ANNEX 2

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

CHAPTER 1
GENERAL

1.1 Application and implementation

1 The following new paragraphs 1.1.1.1 to 1.1.1.3 are added after existing paragraph 1.1.1:

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

1.1.1.2 Ships subject to this Code using gaseous fuels or low-flashpoint fuels, other than the products listed in chapter 19, shall be approved by the Administration, taking into account the guidelines developed by the Organization specifically for ships subject to this Code.

1.1.1.3 The products shall be listed on the ship's International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk and identified as cargo and/or fuel, as appropriate."

2 Paragraph 1.1.2.2 is replaced by the following:

"1.1.2.2 For the purpose of the Code, the expression "ships constructed" means ships the keels of which are laid or which are at a similar stage of construction, unless otherwise specified in the Code."

3 The following new paragraph is added after existing paragraph 1.1.2.2:

"1.1.2.2.1 The expression "ships constructed on or after [1 July 2028]" means ships:

.1 for which the building contract is placed on or after [1 July 2028]; or

.2 in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after [1 January 2029]; or

.3 the delivery of which is on or after [1 July 2032]."

1.2 Definitions

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

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

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

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

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

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

CHAPTER 2
SHIP SURVIVAL CAPABILITY AND LOCATION OF CARGO TANKS

2.1 General

5 Paragraph 2.1.4 is replaced by the following:

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

2.7 Survival requirements

2.7.2 At final equilibrium after flooding

6 Paragraph 2.7.2.1 is replaced by the following:

".1 the righting lever curve shall have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range shall not be less than 0.0175 m-radians. The 20° range may be measured from any angle commencing between the position of equilibrium and the angle of 25° (or 30° if no deck immersion occurs). Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.7.1.1 and other openings capable of being closed weathertight may be permitted, except for those ventilators (in compliance with regulation 19(4) of the International Convention on Load Lines, 1966/88) which have to remain open to supply air to the engine-room or emergency generator room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship; and"

CHAPTER 3
SHIP ARRANGEMENTS

3.2 Accommodation, service and machinery spaces and control stations

7 Paragraph 3.2.6 is renumbered as 3.2.6.1 and the following new paragraphs are added after renumbered paragraph 3.2.6.1:

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

3.2.6.3 The closing devices shall be gastight. For ships constructed on or after [1 July 2028], ordinary steel fire-flaps without gaskets/seals shall not be considered to be satisfactory.

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

3.3 Cargo machinery spaces and turret compartments

8 Paragraph 3.3.1 is replaced by the following:

"3.3.1 Cargo machinery spaces shall be situated above the weather deck and located within the cargo area. Cargo machinery spaces and turret compartments shall be treated as cargo pump-rooms for the purpose of fire protection according to SOLAS regulation II-2/9.2.4."

3.5 Access to spaces in the cargo area

9 Paragraph 3.5.3.1.2 is replaced by the following:

".2 access through horizontal openings, hatches or manholes. The dimensions shall be sufficient to allow a person wearing a breathing apparatus to ascend or descend any ladder without obstruction, and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening shall be not less than 600 mm x 600 mm. For ships constructed on or after [1 July 2028], the minimum clear opening of 600 mm x 600 mm may have corner radii up to 100 mm. In a case where the stress needs to be reduced around the opening as a consequence of structural analysis of a given design, appropriate measures shall be taken to reduce the stress such as making the opening larger with increased radii, e.g. 600 x 800 with 300 mm radii, in which a clear opening of 600 mm x 600 mm with corner radii up to 100 mm maximum fits;"

10 Paragraph 3.5.3.1.3 is replaced by the following, and subsequent figures in this chapter are renumbered accordingly:

".3 access through vertical openings or manholes providing passage through the length and breadth of the space. The minimum clear opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom plating unless gratings or other footholds are provided. For ships constructed on or after [1 July 2028], the minimum clear opening of not less than 600 mm x 800 mm may

also include an opening with corner radii of 300 mm (see figure 3.1). An opening of 600 mm in height x 800 mm in width may be accepted as access openings in vertical structures where it is not desirable to make a large opening in the structural strength aspects, i.e. girders and floors in double bottom tanks.

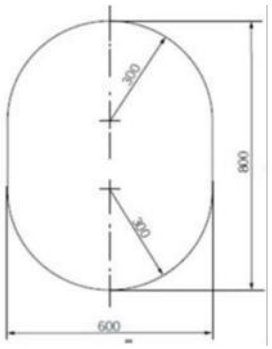

Figure 3.1

Subject to verification of easy evacuation of an injured person on a stretcher the vertical opening 850 mm x 620 mm with wider upper half than 600 mm, while the lower half may be less than 600 mm with the overall height not less than 850 mm is considered an acceptable alternative to the traditional opening of 600 mm x 800 mm with corner radii of 300 mm (see figure 3.2).

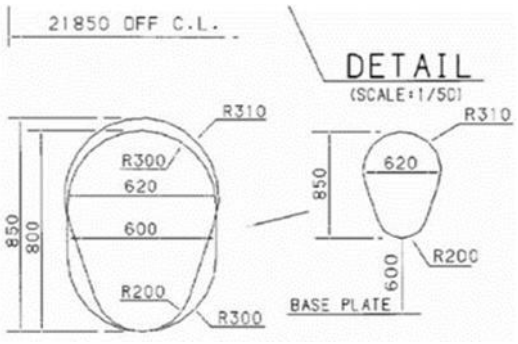

Figure 3.2

If a vertical opening is at a height of more than 600 mm, steps and handgrips shall be provided. In such arrangements it shall be demonstrated that an injured person can be easily evacuated; and"

3.7 Bilge, ballast and oil fuel arrangements

11 Paragraph 3.7.5 is replaced by the following:

"3.7.5 Ballast spaces, including wet duct keels used as ballast piping, oil fuel tanks and non-hazardous spaces, may be connected to pumps in the machinery spaces. Dry duct keels with ballast piping passing through may be connected to pumps in the machinery spaces, provided the connections are led directly to the pumps, and the discharge from the pumps is led directly overboard with no valves or manifolds in either line that could connect the line from the duct keel to lines serving non-hazardous spaces. For pumps in the machinery spaces serving dry duct keels through which ballast piping passes, pump vents shall not be open to machinery spaces."

CHAPTER 4
CARGO CONTAINMENT

4.19 Materials

4.19.1 Materials forming ship structure

12 Paragraph 4.19.1.6.2 is replaced by the following:

".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 paragraph 4.19.1.6.1 shall be supplied from the emergency source of electrical power; and"

13 The following new paragraph is added after existing paragraph 4.19.1.6:

"4.19.1.7 For ships constructed on or after [1 July 2028], the heating system referred to in paragraph 4.19.1.6.1 shall also comply with the following requirements:

.1 In case of a single failure of a mechanical or electrical component in any part of the system, heating can be maintained at not less than 100% of the theoretical heat requirement.

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

.3 Where duplication of the primary source of heat, e.g. an oil-fired boiler, is not feasible, alternative means may be accepted such as an electric heater capable of providing 100% of the theoretical heat requirement provided and supplied by an individual circuit arranged separately on the emergency switchboard. Other means may be accepted as satisfying the requirements of paragraph 4.19.1.6.1, provided a suitable risk assessment is conducted to the satisfaction of the Administration. In such cases, essential electrical components of at least one of the systems shall be supplied from the emergency source of electrical power."

4.20 Construction processes

4.20.1 Weld joint design

14 The following new paragraph is added after existing paragraph 4.20.1.1:

"4.20.1.1.1 For ships constructed on or after [1 July 2028], all welded joints of the shells of type A independent tanks and type B independent tanks, primarily constructed of plane surfaces, shall be of the in-plane butt weld full penetration type. Welded corners (i.e. corners made of weld metal) shall not be used in the main tank shell construction, i.e. corners between shell side (sloped plane surfaces parallel to hopper or top side inclusive if any) and bottom or top of the tank, and between tank end transverse bulkheads and bottom, top or shell sides (sloped plane surfaces inclusive if any) of the tank. Instead, tank corners which are constructed using bent plating aligned with the tank surfaces and connected with in-plane welds shall be

used. For localized constructions of the shell, such as suction well, sump, dome, and their connections to shell, however, tee welds of the full penetration type may be used depending on the results of the tests carried out at the approval of the welding procedure. Except for small penetrations on domes, nozzle welds shall also be designed with full penetration."

15 Paragraph 4.20.1.2 is replaced by the following, and subsequent figures in this chapter are renumbered accordingly:

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

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

.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 or recognized organization acting on its behalf. 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; and

.3 for welding joint details of type C independent tanks installed for ships constructed on or after 1 July 2028, cruciform full penetration welded joints in a bi-lobe tank with centreline bulkhead may be accepted for the tank structure construction at tank centreline welds with bevel preparation subject to the approval of the Administration or recognized organization acting on its behalf, depending on the results of the tests carried out at the approval of the welding procedure (see figure 4.1).

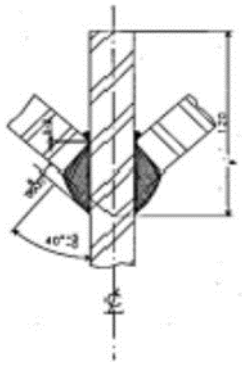

Figure 4.1"

4.23 Type C independent tanks

4.23.1 Design basis

16 Paragraph 4.23.1.1 is replaced by the following:

"4.23.1.1 The design basis for type C independent tanks is based on pressure vessel criteria modified to include fracture mechanics and crack propagation criteria. The minimum design vapour pressure defined in 4.23.1.2 is intended to ensure that the dynamic stress range shall be sufficiently small so that an initial surface flaw will not have significant propagation."

4.23.3 Ultimate design condition

17 The following new paragraph 4.23.3.3 is added after existing paragraph 4.23.3.2:

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

4.23.4 Fatigue design condition

18 Paragraph 4.23.4 is replaced by the following:

"**4.23.4 Fatigue design condition**

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

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

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

4.28 Guidance notes for chapter 4

19 The following new paragraphs 4.28.4 and 4.28.5 are added after existing paragraph 4.28.3 (Stress categories):

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

4.28.4.1 General

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

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

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

.2 Tanks of novel design or configuration.

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

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

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

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

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

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

4.28.4.2 Allowable stresses for finite element analysis

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

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

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

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

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

where:

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

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

Note:

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

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

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

4.28.5 Buckling assessment of type C cargo tanks for ships constructed on or after [1 July 2028]

4.28.5.1 General

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

4.28.5.1.2 The lateral buckling of stiffening ring should be considered additionally in accordance with international standards (e.g. PD 5500) or equivalent regulations.

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

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

4.28.5.2 Scantling of shells and stiffening rings under external pressure

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

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

where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

t = net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance

E = Young's modulus, in N/mm^2

v = Poisson's ratio

n = number of circumferential buckling waves. It is to be taken as the integral value to minimize the critical pressure P_c with $n \geq Max\left(2, \frac{\pi D}{2L}\right)$.

L = effective distance between stiffening rings, in mm

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

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

where:

R = outside radius of the sphere shell, in mm, based on gross scantling

E = Young's modulus, in N/mm^2

t = net thickness of the spherical shell, in mm, exclusive of corrosion allowance

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

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

$$I = \frac{0.18 \cdot D^3 \cdot L \cdot P_e}{E}$$

where:

D = outside diameter of the cylindrical shell, in mm, based on gross scantling

E = Young's modulus, in N/mm^2

L = effective distance between stiffening rings, in mm

P_e = external design pressure, in MPa

The width of shell, in mm, contributing to the moment of inertia should not be greater than $0.75\sqrt{Dt}$, where t=net thickness of the cylindrical shell, in mm, exclusive of corrosion allowance.

4.28.5.2.4 Cylindrical and spherical shells should satisfy the following criteria:

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

$\frac{P_c}{P_e} \geq 15$ for spherical shell

where:

P_c = critical buckling pressure, in MPa

P_e = external design pressure, in MPa."

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

5.2 System requirements

5.2.2 Arrangements: general

20 Paragraph 5.2.2.1 and sub-paragraph .1 are replaced by the following:

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

.1 be segregated from other piping systems, except where interconnections are required for cargo-related operations such as purging, gas freeing or inerting. The requirements of 9.4.4 and 16.4.1.5 shall be taken into account with regard to preventing back-flow of cargo. In such cases, precautions shall be taken to ensure that cargo or cargo vapour cannot enter other piping systems through the interconnections;"

21 The following new sub-paragraph 5.2.2.1.2 is inserted after sub-paragraph 5.2.2.1.1 and subsequent sub-paragraphs are renumbered accordingly.

".2 notwithstanding .1 above, ships operating in fixed locations, in a re-gasification and gas discharge mode or a gas receiving, processing, liquefaction and storage mode are not considered as vessels "at sea" with regard to sub-paragraph .6 of this paragraph. Cargo piping only operated in fixed locations (example: re-gasification systems and its piping) and kept depressurized inerted and isolated at sea, other than athwartship shore connection piping or emergency cargo jettisoning piping systems, may also be located outboard of the transverse tank location requirements of 2.4.1, but not closer than a minimum distance of 0.8 metre from the ship outer shell;"

5.4 Design pressure

22 Paragraph 5.4.4 is replaced by the following:

"5.4.4 The design pressure of the outer pipe or duct of gas fuel systems shall not be less than the maximum built-up pressure arising in the annular space considering the local instantaneous peak pressure in way of any rupture and a suitable pressure relief system shall be considered in the design:

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

.2 for ships constructed on or after [1 July 2028], for gas fuel systems with inner pipe having a working pressure greater than 1 MPa, the maximum built-up pressure arising in the annular space, after the inner pipe rupture, shall be calculated in accordance with paragraph 5.11.4.2."

5.5 Cargo system valve requirements

23 The following new paragraph 5.5.1.3 is added after existing paragraph 5.5.1.2:

"5.5.1.3 For ships constructed on or after [1 July 2028], in addition, remotely operated valves shall be fitted, as appropriate, as part of the emergency shutdown (ESD) system (see paragraph 18.10)."

5.5.2 Cargo tank connections

24 Paragraph 5.5.2.1 is replaced by the following:

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

25 The following new paragraph is added after existing paragraph 5.5.2.2:

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

5.5.3 Cargo manifold connections

26 Paragraph 5.5.3 is replaced by the following:

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

5.5.3.2 If the cargo tank MARVS exceeds 0.07 MPa, an additional manual valve shall be provided for each transfer connection, and may be inboard or outboard of the ESD valve to suit the ship's design.

5.5.3.3 For ships constructed on or after [1 July 2028], in addition to the ESD valve, a manual valve shall be provided for each liquid connection. A manual valve shall also be provided for vapour connections where cargo tank MARVS exceeds 0.07 MPa. The manual valves may be located inboard or outboard of the ESD valve to suit the ship's design."

5.6 Cargo transfer arrangements

5.6.5 Cargo sampling connections

27 Paragraph 5.6.5.1 is replaced by the following:

"5.6.5.1 Connections to cargo piping systems for taking cargo liquid samples, if fitted on board, shall be clearly marked and shall be designed to minimize the release of cargo vapours. For vessels permitted to carry toxic products, the sampling system, if

fitted on board, shall be of a closed loop design to ensure that cargo liquid and vapour are not vented to atmosphere. Connections used for control of atmosphere in cargo tanks during inerting or gassing up are not considered as cargo sampling connections."

5.6.6 Cargo filters

28 Paragraph 5.6.6 is replaced by the following:

"**5.6.6 Cargo filters**

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

5.6.6.2 Means to indicate that filters are becoming blocked and filter maintenance is required shall be provided for fixed in-line filter arrangement and portable filter installations where dedicated filter housing piping is provided. Where portable filters for fitting to manifold presentation flanges are used without dedicated filter housing, and these can be visually inspected after each loading and discharging operation, no additional arrangements for indicating blockage or facilitating drainage are required."

5.11 Piping system component requirements

29 Paragraph 5.11.2.2 is replaced by the following:

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

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

where:

t_0 = theoretical thickness, determined by the following formula

$$t_0 = \frac{P \cdot D}{2 \cdot K \cdot e + P}\ (mm)$$

with:

P = design pressure (MPa) referred to in 5.4;

D = outside diameter (mm);

K = allowable stress (N/mm²) referred to in 5.11.3; and

e = efficiency factor equal to 1.0 for seamless pipes and for longitudinally or spirally welded pipes, delivered by approved manufacturers of welded pipes, that are considered equivalent to seamless pipes when non-destructive testing on welds is carried out in accordance with

recognized standards. In other cases, an efficiency factor of less than 1.0, in accordance with recognized standards, may be required depending on the manufacturing process;

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

$$b = \frac{D \cdot t_0}{2.5 \cdot r}$$

with:

r = mean radius of the bend (mm);

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

a = negative manufacturing tolerance for thickness (%), i.e. where a is the manufacturing tolerance of –5%, |a| is equal to 5 and shall be entered into the formula as 1– (5/100)."

5.11.4 High-pressure gas fuel outer pipes or ducting scantlings

30 Paragraph 5.11.4 is replaced by the following:

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

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

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

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

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

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

where:

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

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

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

5.11.6 Flanges, valves and fittings

31 Paragraph 5.11.6.1 is replaced by the following:

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

5.12 Materials

32 Paragraph 5.12.4 is replaced by the following:

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

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

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

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

5.12.3 Cargo piping insulation system

33 Section 5.12.3, and paragraphs 5.12.3.1 and 5.12.3.2 therein are replaced by the following:

"**5.12.4 Cargo piping insulation system**

5.12.4.1 Cargo piping systems shall be provided with a thermal insulation system as necessary to minimize heat leak into the cargo during transfer operations and to protect personnel from direct contact with cold surfaces. For ships constructed on or after [1 July 2028], the requirements in sub-paragraphs .1 and .2 below shall be complied with to address cold or hot surfaces:

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

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

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

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

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

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

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

5.13 Testing requirements

5.13.1 Type testing of piping components

34 Paragraph 5.13.1.1 is replaced by the following:

"5.13.1.1 *Valves**

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

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

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

.1 for pressure relief valves (PRVs) that are subject to paragraph 8.2.6, the flow or capacity shall be certified by the Administration or recognized organization acting on its behalf; and

.2 for other types of valves, the manufacturer shall certify the flow properties of the valves based on tests carried out according to recognized standards;

.3 pressurized components shall be pressure tested to at least 1.5 times the rated pressure; and

.4 for emergency shutdown valves, with materials contributing to shell or seat tightness of the valve having melting temperatures lower than 925°C, the type testing shall include a fire test to a standard acceptable to the Administration.

* Refer to SIGTTO Publication on "*The Selection and Testing of Valves for LNG Applications*"."

5.13.2 System testing requirements

35 Paragraph 5.13.2.1 is replaced by the following:

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

36 Paragraph 5.13.2.4 is replaced by the following:

"15.13.2.4 In double-wall gas-fuel piping systems, the outer pipe or duct shall also be pressure tested to show that it can withstand the expected maximum pressure at gas pipe rupture. The maximum pressure at gas pipe rupture is the maximum pressure to which the outer pipe or duct is subjected after the inner pipe rupture and for testing purposes it is the same as the design pressure used in paragraph 5.4.4."

CHAPTER 8
VENT SYSTEMS FOR CARGO CONTAINMENT

8.1 General

37 Section 8.1 is replaced by the following:

"**8.1 General**

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

8.1.2 For ships constructed on or after [1 July 2028], inter-barrier spaces which may be subject to pressures beyond their design capabilities, shall also be provided with a suitable pressure relief system, as defined below:

.1 The formula for determining the relieving capacity given in 8.2.5 is for inter-barrier spaces surrounding independent type A cargo tanks, where the thermal insulation is fitted to the cargo tanks.

.2 The relieving capacity of pressure relief devices of inter-barrier spaces surrounding independent type B cargo tanks may be determined on the basis of the method given in 8.2.5. However, the leakage rate shall be determined in accordance with paragraph 4.7.2.

.3 The relieving capacity of pressure relief devices for inter-barrier spaces of membrane and semi-membrane tanks shall be evaluated on the basis of specific membrane/semi-membrane tank design.

.4 The relieving capacity of pressure relief devices for inter-barrier spaces adjacent to integral type cargo tanks may, if applicable, be determined as for type A independent cargo tanks."

8.2 Pressure relief systems

38 The following new paragraph is inserted after existing paragraph 8.2.4 and subsequent paragraphs, figures and cross references to those figures in this chapter are renumbered accordingly:

"8.2.5 For ships constructed on or after [1 July 2028], the combined relieving capacity of the pressure relief devices for inter-barrier spaces surrounding type A independent cargo tanks where the insulation is fitted to the cargo tanks may be determined by the following formula:

$$Q_{sa} = 3.4 \cdot A_c \cdot \frac{\rho}{\rho_v} \cdot \sqrt{h}$$

where:

Q_{sa} = minimum required discharge rate of air (m^3/s) at standard conditions of 273 K and 1.013 bar

A_c = design crack opening area (m^2)

$$A_c = \pi/4 \cdot \delta \cdot l$$

δ = max, crack opening width (m)

δ = 0.2 t (m)

t = thickness of tank bottom plating (m)

l = design crack length (m) equal to the diagonal of the largest plate panel of the tank bottom, see figure 8.1.

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

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

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

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

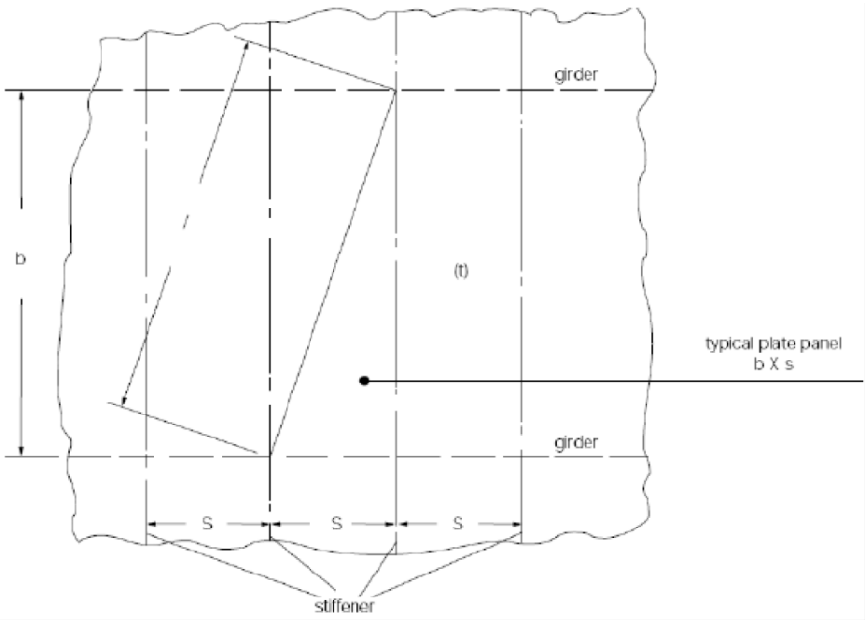

Figure 8.1"

39 Renumbered paragraph 8.2.10 is replaced by the following:

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

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

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

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

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

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

40 Renumbered paragraph 8.2.19 is replaced by the following:

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

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

.2 the PRV; and

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

This paragraph need not apply when the reference temperature is defined in accordance with 15.1.3.1.

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

8.4 Sizing of pressure relieving system

8.4.1 Sizing of pressure relief valves

41 The following new paragraph is added after existing paragraph 8.4.1.3:

"8.4.1.4 For ships constructed on or after [1 July 2028], for prismatic tanks, vapours generated under fire exposure shall be computed using the formula given in paragraph 8.4.1.2 and the following formula variables:

.1 For non-tapered tanks, L_{min} is the smaller of the horizontal dimensions of the flat bottom of the tank. For tapered tanks, as would be used for the forward tank, L_{min} is the smaller of the length and the average width.

.2 For prismatic tanks whose distance between the flat bottom of the tank and bottom of the hold space is equal to or less than $L_{min}/10$:

A = external surface area minus flat bottom surface area.

.3 For prismatic tanks whose distance between the flat bottom of the tank and bottom of the hold space is greater than $L_{min}/10$:

A = external surface area. "

42 Paragraphs 8.4.2 and 8.4.3 are replaced by the following:

"**8.4.2 Sizing of vent system**

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

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

8.4.3 Upstream pressure losses

8.4.3.1 The pressure losses in the vent line from the tank to the PRV inlet shall not exceed 3% of the valve set pressure at the calculated flow rate, in accordance with 8.4.1. For ships constructed on or after [1 July 2028], the compliance shall be documented by flow calculations.

8.4.3.2 Pilot-operated PRVs shall be unaffected by inlet pipe pressure losses when the pilot senses directly from the tank dome. For ships constructed on or after [1 July 2028], pilot-operated PRV sensing lines shall be sized to avoid pressure losses which affect the function of the PRV. The sensing line shall be self-draining and free from liquid pockets."

43 Paragraph 8.4.5 is replaced by the following:

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

CHAPTER 9
CARGO CONTAINMENT SYSTEM ATMOSPHERE CONTROL

9.4 Inerting

44 Paragraph 9.4.6 is replaced by the following:

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

45 The following new paragraph 9.4.7 is added after existing paragraph 9.4.6:

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

CHAPTER 10
ELECTRICAL INSTALLATIONS

10.2 General requirements

46 Paragraph 10.2.6 is replaced by the following:

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

* IEC 60812, Edition 2.0 2006-01 "Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)"'

47 Paragraph 10.2.8 is replaced by the following:

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

CHAPTER 11
FIRE PROTECTION AND EXTINCTION

11.1 Fire safety requirements

48 Paragraph 11.1.4 is replaced by the following:

"11.1.4 For the purposes of fire-fighting, any weather deck areas above cofferdams, ballast or void spaces at the after end of the aftermost hold space or at the forward end of the forwardmost hold space shall be included in the cargo area. For ships constructed on or after [1 July 2028], where F.O. tanks are installed at the after end of the aftermost hold space or at the forward end of the forwardmost hold space instead of cofferdams as allowed for in paragraphs 3.1.2 and 3.1.3, the weather deck area above these tanks shall be regarded as a cargo area for the purpose of applying paragraph 11.3.6."

11.2 Fire mains and hydrants

49 The following new paragraphs are added after existing paragraph 11.2.5:

"11.2.6 For ships constructed on or after [1 July 2028], the maximum capacity of emergency fire pump shall be calculated in accordance with this paragraph.

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

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

.2 two fire hydrants (as required in paragraph 11.2).

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

11.2.6.3 On the basis of the principle of dealing with a single fire incident at a time, the emergency fire pump does not need to be sized to cover all systems in paragraph 11.2.6.1 and paragraph 11.2.6.2 above at the same time and shall need only be sized to cover the most demanding area and required systems, as follows:

.1 the fixed high-expansion foam fire-extinguishing system or the fixed pressure water-spraying fire-extinguishing system (as required in paragraph 11.2.6.2) and two hydrants (as required in paragraph 11.2.6.1.2); or

.2 the water spray system and two hydrants (as required in paragraph 11.2.6.1),

whichever is greater."

11.3 Water-spray system

50 The following new sub-paragraph is added after existing sub-paragraph 11.3.1.7, the word "and" at the end of existing paragraph 11.3.1.7 is deleted, and existing sub-paragraph 11.3.1.8 is renumbered as 11.3.1.9:

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

51 Paragraph 11.3.2.2 is replaced by the following:

"11.3.2.2 On vertical surfaces and for structures not having clearly defined horizontal or vertical surfaces, spacing of nozzles protecting lower areas may take account of anticipated rundown from higher areas. Stop valves shall be fitted in the main supply line(s) in the water-spray system, at intervals not exceeding 40 m, for the purpose of isolating damaged sections. Alternatively, the system may be divided into two or more sections that may be operated independently, provided the necessary controls are located together in a readily accessible position outside the cargo area. A section protecting any area included in 11.3.1.1 and 11.3.1.2 shall cover at least the entire athwartship tank grouping in that area. Any gas process unit(s) included in 11.3.1.3 may be served by an independent section."

52 Paragraph 11.3.3 is replaced by the following:

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

.1 any two complete tank groupings, where one group is defined as tanks located in transverse direction from ship side to ship side,

representing an area equal to the combined area of the largest tank groupings, including any gas process units within these areas. Where there is only one cargo tank occupying a hold space from ship side to ship side, it will be considered as a grouping for the purpose of the above requirement; or

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

in addition to the surfaces specified in 11.3.1.4 to 11.3.1.9. Alternatively, the main fire pumps may be used for this service, provided that their total capacity is increased by the amount needed for the water-spray system. In either case, a connection, through a stop valve, shall be made between the fire main and water-spray system main supply line outside the cargo area."

53 Paragraph 11.3.4 is replaced by the following:

"11.3.4 The boundaries of normally manned superstructures and deckhouses, and lifeboats, liferafts and muster areas facing the cargo area, shall also be capable of being served by one of the fire pumps (required in accordance with SOLAS regulation II-2/10.2.2.2.2) or the emergency fire pump, if a fire in one compartment could disable both fire pumps (required in accordance with SOLAS regulation II-2/10.2.2.2.2).

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

11.3.4.2 For ships constructed on or after [1 July 2028], fire pumps and emergency fire pumps required by SOLAS regulation II-2/10.2.2 and used to comply with 11.3.4 shall be installed outside the space where water-spray pump(s) are located.

11.3.4.3 For ships constructed on or after [1 July 2028], the compartment in paragraph 11.3.4 is a compartment provided with A class boundaries in which the fire pump(s), or the source of power of the fire pump(s), serving the water-spray system in accordance with paragraph 11.3.3, are located."

54 Paragraph 11.3.6 is replaced by the following:

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

55 The following new paragraph 11.3.8 is added after existing paragraph 11.3.7 and existing paragraph 11.3.8 is renumbered as paragraph 11.3.9:

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

11.4 Dry chemical powder fire-extinguishing systems

56 The following new paragraph 11.4.8.1 is added after existing paragraph 11.4.8:

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

CHAPTER 12
ARTIFICIAL VENTILATION IN THE CARGO AREA

12.1 Spaces required to be entered during normal cargo handling operations

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

"12.1.1.1 For ships constructed on or after [1 July 2028], electric motor rooms located outside the cargo area defined by 1.2.7 shall comply with requirements for separation of non-hazardous areas and hazardous areas, including 12.1.10, and be designed in accordance with specifications not inferior to standards acceptable to the Organization.*

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

58 Paragraph 12.1.8 is replaced by the following:

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

12.2 Spaces not normally entered

59 Paragraph 12.2.2 is replaced by the following:

"12.2.2 For permanent installations, the capacity of 8 air changes per hour shall be provided and for portable systems, the capacity of 16 air changes per hour shall be provided. Accessed hold spaces and cofferdams shall be provided with ventilation not

less than the capacity of 2 air changes per hour, subject to meeting the requirements of 18.8."

CHAPTER 13
INSTRUMENTATION AND AUTOMATION SYSTEMS

13.2 Level indicators for cargo tanks

60 Paragraph 13.2.2 is replaced by the following:

"13.2.2 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. Any part of this level gauge, other than components not subject to failure under normal service, shall be capable of being repaired with the tank in service."

13.3 Overflow control

61 Paragraph 13.3.1 is replaced by the following:

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

62 Paragraph 13.3.2 is replaced by the following:

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

63 The following new paragraph 13.3.3 is inserted after existing paragraph 13.3.2 and subsequent paragraphs are renumbered accordingly:

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

64 Renumbered paragraph 13.3.4 is replaced by the following:

"13.3.4 An emergency shutdown valve referred to in 5.5.2 and 18.10 may be used for this purpose. If another valve is used for this purpose, the same information as referred to in 18.10.2.1.3 shall be available on board. During loading, whenever the use of these valves may possibly create a potential excess pressure surge in the loading system, alternative arrangements such as limiting the loading rate shall be used."

65 Existing paragraphs 13.3.4 and 13.3.5 are replaced by the following:

"13.3.9 For ships constructed before [1 July 2028], a high liquid level alarm and automatic shut-off of cargo tank filling need not be required, when the cargo tank:

.1 is a pressure tank with a volume of not more than 200 m^3; or

.2 is designed to withstand the maximum possible pressure during the loading operation, and such pressure is below that of the set pressure of the cargo tank relief valve.

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

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

.2 after each renewal survey required in 1.4.2.2.

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

66 The following new paragraph 13.3.8 is added after existing paragraph 13.3.7:

"13.3.8 The override system permitted by 13.3.7 may be used at sea to prevent false alarms or shutdowns. When level alarms are overridden, operation of cargo pumps and the opening of manifold ESD valves shall be inhibited except when high-level alarm testing is carried out in accordance with 13.3.5 (see 18.10.3.6)."

13.6 Gas detection

67 The following new paragraph is added after existing paragraph 13.6.4:

"13.6.4.1 For ships constructed on or after [1 July 2028], two oxygen sensors shall be positioned at appropriate locations in the space or spaces containing the inert gas system, in accordance with paragraph 2.2.4.5.4 in chapter 15 of the FSS Code, irrespective of the carriage of cargo indicated by an "A" in column "f" in the table in chapter 19 of the Code."

68 Paragraph 13.6.17 is replaced by the following:

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

13.9 System integration

69 Paragraph 13.9.3 is replaced by the following:

"13.9.3 Key hazards of the integrated system based on combination and of computer-based technologies and interconnection of computer systems used for control, monitoring/alarm and safety systems for carriage, handling and conditioning of cargo liquid and vapours shall be identified using appropriate risk-based techniques. For ships constructed on or after [1 July 2028], such integrated systems shall ensure reliable communication between computer-based system components* and allow centralized access to monitoring/alarm and safety information and/or command/control.

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

CHAPTER 15
FILLING LIMITS FOR CARGO TANKS

15.1 Definitions

70 Paragraph 15.1.3.1 is replaced by the following:

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

15.2 General requirements

71 Section 15.2 is replaced by the following:

"**15.2 General requirements**

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

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

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

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

15.3 Default filling limit

72 Section 15.3 (Default filling limit) is deleted.

15.4 Determination of increased filling limit

73 Section 15.4 is renumbered as section 15.3 and replaced by the following:

"**15.3 Determination of increased filling limit**

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

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

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

.2 allowances shall be provided for:

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

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

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

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

15.5 Maximum loading limit

74 Section 15.5 is renumbered as section 15.4 and replaced by the following:

"**15.4 Maximum loading limit**

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

$$LL = FL \cdot \frac{\rho_R}{\rho_L}$$

where:

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

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

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

ρ_L = relative density of cargo at the loading temperature.

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

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

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

15.6 Information to be provided to the master

75 Section 15.6 and paragraphs therein are renumbered as section 15.5, and paragraphs 15.5.1, 15.5.2 and 15.5.3.

CHAPTER 16
USE OF CARGO AS FUEL

16.1 General

76 Section 16.1 is replaced by the following:

"**16.1 General**

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

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

16.2 Use of cargo vapour as fuel

77 The title of section 16.2 is replaced by the following:

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

78 Paragraph 16.2.1 is replaced by the following:

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

79 The following new paragraphs 16.2.3. 16.2.4 and 16.2.5 are added after existing paragraph 16.2.2:

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

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

16.2.5 A risk assessment using acceptable and recognized risk analysis techniques shall be conducted for LPG or ethane fuel supply arrangements including associated

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

16.3 Arrangement of spaces containing gas consumers

80 The title of existing section 16.3 is replaced by the following:

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

81 Paragraph 16.3.4 is replaced by the following:

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

82 The following new paragraphs 16.3.5 and 16.3.6 are added after existing paragraph 16.3.4:

"16.3.5 For spaces outside the cargo area containing LPG or ethane fuel systems, special consideration shall be given to the density and lower flammability limit (LFL) of LPG or ethane vapour. For ships constructed on or after [1 July 2028], ventilation capacity, including ventilation inlet and outlet location, shall be supported by numerical calculations. The numerical calculations shall be performed in accordance with a recognized standard. These may include computational fluid dynamics (CFD), gas dispersion analysis or another method approved by the Administration. Notwithstanding, for enclosed spaces within the cargo area, on the open deck and containing LPG or ethane fuel conditioning equipment, the requirements of paragraph 12.1.3 shall apply.

16.3.6 For spaces outside the cargo area containing LPG or ethane fuel systems, in addition to the requirements of paragraph 13.6.12, gas detection heads shall be fitted in spaces where LPG or ethane vapour may accumulate particularly where air circulation is reduced or near the bottom of the space. For ships constructed on or after [1 July 2028], the suitability of their location shall be supported by numerical calculations. The numerical calculations shall be performed in accordance with a recognized standard. These may include computational fluid dynamics (CFD), gas dispersion analysis, a physical smoke test or another method approved by the Administration. The numerical calculations shall include the possible range of composition of the intended fuel."

16.4 Gas fuel supply

16.4.1 General

83 The following new paragraphs 16.4.1.2 and 16.4.1.3 are inserted after existing paragraph 16.4.1.1 and existing paragraph 16.4.1.2 is renumbered as 16.4.1.4:

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

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

84 The following new paragraphs are added after renumbered paragraph 16.4.1.4:

"16.4.1.5 For permanent installations for ships constructed on or after [1 July 2028], the inert gas piping connected to the fuel piping shall be fitted with double-block-and-bleed valves. In addition, a non-return valve shall be installed between the double-block-and-bleed arrangement and the fuel piping. For LPG liquid fuel supply systems, the piping shall have a means of being drained without release of liquid to the atmosphere. LPG liquid trapped in double-block-and-bleed valves or the inert gas system piping shall have a means of being drained without release of liquid to the atmosphere.

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

16.4.1.6.1 Main functions as described in the subsequent paragraphs as well as in other parts with reference to table 18.1 as guidance.

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

16.4.3 Routeing of fuel supply pipes

85 Section 16.4.3 is replaced by the following:

"**16.4.3 Routeing of fuel supply pipes**

16.4.3.1 Fuel piping may pass through or extend into enclosed spaces other than those mentioned in 16.4.1, provided it fulfils one of the following conditions:

.1 it is of a double-wall design with the space between the concentric pipes pressurized with inert gas at a pressure greater than the gas

fuel pressure. The master gas fuel valve, as required by 16.4.6, closes automatically upon loss of inert gas pressure; or

.2 it is installed in a pipe or duct equipped with mechanical exhaust ventilation having a capacity of at least 30 air changes per hour and is arranged to maintain a pressure less than the atmospheric pressure. The mechanical ventilation is in accordance with chapter 12, as applicable. The ventilation is always in operation when there is fuel in the piping and the master gas fuel valve, as required by 16.4.6, closes automatically if the required air flow is not established and maintained by the exhaust ventilation system. The inlet or the duct may be from a non-hazardous machinery space, and the ventilation outlet is in a safe location.

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

16.4.5 Gas consumer isolation

86 Paragraph 16.4.5 is replaced by the following:

"**16.4.5 Gas consumer isolation**

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

16.5 Gas fuel plant and related storage tanks

16.5.2 Remote stops

87 Paragraph 16.5.2.2 is replaced by the following:

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

16.7 Special requirements for gas-fired internal combustion engines

16.7.1 Arrangements

88 Paragraph 16.7.1.4 is replaced by the following:

"16.7.1.4 Unless designed with the strength to withstand the worst-case overpressure due to ignited gas leaks, air inlet manifolds, scavenge spaces, exhaust system and crank cases shall be fitted with suitable pressure relief systems. Pressure relief systems shall lead to a safe location, away from personnel. For ships constructed on or after [1 July 2028]:

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

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

16.7.3 Safety

89 The following new paragraphs 16.7.3.3.1 to 16.7.3.3.3 are added after existing paragraph 16.7.3.3:

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

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

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

16.8 Special requirements for gas turbines

16.8.1 Arrangements

90 The following new paragraph 16.8.1.2 is inserted after existing paragraph 16.8.1.1 and subsequent paragraphs are renumbered accordingly:

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

16.9 Alternative fuels and technologies

91 Paragraph 16.9.1 is replaced by the following:

"16.9.1 If acceptable to the Administration, cargo gases not covered by 16.1.1 may be used as fuel, provided that the same level of safety as natural gas in this Code is ensured."

92 Paragraphs 16.9.3 to 16.9.5 are replaced by the following:

"16.9.3 For cargoes not covered by 16.1.1, the fuel supply system and gas consumers shall comply with the requirements of 16.2 to 16.8, as applicable, and shall include means for preventing condensation of vapour in the fuel supply system.

16.9.4 In addition to the requirements of 16.4.3.1.2, both ventilation inlet and outlet shall be located outside the machinery space. The inlet shall be in a non-hazardous area and the outlet shall be in a safe location."

CHAPTER 17
SPECIAL REQUIREMENTS

17.4 Refrigeration systems

93 The following new explanatory sentence is inserted under the title of section 17.4 (Refrigeration systems) before existing paragraph 17.4.1:

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

17.21 Carbon dioxide: high purity

94 The title of section 17.21 is replaced by the following:

"**17.21 Carbon dioxide**"

95 Paragraph 17.21.1 is replaced by the following:

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

96 Paragraph 17.21.4 is replaced by the following:

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

97 Paragraph 17.21.6 is replaced by the following:

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

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

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

17.21.8 Other requirements

17.21.8.1 The requirements for flammable products may be waived.

17.21.8.2 Carbon dioxide is considered a toxic product for the purpose of the Code. The requirements applicable to carbon dioxide as a toxic product in the Code are limited to those indicated in the following paragraphs and as shown in the table in chapter 19 for carbon dioxide.

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

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

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

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

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

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

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

99 Section 17.22 (Carbon dioxide: reclaimed quality) is deleted.

CHAPTER 18
OPERATING REQUIREMENTS

18.9 Cargo sampling

100 The following new paragraph is added after existing paragraph 18.9.5:

"18.9.6 The requirements in paragraphs 18.9.1 to 18.9.5 are only applicable if such a sampling system is fitted on board. Connections used for control of atmosphere in cargo tanks during inerting or gassing up are not considered as cargo sampling connections."

18.10 Cargo emergency shutdown (ESD) system

18.10.1 General

101 Paragraph 18.10.1.1 is replaced by the following:

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

102 Paragraph 18.10.1.3 is replaced by the following:

"18.10.1.3 The ESD system shall be activated by the manual and automatic initiations listed in table 18.1, which is a summary of ESD shutdown related system functions taking into account those required by the relevant sections of the Code, including chapter 16, and may not describe all requirements. The actual enforceable requirements are found in the Code. Any additional initiations shall only be included in the ESD system if it can be shown that their inclusion does not reduce the integrity and reliability of the system overall. A failure of any part of the system shall activate an ESD. Failure of the system includes loss of power for ESD valves and main electric power failure."

18.10.2 ESD valve requirements

103 Paragraph 18.10.2.1.3 is replaced by the following:

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

104 Paragraphs 18.10.2.1.4, 18.10.2.2 (Ship-shore and ship-ship manifold connections) and 18.10.2.3 (Cargo system valves) are deleted.

18.10.3 ESD system controls

105 The following new paragraphs 18.10.3.1 and 18.10.3.2 are inserted after the heading "18.10.3 ESD system controls", and subsequent paragraphs are renumbered accordingly:

"18.10.3.1 The ESD system shall be designed to be activated by the manual and automatic initiations as specified in the Code. Any additional initiations shall only be included in the ESD system if it can be shown that their inclusion does not reduce the integrity and reliability of the system overall.

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

106 Renumbered paragraph 18.10.3.5 is replaced by the following:

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

107 The title of section 18.10.4 (Additional shutdowns) is replaced by the following:

"**18.10.4 Associated safety systems**"

108 Table 18.1 is replaced by the following table:

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

Initiation		Shutdown action (See 18.10.1.1)								
		Emergency shutdown system (ESD)						Gas Burning Safety System (GBSS)		
		Cargo Pumps	Compressor used for cargo handling	ESD valves on manifold	Cargo tank ESD valves	ESD link (to terminal)	Reliquefication plant including relevant aux systems and compressor	Pumps used for gas fuel	Compressors used for gas fuel	Master valve
1	ESD System failure (see 18.10.1.3)	√	√	√	√	√	√	√	√	√
2	ESD Push-button (see 18.10.3.3)	√	√	√	√	√	√	√	√	√
3	Fire detection in cargo area. (see 18.10.3.4)	√	√	√	√	√	√	√	√	√
4	ESD link from terminal① (see 18.10.1.4)	√	√	√	√①	√	N/A	N/A	N/A	N/A
5	Overflow protection (See 13.3.2) ②	√	√	√	√	√	√	√	√	√
6	Low pressure protection in cargo tanks ④ (see 8.3.1.1, 18.10.4)	√	√	√	√	√	√	√	√	√
7	Master valve receives shut signal ③ (see 16.4.2, 16.4.3,	N/A	N/A	N/A	N/A	N/A	N/A	√	√	√

Initiation		Shutdown action (See 18.10.1.1)								
		Emergency shutdown system (ESD)						Gas Burning Safety System (GBSS)		
		Cargo Pumps	Compressor used for cargo handling	ESD valves on manifold	Cargo tank ESD valves	ESD link (to terminal)	Reliquefication plant including relevant aux systems and compressor	Pumps used for gas fuel	Compressors used for gas fuel	Master valve
	16.4.6.2.1, 16.4.6.3.1, 16.4.8)									
8	Fuel gas push-button (see 16.4.6.2.2, 16.4.6.3.2, 16.5.2.1)	N/A	N/A	N/A	N/A	N/A	N/A	√	√	√
9	Low suction pressure in gas fuel (see 16.5.2.2) ④	N/A	N/A	N/A	N/A	N/A	N/A	√	√	√
10	Fire detection outside cargo area (see 16.5.2.2)	N/A	N/A	N/A	N/A	N/A	N/A	√	√	√

Note:

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

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

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

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

"

CHAPTER 19
SUMMARY OF MINIMUM REQUIREMENTS

109 The entries for "Carbon Dioxide (high purity)" and "Carbon Dioxide (Reclaimed quality)" in the table in chapter 19 are replaced by the following single entry:

"

Product name		***Ship type***	***Independent tank type C required***	***Control of vapour space within cargo tanks***	***Vapour detection***	***Gauging***		***Special requirements***
Carbon Dioxide		3G	'	'	T	C		14.4.2, 14.4.4 and 17.21

"

110 The following new entry is added after the existing entry of "Vinylidene chloride" in the table in chapter 19, with the associated footnote.

"

Product name		***Ship type***	***Independent tank type C required***	***Control of vapour space within cargo tanks***	***Vapour detection***	***Gauging***		***Special requirements***
VOC Condensate		2G/2PG	-	-	F + T †	C		14.4.2, 14.4.3, 17.9, 17.11

† The toxic vapour detection equipment shall be able to detect "Benzene", "Hexane" and "Toluene"."

APPENDIX 2

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

111 The entries under "Particulars of ships" are replaced by the following:

"Name of ship …….
Distinctive number or letters …….
IMO number …….
Port of registry …….
Cargo capacity (m^3) …….
Ship type (Code paragraph 2.1.2) …….
Date of build (all applicable dates shall be completed)
Date of building contract …….
Date on which keel was laid or on which the ship was at similar stage of construction …….
Date of delivery ……
Date on which conversion to a gas carrier was commenced …….
The ship also complies fully with the following amendments to the Code: ……..
The ship is exempted from compliance with the following provisions of the Code: ……."

112 The table in paragraph 3.3 is replaced by the following:

".3

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

"

113 The following new paragraph 3.5 is added after existing paragraph 3.4:

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

114 Existing paragraph 4 is replaced by the following, the following new paragraph 5 is added after paragraph 4, and subsequent paragraphs are renumbered accordingly:

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

Products	**Conditions of carriage (tank numbers, etc.)**	**Minimum temperature**

Continued on attachment 1, additional signed and dated sheets. Tank numbers referred to in this list are identified on attachment 2, signed and dated tank plan.		

"

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

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

"

Consequential amendments to referenced figure numbers

115 According to each row of the following table, in the paragraph indicated in the left column, the referenced figure number specified in the second column from the left is replaced with the figure number shown in the third column, following the note specified in the right column.

Paragraph	Existing referenced figure number	Amended referenced figure number	Note
paragraph 3.5.3.5.1	figure 3.1	figure 3.3	
paragraph 3.5.3.5.2	figure 3.2	figure 3.4	
paragraph 3.5.3.5.3	figure 3.3	figure 3.5	
paragraph 3.5.3.5.4	figure 3.4	figure 3.6	
paragraph 3.5.3.5.5	figure 3.5	figure 3.7	twice
paragraph 3.5.3.5.6	figure 3.6	figure 3.8	
paragraph 4.18.2.6.3	figure 4.4	figure 4.5	
paragraph 4.28.1.2 in the text for α_β	figure 4.1	figure 4.2	
paragraph 4.28.1.2 in the text for Z_β	figure 4.2	figures 4.3 and 4.4	
paragraph 8.4.1.2	figure 8.1	figure 8.2	

Consequential amendments to referenced paragraph numbers

116 According to each row of the following table, in the paragraph indicated in the left column, the referenced paragraph number specified in the second column from the left is replaced with the paragraph number shown in the third column.

Paragraph	Existing referenced paragraph number	Amended referenced paragraph number
paragraph 1.4.1.2	1.2.43	1.2.46
paragraph 3.8.2	1.2.53	1.2.57
paragraph 7.4.1	1.2.52	1.2.56
paragraph 7.7	1.2.47	1.2.51
renumbered paragraph 8.2.18	1.2.31	1.2.34
paragraph 17.15	1.2.47	1.2.51

Paragraph	Existing referenced paragraph number	Amended referenced paragraph number
paragraph 17.16.5	1.2.28	1.2.30
paragraph 17.16.5	1.2.47	1.2.51
paragraph 17.18.23	1.2.28	1.2.30
paragraph 18.4.2.2	1.2.47	1.2.51
paragraph 5.6.2	8.2.7	8.2.8
paragraph 5.6.2	8.2.8	8.2.9
renumbered paragraph 8.2.9	8.2.7	8.2.8
renumbered paragraph 8.2.13	8.2.10	8.2.11
renumbered paragraph 8.2.13	8.2.11.1	8.2.12.1
renumbered paragraph 8.2.13	8.2.11.2	8.2.12.2
paragraph 13.4.3	8.2.7	8.2.8
new paragraph 15.3.1	8.2.18	8.2.19
renumbered paragraph 15.3.2	8.2.17	8.2.18
renumbered paragraph 15.4.2	8.2.18	8.2.19
paragraph 17.9	8.2.15	8.2.16
paragraph 17.16.4.3	8.2.10	8.2.11
paragraph 17.16.4.3	8.2.11	8.2.12
paragraph 17.16.4.3	8.2.15	8.2.16
paragraph 17.21.2	8.2.9.2	8.2.16
paragraph 17.21.2	8.2.15	8.2.16
paragraph 17.21.3	8.2.10	8.2.11
paragraph 17.21.3	8.2.15	8.2.16
paragraph 18.2.2.10	8.2.8	8.2.9
paragraph 18.12	8.2.7	8.2.8
paragraph 18.12	8.2.8	8.2.9
paragraph 18.12	8.2.9	8.2.10
paragraph 11.3.2.1	11.3.1.8	11.3.1.9
paragraph 16.4.4.2	16.4.3.2	16.4.3.1.2
paragraph 16.9.5	16.4.3.2	16.4.3.1.2
renumbered paragraph 8.2.i in section starting with the words "THIS IS TO CERTIFY:" in Appendix 2	6	7
renumbered paragraph 8.2.iii in section starting with the words "THIS IS TO CERTIFY:" in Appendix 2	6	7
renumbered paragraph 8.2.iv in section starting with the words "THIS IS TO CERTIFY:" in Appendix 2	6	7

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