paragraph 2, the sentence "One of the ends should allow pressurized nitrogen to be connected." is deleted.

21 In appendix 1, note 2 to paragraph 2, the following sentence is added at the end:

"At least largest and smallest diameter or wall thickness should be tested for approval."

22 In appendix 1, paragraph 7 is deleted.

23 Appendix 3 is replaced by the following:

"Appendix 3

Test methods and criteria for flame spread, smoke generation and toxicity of plastic piping

Flame spread, smoke generation and toxicity of plastic piping should be determined by the 2010 FTP Code, annex 1, parts 2 and 5 with the modifications listed below.

Tests should be made for each pipe material and should take into account differences in wall thickness.

When conducting testing of plastic piping, testing need not be conducted on every pipe size. Testing should be conducted on pipe sizes with the maximum and minimum wall thicknesses intended to be used. This will qualify all piping sizes for a specific piping material provided that the wall thickness falls within the tested range.

1 Test Specimen Preparation

1.1 For homogenous thermoplastic pipes, the test specimens may be produced as flat plates in the required wall thickness(es).

1.2 The test sample should be fabricated by cutting pipes lengthwise into individual sections and then assembling the sections into a test sample as representative as possible of a flat surface. A test sample should consist of at least two sections. All cuts should be made normal to the pipe wall. The test sample should be 800 mm ± 5 mm long for tests to 2010 FTP Code, annex 1, part 5. The test sample should be 75 mm ± 1 mm square for tests to 2010 FTP Code, annex 1, part 2.

1.3 The number of sections that must be assembled together to form a test sample should be that which corresponds to the nearest integral number of sections which should make a test sample (with an equivalent linearized surface width between 155 mm and 180 mm). The surface width is defined as the measured sum of the outer circumference of the assembled pipe sections that are exposed to the flux from the radiant panel.

1.4 The assembled test sample should have no gaps between individual sections.

1.5 The assembled test sample should be constructed in such a way that the edges of two adjacent sections should coincide with the centreline of the test holder.

1.6 For testing flame spread the individual test sections should be attached to the backing calcium silicate board using wire (No.18 recommended) inserted at 50 mm intervals through the board and tightened by twisting at the back.

1.7 The individual pipe sections should be mounted so that the highest point of the exposed surface is in the same plane as the exposed flat surface of a normal surface.

1.8 The space between the concave unexposed surface of the test sample and the surface of the calcium silicate backing board should be left void.

1.9 The void space between the top of the exposed test surface and the bottom edge of the sample holder frame should be filled with a high temperature insulating wool if the width of the pipe segments extend under the side edges of the sample holding frame.

2 Test Methods

Flame spread of plastic piping should be determined by the 2010 FTP Code, annex 1, part 5. The smoke density and toxicity of gases produced by plastic pipes should be determined by the 2010 FTP Code, annex 1, part 2.

3 Criteria

Flame Spread

Parameters	*Criteria*
CFE(kW/m²)	*≥20.0*
Q_{sb} *(MJ/m²)*	*≥1.5*
Q_t *(MJ)*	*≤0.7*
Q_p *(kW)*	*≤4.0*
Burning Droplets	*No burning droplets*

Smoke and Toxicity

Smoke: the D_m value shall not exceed 400 in any test condition

Toxicity: the average value of the gas concentration measured under each test condition shall not exceed the following limits:

Species	Concentration (ppm)
CO	1450
HCl	600
HF	600
HBr	600
HCN	140
SO_2	120
NO_x	350

4 Exemption of the test in accordance with part 2 of the 2010 FTP Code

Piping with both the total heat release (Q_t) of not more than 0.2 MJ and the peak heat release rate (Q_p) of not more than 1.0kW (both values determined in accordance with the 2010 FTP Code, annex 1, part 5) are considered to comply with the requirements the 2010 FTP Code, annex 1, part 5 without further testing (see the 2010 FTP Code, annex 2, paragraph 2.2)."

24 In appendix 4, in the fire endurance requirements matrix, the following new row is added at the end of the matrix:

"

32	Central vacuum cleaners	NA	NA	NA	0	NA	NA	NA	NA	0	0	0

"

25 In appendix 4, footnote 10, the reference "paragraph 3(f) of regulation 13F" is replaced by the reference "paragraph 3.6 of regulation 19".

26 In appendix 4, in location definitions, in the definition of location A – Machinery spaces of category A, the reference "regulation II-2/3.19" is replaced by the reference "regulation II-2/3.31"

27 In appendix 4, in location definitions, in the definition of location B – Other machinery spaces and pump-rooms, the word "pumps," is deleted.

28 In appendix 4, in location definitions, in the definition of location B – Other machinery spaces and pump-rooms, between the words "boilers," and "steam and internal combustion engines" add the words "fuel oil units,".

29 In appendix 4, in location definitions, in the definition of location J – Accommodation, service and control spaces, the reference "regulation II-2/3.10, 3.12, 3.22" is replaced by the reference "regulations II-2/3.1, 3.45, 3.18".

30 In appendix 4, in location definitions, in the definition of location K – Open decks, the reference "regulation II-2/26.2.2(5)" is replaced by the reference "regulation II-2/9.2.2.3.2(5)".

***

ANNEX 16

RESOLUTION MSC.400(95)
(Adopted on 8 June 2015)

AMENDMENTS TO THE REVISED PERFORMANCE STANDARDS AND FUNCTIONAL REQUIREMENTS FOR THE LONG-RANGE IDENTIFICATION AND TRACKING OF SHIPS (RESOLUTION MSC.263(84), AS AMENDED)

THE MARITIME SAFETY COMMITTEE,

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

RECALLING ALSO resolution A.886(21) on *Procedure for the adoption of, and amendments to, performance standards and technical specifications*, by which the Assembly resolved that the function of adopting performance standards and technical specifications, as well as amendments thereto shall be performed by the Maritime Safety Committee,

BEARING IN MIND the provisions of regulation V/19-1 of the International Convention for the Safety of Life at Sea, 1974 (the Convention), relating to the long-range identification and tracking of ships, and the *Revised performance standards and functional requirements for the long-range identification and tracking of ships* (Revised performance standards), adopted by resolution MSC.263(84), as amended by resolution MSC.330(90),

HAVING CONSIDERED, at its [ninety-fifth] session, a number of modifications to the Long-Range Identification and Tracking of ships (LRIT) system with a view to improving the efficiency, effectiveness and use of the system,

1 ADOPTS amendments to the *Revised performance standards and functional requirements for the long-range identification and tracking (LRIT) of ships* (resolution MSC.263(84), as amended), the text of which is set out in the annex to the present resolution; and

2 INVITES Contracting Governments to the Convention to bring the above amendments to the attention of all parties concerned.

ANNEX

AMENDMENTS TO THE REVISED PERFORMANCE STANDARDS AND FUNCTIONAL REQUIREMENTS FOR THE LONG-RANGE IDENTIFICATION AND TRACKING OF SHIPS (RESOLUTION MSC.263(84), AS AMENDED)

1 Table 2 (Data to be added by an Application Service Provider and at the LRIT Data Centre) is amended as followsreplaced by the following table and notes:

"**Table 2**

DATA TO BE ADDED BY AN APPLICATION SERVICE PROVIDER AND AT THE LRIT DATA CENTRE

Parameters	**Comments**
Ship Identity[(1)]	The IMO ship identification number[(1)] and MMSI for the ship.
Name of ship	Name of the ship which has transmitted the LRIT information in the English language using latin-1 alphabet and UTF-8 encoding.
Type of ship[(2)]	Type of the ship which has transmitted the LRIT information using a pre-defined code.
Time Stamp 2	The date and time[(23)] the transmission of LRIT information is received by the ASP (if used).
Time Stamp 3	The date and time[(23)] the received LRIT information is forwarded from the ASP (if used) to the appropriate LRIT Data Centre.
LRIT Data Centre Identifier	The identity of the LRIT Data Centre to be clearly indicated by a Unique Identifier.
Time Stamp 4	The date and time[(23)] the LRIT information is received by the LRIT Data Centre.
Time Stamp 5	The date and time[(23)] the transmission of LRIT information is forwarded from the LRIT Data Centre to an LRIT Data User.

Notes: (1) See regulation XI-1/3 and resolution A. 6001078(1528) on *IMO ship identification number scheme*.
(2) Types of ships to be used in LRIT messages are outlined in LRIT Technical documentation, part I (MSC.1/Circ.1259, as revised).
(23) All times should be indicated as Universal Coordinated Time (UTC)."

2 Paragraph 15.2 is amended as follows replaced by the following:

"15.2 Each Administration should provide to the selected LRIT Data Centre the following information for each of the ships entitled to fly its flag which is required to transmit LRIT information:

.1 name of ship;

.2 IMO Ship identification number;

.3 call sign;

.4 Maritime Mobile Service Identity; and

.5 Type of ship."

***