CHAPTER 9.3

RULES FOR CONSTRUCTION OF TANK VESSELS

9.3.1 Rules for construction of type G tank vessels

The rules for construction of 9.3.1.0 to 9.3.1.99 apply to type G tank vessels.

9.3.1.0 *Materials of construction*

9.3.1.0.1 (a) The vessel's hull and the cargo tanks shall be constructed of shipbuilding steel or other at least equivalent metal.

The independent cargo tanks may also be constructed of other materials, provided these have at least equivalent mechanical properties and resistance against the effects of temperature and fire.

(b) Every part of the vessel including any installation and equipment which may come into contact with the cargo shall consist of materials which can neither be dangerously affected by the cargo nor cause decomposition of the cargo or react with it so as to form harmful or hazardous products.

9.3.1.0.2 Except where explicitly permitted in 9.3.1.0.3 below or in the certificate of approval, the use of wood, aluminium alloys or plastic materials within the cargo area is prohibited.

9.3.1.0.3 (a) The use of wood, aluminium alloys or plastic materials within the cargo area is only permitted for:

– gangways and external ladders;

– movable items of equipment;

– chocking of cargo tanks which are independent of the vessel's hull and chocking of installations and equipment;

– masts and similar round timber;

– engine parts;

– parts of the electrical installation;

– lids of boxes which are placed on the deck.

(b) The use of wood or plastic materials within the cargo area is only permitted for:

– supports and stops of any kind.

(c) The use of plastic materials or rubber within the cargo area is only permitted for:

– all kinds of gaskets (e.g. for dome or hatch covers);

– electric cables;

– hoses for loading and unloading;

– insulation of cargo tanks and of hoses for loading and unloading.

(d) All permanently fitted materials in the accommodation or wheelhouse, with the exception of furniture, shall not readily ignite. They shall not evolve fumes or toxic gases in dangerous quantities, if involved in a fire.

9.3.1.0.4 The paint used in the cargo area shall not be liable to produce sparks in case of impact.

9.3.1.0.5 The use of plastic material for vessel's boats is permitted only if the material does not readily ignite.

9.3.1.1-9.3.1.7 (*Reserved*)

9.3.1.8 ***Classification***

9.3.1.8.1 The tank vessel shall be built under survey of a recognised classification society in accordance with the rules established by that classification society for its highest class, and the tank vessel shall be classed accordingly.

The vessel's highest class shall be continued.

The classification society shall issue a certificate certifying that the vessel is in conformity with the rules of this section.

The design pressure and the test pressure of cargo tanks shall be entered in the certificate.

If a vessel has cargo tanks with different valve opening pressures, the design and test pressures of each tank shall be entered in the certificate.

The classification society shall draw up a certificate mentioning all the dangerous goods accepted for carriage by the vessel (see also 1.16.1.2.5).

9.3.1.8.2 The cargo pump-rooms shall be inspected by a recognised classification society whenever the certificate of approval has to be renewed as well as during the third year of validity of the certificate of approval. The inspection shall comprise at least:

– an inspection of the whole system for its condition, for corrosion, leakage or conversion works which have not been approved;

– a checking of the condition of the gas detection system in the cargo pump-rooms.

Inspection certificates signed by the recognised classification society with respect to the inspection of the cargo pump-rooms shall be kept on board. The inspection certificates shall at least include particulars of the above inspection and the results obtained as well as the date of the inspection.

9.3.1.8.3 The condition of the gas detection system referred to in 9.3.1.52.3 shall be checked by a recognised classification society whenever the certificate of approval has to be renewed and during the third year of validity of the certificate of approval. A certificate signed by the recognised classification society shall be kept on board.

9.3.1.9 (*Reserved*)

9.3.1.10 ***Protection against the penetration of gases***

9.3.1.10.1 The vessel shall be designed so as to prevent gases from penetrating into the accommodation and the service spaces.

9.3.1.10.2 Outside the cargo area, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches to under-deck spaces shall have a height of not less than 0.50 m above the deck

This requirement need not be complied with if the wall of the superstructures facing the cargo area extends from one side of the ship to the other and has doors the sills of which have a height of not less than 0.50 m. The height of this wall shall not be less than 2.00 m. In this case, the lower edges of door-openings in the sidewalls of superstructures and the coamings of access hatches behind this wall shall have a height of not less than 0.10 m. The sills of engine room doors and the coamings of its access hatches shall, however, always have a height of not less than 0.50 m.

9.3.1.10.3 In the cargo area, the lower edges of door-openings in the sidewalls of superstructures shall have a height of not less than 0.50 m above the deck and the sills of hatches and ventilation openings of premises located under the deck shall have a height of not less than 0.50 m above the deck. This requirement does not apply to access openings to double-hull and double bottom spaces.

9.3.1.10.4 The bulwarks, foot-rails, etc shall be provided with sufficiently large openings which are located directly above the deck.

9.3.1.11 ***Hold spaces and cargo tanks***

9.3.1.11.1 (a) The maximum permissible capacity of a cargo tank shall be determined in accordance with the following table:

$L \times B \times H$ (m^3)	Maximum permissible capacity of a cargo tank (m^3)
up to 600	$L \times B \times H \times 0.3$
600 to 3 750	$180 + (L \times B \times H - 600) \times 0.0635$
> 3 750	380

Alternative constructions in accordance with 9.3.4 are permitted.

In the table above $L \times B \times H$ is the product of the main dimensions of the tank vessel in metres (according to the measurement certificate), where:

L = overall length of the hull in m;
B = extreme breadth of the hull in m;
H = shortest vertical distance between the top of the keel and the lowest point of the deck at the side of the vessel (moulded depth) within the cargo area in m;
where:

For trunk vessels, H shall be replaced by H', where H' shall be obtained from the following formula:

$$H' = H + \left(ht \times \frac{bt}{B} \times \frac{lt}{L} \right)$$

where:

ht = trunk height (distance between trunk deck and main deck measured on trunk side at L/2) in m;
bt = trunk breadth in m;
lt = trunk length in m;

(b) Pressure tanks whose ratio of length to diameter exceeds 7 are prohibited.

(c) The pressure tanks shall be designed for a cargo temperature of + 40 °C.

9.3.1.11.2 (a) In the cargo area, the hull shall be designed as follows:[1]

– as a double-hull and double bottom vessel. The internal distance between the sideplatings of the vessel and the longitudinal bulkheads shall not be less than 0.80 m, the height of the double bottom shall be not less than 0.60 m, the cargo tanks shall be supported by saddles extending between the tanks to not less than 20° below the horizontal centreline of the cargo tanks.

Refrigerated cargo tanks shall be installed only in hold spaces bounded by double-hull spaces and double-bottom. Cargo tank fastenings shall meet the requirements of a recognised classification society; or

– as a single-hull vessel with the sideplatings of the vessel between gangboard and top of floor plates provided with side stringers at regular intervals of not more than 0.60 m which are supported by web frames spaced at intervals of not more than 2.00 m. The side stringers and the web frames shall have a height of not less than 10% of the depth, however, not less than 0.30 m. The side stringers and web frames shall be fitted with a face plate made of flat steel and having a cross-section of not less that 7.5 cm^2 and 15 cm^2, respectively.

The distance between the sideplating of the vessel and the cargo tanks shall be not less than 0.80 m and between the bottom and the cargo tanks not less than 0.60 m. The depth below the suction wells may be reduced to 0.50 m.

The lateral distance between the suction well of the cargo tanks and the bottom structure shall be not less than 0.10 m.

The cargo tank supports and fastenings should extend to not less than 10° below the horizontal centreline of the cargo tanks.

(b) The cargo tanks shall be fixed so that they cannot float.

(c) The capacity of a suction well shall be limited to not more than 0.10 m^3. For pressure cargo tanks, however, the capacity of a suction well may be of 0.20 m^3.

(d) Side-struts linking or supporting the load-bearing components of the sides of the vessel with the load-bearing components of the longitudinal walls of cargo tanks and side-struts linking the load-bearing components of the vessel's bottom with the tank-bottom are prohibited.

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[1] *For a different design of the hull in the cargo area, proof shall be furnished by way of calculation that in the event of a lateral collision with another vessel having a straight bow, an energy of 22 MJ can be absorbed without any rupture of the cargo tanks and the piping leading to the cargo tanks. Alternative constructions in accordance with 9.3.4 are permitted.*

9.3.1.11.3 (a) The hold spaces shall be separated from the accommodation and service spaces outside the cargo area below deck by bulkheads provided with a Class A-60 fire protection insulation according to SOLAS 74, Chapter II-2, Regulation 3. A space of not less than 0.20 m shall be provided between the cargo tanks and the end bulkheads of the hold spaces. Where the cargo tanks have plane end bulkheads this space shall be not less than 0.50 m.

(b) The hold spaces and cargo tanks shall be capable of being inspected.

(c) All spaces in the cargo area shall be capable of being ventilated. Means for checking their gas-free condition shall be provided.

9.3.1.11.4 The bulkheads bounding the hold spaces shall be watertight. The cargo tanks and the bulkheads bounding the cargo area shall have no openings or penetrations below deck.
The bulkhead between the engine room and the service spaces within the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the requirements of 9.3.1.17.5.

9.3.1.11.5 Double-hull spaces and double bottoms in the cargo area shall be arranged for being filled with ballast water only. Double bottoms may, however, be used as oil fuel tanks, provided they comply with the requirements of 9.3.1.32.

9.3.1.11.6 (a) A space in the cargo area below deck may be arranged as a service space, provided that the bulkhead bounding the service space extends vertically to the bottom and the bulkhead not facing the cargo area extends from one side of the vessel to the other in one frame plane. This service space shall only be accessible from the deck.

(b) The service space shall be watertight with the exception of its access hatches and ventilation inlets.

(c) No pipes for loading or unloading shall be fitted within the service space referred to under (a) above.

Pipes for loading and unloading may be fitted in the cargo pump-rooms below deck only when they conform to the provisions of 9.3.1.17.6.

9.3.1.11.7 Where service spaces are located in the cargo area under deck, they shall be arranged so as to be easily accessible and to permit persons wearing protective clothing and breathing apparatus to safely operate the service equipment contained therein. They shall be designed so as to allow injured or unconscious personnel to be removed from such spaces without difficulty, if necessary by means of fixed equipment.

9.3.1.11.8 Hold spaces and other accessible spaces within the cargo area shall be arranged so as to ensure that they may be completely inspected and cleaned in an appropriate manner. The dimensions of openings, except for those of double-hull spaces and double bottoms which do not have a wall adjoining the cargo tanks, shall be sufficient to allow a person wearing breathing apparatus to enter or leave the space without difficulty. These openings shall have a minimum cross-sectional area of 0.36 m^2 and a minimum side length of 0.50 m. They shall be designed so as to allow injured or unconscious persons to be removed from the bottom of such spaces without difficulties, if necessary by means of fixed equipment. In these spaces the distance between the reinforcements shall not be less than 0.50 m. In double bottoms this distance may be reduced to 0.45 m.

Cargo tanks may have circular openings with a diameter of not less than 0.68 m.

9.3.1.12 ***Ventilation***

9.3.1.12.1 Each hold space shall have two openings the dimensions and location of which shall be such as to permit effective ventilation of any part of the hold space. If there are no such openings, it shall be possible to fill the hold spaces with inert gas or dry air.

9.3.1.12.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water and cofferdams between engine rooms and pump-rooms, if they exist, shall be provided with ventilation systems.

9.3.1.12.3 Any service spaces located in the cargo area below deck shall be provided with a system of forced ventilation with sufficient power for ensuring at least 20 changes of air per hour based on the volume of the space.

The ventilation exhaust ducts shall extend down to 50 mm above the bottom of the service space. The air shall be supplied through a duct at the top of the service space. The air inlets shall be located not less than 2.00 m above the deck, at a distance of not less than 2.00 m from tank openings and 6.00 m from the outlets of safety valves.

The extension pipes, which may be necessary, may be of the hinged type.

9.3.1.12.4 Ventilation of accommodation and service spaces shall be possible.

9.3.1.12.5 Ventilators used in the cargo area shall be designed so that no sparks may be emitted on contact of the impeller blades with the housing and no static electricity may be generated.

9.3.1.12.6 Notice boards shall be fitted at the ventilation inlets indicating the conditions when they shall be closed. All ventilation inlets of accommodation and service spaces leading outside shall be fitted with fire flaps. Such ventilation inlets shall be located not less than 2.00 m from the cargo area.

Ventilation inlets of service spaces in the cargo area may be located within such area.

9.3.1.13 ***Stability (general)***

9.3.1.13.1 Proof of sufficient stability shall be furnished including for stability in damaged condition.

9.3.1.13.2 The basic values for the stability calculation - the vessel's lightweight and location of the centre of gravity - shall be determined either by means of an inclining experiment or by detailed mass and moment calculation. In the latter case the lightweight of the vessel shall be checked by means of a lightweight test with a tolerance limit of ± 5% between the mass determined by calculation and the displacement determined by the draught readings.

9.3.1.13.3 Proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition.

Floatability after damage shall be proved for the most unfavourable loading condition. For this purpose, calculated proof of sufficient stability shall be established for critical intermediate stages of flooding and for the final stage of flooding. Negative values of stability in intermediate stages of flooding may be accepted only if the continued range of curve of righting lever in damaged condition indicates adequate positive values of stability.

9.3.1.14 ***Stability (intact)***

The requirements for intact stability resulting from the damaged stability calculation shall be fully complied with.

9.3.1.15 ***Stability (damaged condition)***

9.3.1.15.1 The following assumptions shall be taken into consideration for the damaged condition:

(a) The extent of side damage is as follows:

longitudinal extent:	at least 0.10 L, but not less than 5.00 m;
transverse extent:	0.79 m;
vertical extent:	from the base line upwards without limit;

(b) The extent of bottom damage is as follows:

longitudinal extent:	at least 0.10 L, but not less than 5.00 m;
transverse extent:	3.00 m;
vertical extent:	from the base 0.59 m upwards, the well excepted;

(c) Any bulkheads within the damaged area shall be assumed damaged, which means that the location of bulkheads shall be chosen so as to ensure that the vessel remains afloat after the flooding of two or more adjacent compartments in the longitudinal direction.

The following provisions are applicable:

– For bottom damage, adjacent athwartship compartments shall also be assumed as flooded;

– The lower edge of any non-watertight openings (e.g. doors, windows, access hatchways) shall, at the final stage of flooding, be not less than 0.10 m above the damage waterline;

– In general, permeability shall be assumed to be 95%. Where an average permeability of less than 95% is calculated for any compartment, this calculated value obtained may be used.

However, the following minimum values shall be used:

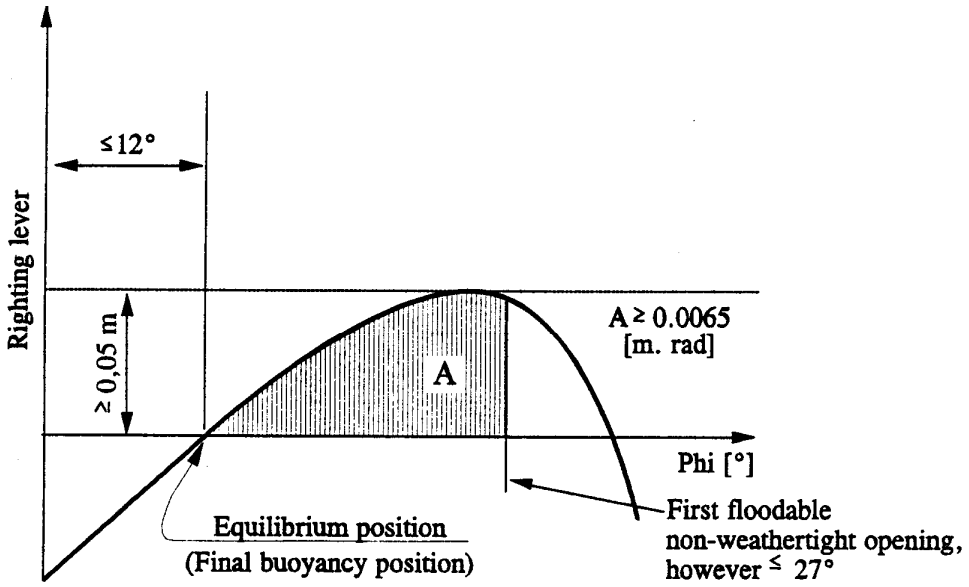
–	engine rooms:	85%;
–	accommodation:	95%;
–	double bottoms, oil fuel tanks, ballast tanks, etc., depending on whether, according to their function, they have to be assumed as full or empty for the vessel floating at the maximum permissible draught:	0% or 95%.

For the main engine room only the one-compartment standard need be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

9.3.1.15.2 At the stage of equilibrium (final stage of flooding), the angle of heel shall not exceed 12°. Non-watertight openings shall not be flooded before reaching the stage of equilibrium. If such openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.

The positive range of the righting lever curve beyond the stage of equilibrium shall have a righting level of ≥ 0.05 m in association with an area under the curve of ≥ 0.0065 m.rad. The

minimum values of stability shall be satisfied up to immersion of the first non-weathertight opening and in any event up to an angle of heel $\leq 27°$. If non-watertight openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purpose of stability calculation.



9.3.1.15.3 If openings through which undamaged compartments may additionally become flooded are capable of being closed watertight, the closing appliances shall be marked accordingly.

9.3.1.15.4 When cross- or down-flooding openings are provided for reduction of unsymmetrical flooding, the time for equalisation shall not exceed 15 minutes, if during the intermediate stages of flooding sufficient stability has been proved.

9.3.1.16 ***Engine rooms***

9.3.1.16.1 Internal combustion engines for the vessel's propulsion as well as internal combustion engines for auxiliary machinery shall be located outside the cargo area. Entrances and other openings of engine rooms shall be at a distance of not less than 2.00 m from the cargo area.

9.3.1.16.2 The engine room shall be accessible from the deck; the entrances shall not face the cargo area. When the doors are not located in a recess whose depth is at least equal to the door width, the hinges shall face the cargo area.

9.3.1.17 ***Accommodation and service spaces***

9.3.1.17.1 Accommodation spaces and the wheelhouse shall be located outside the cargo area forward of the fore vertical plane or abaft the aft vertical plane bounding the part of cargo area below deck. Windows of the wheelhouse which are located not less than 1.00 m above the bottom of the wheelhouse may tilt forward.

9.3.1.17.2 Entrances to spaces and openings of superstructures shall not face the cargo area. Doors opening outward and not located in a recess the depth of which is at least equal to the width of the doors shall have their hinges facing the cargo area.

9.3.1.17.3 Entrances from the deck and openings of spaces facing the weather shall be capable of being closed. The following instruction shall be displayed at the entrance of such spaces:

Do not open during loading and unloading without the permission of the master. Close immediately.

9.3.1.17.4 Entrances and windows of superstructures and accommodation spaces which can be opened as well as other openings of these spaces shall be located not less than 2.00 m from the cargo area. No wheelhouse doors and windows shall be located within 2.00 m from the cargo area, except where there is no direct connection between the wheelhouse and the accommodation.

9.3.1.17.5 (a) Driving shafts of the bilge or ballast pumps may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 9.3.1.11.6.

(b) The penetration of the shaft through the bulkhead shall be gastight and shall have been approved by a recognised classification society.

(c) The necessary operating instructions shall be displayed.

(d) Penetrations through the bulkhead between the engine room and the service space in the cargo area, and the bulkhead between the engine room and the hold spaces may be provided for electrical cables, hydraulic lines and piping for measuring, control and alarm systems, provided that the penetrations have been approved by a recognised classification society. The penetrations shall be gastight. Penetrations through a bulkhead with an "A-60" fire protection insulation according to SOLAS 74, Chapter II-2, Regulation 3, shall have an equivalent fire protection.

(e) Pipes may pass through the bulkhead between the engine room and the service space in the cargo area provided that these are pipes between the mechanical equipment in the engine room and the service space which do not have any openings within the service space and which are provided with shut-off devices at the bulkhead in the engine room.

(f) Notwithstanding 9.3.1.11.4, pipes from the engine room may pass through the service space in the cargo area or a cofferdam or a hold space or a double-hull space to the outside provided that within the service space or cofferdam or hold space or double-hull space they are of the thick-walled type and have no flanges or openings.

(g) Where a driving shaft of auxiliary machinery penetrates through a wall located above the deck the penetration shall be gastight.

9.3.1.17.6 A service space located within the cargo area below deck shall not be used as a cargo pump-room for the vessel's own gas discharging system, e.g. compressors or the compressor/heat exchanger/pump combination, except where:

– the pump-room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an "A-60" fire protection insulation according to SOLAS 74, Chapter II-2, Regulation 3, or by a service space or a hold space;

– the "A-60" bulkhead required above does not include penetrations referred to in 9.3.1.17.5 (a);

– ventilation exhaust outlets are located not less than 6.00 m from entrances and openings of the accommodation and service spaces;

– the access hatches and ventilation inlets can be closed from the outside;

– all pipes for loading and unloading (at the suction side and delivery side) are led through the deck above the pump-room. The necessary operation of the control devices in the pump-room, starting of pumps or compressors and necessary control of the liquid flow rate shall be effected from the deck;

– the system is fully integrated in the gas and liquid piping system;

– the cargo pump-room is provided with a permanent gas detection system which automatically indicates the presence of explosive gases or lack of oxygen by means of direct-measuring sensors and which actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosive limit. The sensors of this system shall be placed at suitable positions at the bottom and directly below the deck.

  Measurement shall be continuous.

  The audible and visual alarms are installed in the wheelhouse and in the cargo pump-room and, when the alarm is actuated, the loading and unloading system is shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of audible and visual alarms;

– the ventilation system prescribed in 9.3.1.12.3 has a capacity of not less than 30 changes of air per hour based on the total volume of the service space.

9.3.1.17.7 The following instruction shall be displayed at the entrance of the cargo pump-room:

Before entering the cargo pump-room check whether
it is free from gases and contains sufficient oxygen.
Do not open doors and entrance openings without
the permission of the master.
Leave immediately in the event of alarm.

9.3.1.18 ***Inerting facility***

In cases in which inerting or blanketing of the cargo is prescribed, the vessel shall be equipped with an inerting system.

This system shall be capable of maintaining a permanent minimum pressure of 7 kPa (0.07 bar) in the spaces to be inerted. In addition, the inerting system shall not increase the pressure in the cargo tank to a pressure greater than that at which the pressure valve is regulated. The set pressure of the vacuum-relief valve shall be 3.5 kPa (0.035 bar).

A sufficient quantity of inert gas for loading or unloading shall be carried or produced on board if it is not possible to obtain it on shore. In addition, a sufficient quantity of inert gas to offset normal losses occurring during carriage shall be on board.

The premises to be inerted shall be equipped with connections for introducing the inert gas and monitoring systems so as to ensure the correct atmosphere on a permanent basis.

When the pressure or the concentration of inert gas in the gaseous phase falls below a given value, this monitoring system shall activate an audible and visible alarm in the wheelhouse. When the wheelhouse is unoccupied, the alarm shall also be perceptible in a location occupied by a crew member.

9.3.1.19-
9.3.1.20 (*Reserved*)

9.3.1.21 ***Safety and control installations***

9.3.1.21.1 Cargo tanks shall be provided with the following equipment:

(a) *(Reserved)*;

(b) a level gauge;

(c) a level alarm device which is activated at the latest when a degree of filling of 86% is reached;

(d) a high level sensor for actuating the facility against overflowing at the latest when a degree of filling of 97.5% is reached;

(e) an instrument for measuring the pressure of the gas phase in the cargo tank;

(f) an instrument for measuring the temperature of the cargo;

(g) a connection for a closed sampling device.

9.3.1.21.2 When the degree of filling in per cent is determined, an error of not more than 0.5% is permitted. It shall be calculated on the basis of the total cargo tank capacity including the expansion trunk.

9.3.1.21.3 The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The permissible maximum filling level of the cargo tank shall be marked on each level gauge.

Permanent reading of the overpressure and vacuum shall be possible from a location from which loading or unloading operations may be interrupted. The permissible maximum overpressure and vacuum shall be marked on each level gauge.

Readings shall be possible in all weather conditions.

9.3.1.21.4 The level alarm device shall give a visual and audible warning on board when actuated. The level alarm device shall be independent of the level gauge.

9.3.1.21.5 (a) The high level sensor referred to in 9.3.1.21.1 (d) shall give a visual and audible alarm on board and at the same time actuate an electrical contact which in the form of a binary signal interrupts the electric current loop provided and fed by the shore facility, thus initiating measures at the shore facility against overflowing during loading operations.

The signal shall be transmitted to the shore facility via a watertight two-pin plug of a connector device in accordance with standard EN 60309-2:1999 for direct current of 40 to 50 volts, identification colour white, position of the nose 10 h.

The plug shall be permanently fitted to the vessel close to the shore connections of the loading and unloading pipes.

The high level sensor shall also be capable of switching off the vessel's own discharging pump.

The high level sensor shall be independent of the level alarm device, but it may be connected to the level gauge.

(b) During discharging by means of the on-board pump, it shall be possible for the shore facility to switch it off. For this purpose, an independent intrinsically safe power line, fed by the vessel, shall be switched off by the shore facility by means of an electrical contact.
It shall be possible for the binary signal of the shore facility to be transmitted via a watertight two-pole socket or a connector device in accordance with standard EN 60309-2:1999, for direct current of 40 to 50 volts, identification colour white, position of the nose 10 h.
This socket shall be permanently fitted to the vessel close to the shore connections of the unloading pipes.

9.3.1.21.6 The visual and audible signals given by the level alarm device shall be clearly distinguishable from those of the high level sensor.

The visual alarm shall be visible at each control position on deck of the cargo tank stop valves. It shall be possible to easily check the functioning of the sensors and electric circuits or these shall be of the "failsafe" design.

9.3.1.21.7 When the pressure or the temperature exceeds a set value, the instruments for measuring the pressure and the temperature of the cargo shall activate a visual and an audible alarm in the wheelhouse. When the wheelhouse is unoccupied the alarm shall also be perceptible in a location occupied by a crew member.

When the pressure exceeds a set value during loading or unloading, the instrument for measuring the pressure shall simultaneously initiate an electrical contact which, by means of the plug referred to in 9.3.1.21.5 above, enables measures to be taken to interrupt the loading and unloading operation. When the vessel's own discharge pump is used, it shall be switched off automatically. The sensor for the alarms referred to above may be connected to the alarm installation.

9.3.1.21.8 Where the control elements of the shut-off devices of the cargo tanks are located in a control room, it shall be possible to stop the loading pumps and read the level gauges in the control room, and the visual and audible warning given by the level alarm device, the high level sensor referred to in 9.3.1.21.1 (d) and the instruments for measuring the pressure and temperature of the cargo shall be noticeable in the control room and on deck.

Satisfactory monitoring of the cargo area shall be ensured from the control room.

9.3.1.21.9 The vessel shall be so equipped that loading or unloading operations can be interrupted by means of switches, i.e. the quick-action stop valve located on the flexible vessel-to-shore connecting line must be capable of being closed. The switches shall be placed at two points on the vessel (fore and aft).

The interruption systems shall be designed according to the quiescent current principle.

9.3.1.21.10 When refrigerated substances are carried the opening pressure of the safety system shall be determined by the design of the cargo tanks. In the event of the transport of substances that must be carried in a refrigerated state the opening pressure of the safety system shall be not less than 25 kPa (0.25 bar) greater than the maximum pressure calculated according to 9.3.1.27.

9.3.1.22 ***Cargo tank openings***

9.3.1.22.1 (a) Cargo tank openings shall be located on deck in the cargo area.

(b) Cargo tank openings with a cross-section greater than 0.10 m^2 shall be located not less than 0.50 m above the deck.

9.3.1.22.2 Cargo tank openings shall be fitted with gastight closures which comply with the provisions of 9.3.1.23.1.

9.3.1.22.3 The exhaust outlets of the pressure relief valves shall be located not less than 2.00 m above the deck at a distance of not less than 6.00 m from the accommodation and from the service spaces located outside the cargo area. This height may be reduced when within a radius of 1.00 m round the pressure relief valve outlet there is no equipment, no work is being carried out and signs indicate the area.

9.3.1.22.4 The closing devices normally used in loading and unloading operations shall not be capable of producing sparks when operated.

9.3.1.22.5 Each tank in which refrigerated substances are carried shall be equipped with a safety system to prevent unauthorized vacuum or overpressure.

9.3.1.23 ***Pressure test***

9.3.1.23.1 Cargo tanks and pipes for loading and unloading shall comply with the provisions concerning pressure vessels which have been established by the competent authority or a recognised classification society for the substances carried.

9.3.1.23.2 Any cofferdams shall be subjected to initial tests before being put into service and thereafter at the prescribed intervals.

The test pressure shall be not less than 10 kPa (0.10 bar) gauge pressure.

9.3.1.23.3 The maximum intervals for the periodic tests referred to in 9.3.1.23.2 above shall be 11 years.

9.3.1.24 ***Regulation of cargo pressure and temperature***

9.3.1.24.1 Unless the entire cargo system is designed to resist the full effective vapour pressure of the cargo at the upper limits of the ambient design temperatures, the pressure of the tanks shall be kept below the permissible maximum set pressure of the safety valves, by one or more of the following means:

(a) a system for the regulation of cargo tank pressure using mechanical refrigeration;

(b) a system ensuring safety in the event of the heating or increase in pressure of the cargo. The insulation or the design pressure of the cargo tank, or the combination of these two elements, shall be such as to leave an adequate margin for the operating period and the temperatures expected; in each case the system shall be deemed acceptable by a recognized classification society and shall ensure safety for a minimum time of three times the operation period;

(c) other systems deemed acceptable by a recognized classification society.

9.3.1.24.2 The systems prescribed in 9.3.1.24.1 shall be constructed, installed and tested to the satisfaction of the recognized classification society. The materials used in their construction shall be compatible with the cargoes to be carried. For normal service, the upper ambient design temperature limits shall be:

air: +30° C;

water: +20° C.

9.3.1.24.3 The cargo storage system shall be capable of resisting the full vapour pressure of the cargo at the upper limits of the ambient design temperatures, whatever the system adopted to deal with the boil-off gas. This requirement is indicated by remark 37 in column (20) of Table C of Chapter 3.2.

9.3.1.25 ***Pumps and piping***

9.3.1.25.1  Pumps, compressors and accessory loading and unloading piping shall be placed in the cargo area. Cargo pumps and compressors shall be capable of being shut down from the cargo area and, in addition, from a position outside the cargo area. Cargo pumps and compressors situated on deck shall be located not less than 6.00 m from entrances to, or openings of, the accommodation and service spaces outside the cargo area.

9.3.1.25.2 (a) Pipes for loading and unloading shall be independent of any other piping of the vessel. No cargo piping shall be located below deck, except those inside the cargo tanks and in the service spaces intended for the installation of the vessel's own gas discharging system.

(b) *(Reserved)*

(c) Pipes for loading and unloading shall be clearly distinguishable from other piping, e.g. by means of colour marking.

 (d) The pipes for loading and unloading on deck, the vapour pipes with the exception of the shore connections but including the safety valves, and the valves shall be located within the longitudinal line formed by the outer boundaries of the domes and not less than one quarter of the vesselʼs breadth from the outer shell. This requirement does not apply to the relief pipes situated behind the safety valves. If there is, however, only one dome athwartships, these pipes and their valves shall be located at a distance not less than 2.70 m from the shell.

Where cargo tanks are placed side by side, all the connections to the domes shall be located on the inner side of the domes. The external connections may be located on the fore and aft centre line of the dome. The shut-off devices shall be located directly at the dome or as close as possible to it. The shut-off devices of the loading and unloading piping shall be duplicated, one of the devices being constituted by a remote-controlled quick-action stop device. When the inside diameter of a shut-off device is less than 50 mm this device may be regarded as a safety device against bursts in the piping.

 (e) The shore connections shall be located not less than 6.00 m from the entrances to or openings of, the accommodation and service spaces outside the cargo area.

(f) Each shore connection of the vapour pipe and shore connections of the pipes for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device and a quick-action stop valve. However, each shore connection shall be fitted with a blind flange when it is not in operation.

(g) Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals.

9.3.1.25.3 The distance referred to in 9.3.1.25.1 and 9.3.1.25.2 (e) may be reduced to 3.00 m if a transverse bulkhead complying with 9.3.1.10.2 is situated at the end of the cargo area. The openings shall be provided with doors.

The following notice shall be displayed on the doors:

Do not open during loading and unloading without the permission of the master. Close immediately.

9.3.1.25.4 Every component of the pipes for loading and unloading shall be electrically connected to the hull.

9.3.1.25.5 The stop valves or other shut-off devices of the pipes for loading and unloading shall indicate whether they are open or shut.

9.3.1.25.6 The pipes for loading and unloading shall have, at the test pressure, the required elasticity, leakproofness and resistance to pressure.

9.3.1.25.7 The pipes for unloading shall be fitted with pressure gauges at the inlet and outlet of the pump.

Reading of the pressure gauges shall be possible from the control position of the vessel's own gas discharging system. The maximum permissible overpressure or vacuum shall be indicated by a measuring device.

Readings shall be possible in all weather conditions.

9.3.1.25.8 Use of the cargo piping for ballasting purposes shall not be possible.

9.3.1.26 *(Reserved)*

9.3.1.27 ***Refrigeration system***

9.3.1.27.1 The refrigeration system referred to in 9.3.1.24.1 (a) shall be composed of one or more units capable of keeping the pressure and temperature of the cargo at the upper limits of the ambient design temperatures at the prescribed level. Unless another means of regulating cargo pressure and temperature deemed satisfactory by a recognized classification society is provided, provision shall be made for one or more stand-by units with an output at least equal to that of the largest prescribed unit. A stand-by unit shall include a compressor, its engine, its control system and all necessary accessories to enable it to operate independently of the units normally used. Provision shall be made for a stand-by heat-exchanger unless the system's normal heat-exchanger has a surplus capacity equal to at least 25% of the largest prescribed capacity. It is not necessary to make provision for separate piping.

Cargo tanks, piping and accessories shall be insulated so that, in the event of a failure of all cargo refrigeration systems, the entire cargo remains for at least 52 hours in a condition not causing the safety valves to open.

9.3.1.27.2 The security devices and the connecting lines from the refrigeration system shall be connected to the cargo tanks above the liquid phase of the cargo when the tanks are filled to

their maximum permissible degree of filling. They shall remain within the gaseous phase, even if the vessel has a list up to 12 degrees.

9.3.1.27.3 When several refrigerated cargoes with a potentially dangerous chemical reaction are carried simultaneously, particular care shall be given to the refrigeration systems so as to prevent any mixing of the cargoes. For the carriage of such cargoes, separate refrigeration systems, each including the full stand-by unit referred to in 9.3.1.27.1, shall be provided for each cargo. When, however, refrigeration is ensured by an indirect or combined system and no leak in the heat exchangers can under any foreseeable circumstances lead to the mixing of cargoes, no provision need be made for separate refrigeration units for the different cargoes.

9.3.1.27.4 When several refrigerated cargoes are not soluble in each other under conditions of carriage such that their vapour pressures are added together in the event of mixing, particular care shall be given to the refrigeration systems to prevent any mixing of the cargoes.

9.3.1.27.5 When the refrigeration systems require water for cooling, a sufficient quantity shall be supplied by a pump or pumps used exclusively for the purpose. This pump or pumps shall have at least two suction pipes, leading from two water intakes, one to port, the other to starboard. Provision shall be made for a stand-by pump with a satisfactory flow; this may be a pump used for other purposes provided that its use for supplying water for cooling does not impair any other essential service.

9.3.1.27.6 The refrigeration system may take one of the following forms:

(a) Direct system: the cargo vapours are compressed, condensed and returned to the cargo tanks. This system shall not be used for certain cargoes specified in Table C of Chapter 3.2. This requirement is indicated by remark 35 in column (20) of Table C of Chapter 3.2;

(b) Indirect system: the cargo or the cargo vapours are cooled or condensed by means of a coolant without being compressed;

(c) Combined system: the cargo vapours are compressed and condensed in a cargo/coolant heat-exchanger and returned to the cargo tanks. This system shall not be used for certain cargoes specified in Table C of Chapter 3.2. This requirement is indicated by remark 36 in column (20) of Table C of Chapter 3.2.

9.3.1.27.7 All primary and secondary coolant fluids shall be compatible with each other and with the cargo with which they may come into contact. Heat exchange may take place either at a distance from the cargo tank, or by using cooling coils attached to the inside or the outside of the cargo tank.

9.3.1.27.8 When the refrigeration system is installed in a separate service space, this service space shall meet the requirements of 9.3.1.17.6.

9.3.1.27.9 For all cargo systems, the heat transmission coefficient shall be determined by calculation. The correctness of the calculation shall be checked by means of a refrigeration test (heat balance test).

This test shall be performed in accordance with the rules set up by a recognised classification society.

9.3.1.27.10 A certificate from a recognized classification society stating that 9.3.1.24.1 to 9.3.1.24.3, 9.2.1.27.1 and 9.3.1.27.4 above have been complied with shall be submitted together with the application for issue or renewal of the certificate of approval.

9.3.1.28 ***Water-spray system***

When water-spraying is required in column (9) of Table C of Chapter 3.2 a water-spray system shall be installed in the cargo area on deck for the purpose of reducing gases given off by the cargo by spraying water.

The system shall be fitted with a connection device for supply from the shore. The spray nozzles shall be so installed that released gases are precipitated safely. The system shall be capable of being put into operation from the wheelhouse and from the deck. The capacity of the water-spray system shall be such that when all the spray nozzles are in operation, the outflow is of 50 litres per square metre of cargo deck area and per hour.

9.3.1.29-
9.3.1.30 (*Reserved*)

9.3.1.31 ***Engines***

9.3.1.31.1 Only internal combustion engines running on fuel with a flashpoint of more than 55 °C are allowed.

9.3.1.31.2 Ventilation inlets of the engine room and, when the engines do not take in air directly from the engine room, the air intakes of the engines shall be located not less than 2.00 m from the cargo area.

9.3.1.31.3 Sparking shall not be possible within the cargo area.

9.3.1.31.4 The surface temperature of the outer parts of engines used during loading or unloading operations, as well as that of their air inlets and exhaust ducts shall not exceed the allowable temperature according to the temperature class of the substances carried. This provision does not apply to engines installed in service spaces provided the provisions of 9.3.1.52.3 are fully complied with.

9.3.1.31.5 The ventilation in the closed engine room shall be designed so that, at an ambient temperature of 20 °C, the average temperature in the engine room does not exceed 40 °C.

9.3.1.32 ***Oil fuel tanks***

9.3.1.32.1 When the vessel is fitted with hold spaces and double bottoms, double bottoms within the cargo area may be arranged as oil fuel tanks, provided their depth is not less than 0.6 m.

Oil fuel pipes and openings of such tanks are not permitted in the hold space.

9.3.1.32.2 Open ends of air pipes of all oil fuel tanks shall extend to not less than 0.5 m above the open deck. The open ends and the open ends of overflow pipes leading on the deck shall be fitted with a protective device consisting of a gauze diaphragm or a perforated plate.

9.3.1.33 (*Reserved*)

9.3.1.34 ***Exhaust pipes***

9.3.1.34.1 Exhausts shall be evacuated from the vessel into the open air either upwards through an exhaust pipe or through the shell plating. The exhaust outlet shall be located not less than 2 m from the cargo area. The exhaust pipes of engines shall be arranged so that the exhausts are led away from the vessel. The exhaust pipes shall not be located within the cargo area.

9.3.1.34.2 Exhaust pipes of engines shall be provided with a device preventing the escape of sparks, e.g. spark arresters.

9.3.1.35 ***Bilge pumping and ballasting arrangements***

9.3.1.35.1 Bilge and ballast pumps for spaces within the cargo area shall be installed within such area.

This provision does not apply to:

– double-hull spaces and double bottoms which do not have a common boundary wall with the cargo tanks;

– cofferdams and hold spaces where ballasting is carried out using the piping of the fire-fighting system in the cargo area and bilge-pumping is performed using eductors.

9.3.1.35.2 Where the double bottom is used as a liquid oil fuel tank, it shall not be connected to the bilge piping system.

9.3.1.35.3 Where the ballast pump is installed in the cargo area, the standpipe and its outboard connection for suction of ballast water shall be located within the cargo area.

9.3.1.35.4 It shall be possible for an under-deck pump-room to be stripped in an emergency using a system located in the cargo area and independent of any other system. This stripping system shall be located outside the pump-room.

9.3.1.36-9.3.1.39 (*Reserved*)

9.3.1.40 ***Fire-extinguishing arrangements***

9.3.1.40.1 A fire-extinguishing system shall be installed on the vessel.

This system shall comply with the following requirements:

– It shall be supplied by two independent fire or ballast pumps, one of which shall be ready for use at any time. These pumps and their means of propulsion and electrical equipment shall not be installed in the same space;

– It shall be provided with a water main fitted with at least three hydrants in the cargo area above deck. Three suitable and sufficiently long hoses with spray nozzles having a diameter of not less than 12 mm shall be provided. It shall be possible to reach any point of the deck in the cargo area simultaneously with at least two jets of water which do not emanate from the same hydrant.

  A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the fire-extinguishing system into the accommodation or service spaces outside the cargo area;

– The capacity of the system shall be at least sufficient for a jet of water to have a minimum reach of not less than the vessel's breadth from any location on board with two spray nozzles being used at the same time.

9.3.1.40.2 In addition the engine rooms, the cargo pump-room and all spaces containing special equipment (switchboards, compressors, etc.) for the refrigerant equipment if any, shall be provided with a permanently fixed fire-extinguishing system meeting the following requirements:

9.3.1.40.2.1 *Extinguishing agents*

For the protection of spaces in engine rooms, boiler rooms and pump rooms, only permanently fixed fire-extinguishing systems using the following extinguishing agents are permitted:

(a) CO_2 (carbon dioxide);

(b) HFC 227 ea (heptafluoropropane);

(c) IG-541 (52% nitrogen, 40% argon, 8% carbon dioxide).

(d) FK-5-1-12 (dodecafluoro 2-methylpentane-3-one).

Other extinguishing agents are permitted only on the basis of recommendations by the Administrative Committee.

9.3.1.40.2.2 *Ventilation, air extraction*

(a) The combustion air required by the combustion engines which ensure propulsion should not come from spaces protected by permanently fixed fire-extinguishing systems. This requirement is not mandatory if the vessel has two independent main engine rooms with a gastight separation or if, in addition to the main engine room, there is a separate engine room installed with a bow thruster that can independently ensure propulsion in the event of a fire in the main engine room.

(b) All forced ventilation systems in the space to be protected shall be shut down automatically as soon as the fire-extinguishing system is activated.

(c) All openings in the space to be protected which permit air to enter or gas to escape shall be fitted with devices enabling them to be closed rapidly. It shall be clear whether they are open or closed.

(d) Air escaping from the pressure-relief valves of the pressurised air tanks installed in the engine rooms shall be evacuated to the open air.

(e) Overpressure or negative pressure caused by the diffusion of the extinguishing agent shall not destroy the constituent elements of the space to be protected. It shall be possible to ensure the safe equalisation of pressure.

(f) Protected spaces shall be provided with a means of extracting the extinguishing agent. If extraction devices are installed, it shall not be possible to start them up during extinguishing.

9.3.1.40.2.3 *Fire alarm system*

The space to be protected shall be monitored by an appropriate fire alarm system. The alarm signal shall be audible in the wheelhouse, the accommodation and the space to be protected.

9.3.1.40.2.4 *Piping system*

(a) The extinguishing agent shall be routed to and distributed in the space to be protected by means of a permanent piping system. Piping installed in the space to be protected and the reinforcements it incorporates shall be made of steel. This shall not apply to the connecting nozzles of tanks and compensators provided that the materials used

have equivalent fire-retardant properties. Piping shall be protected against corrosion both internally and externally.

(b) The discharge nozzles shall be so arranged as to ensure the regular diffusion of the extinguishing agent. In particular, the extinguishing agent must also be effective beneath the floor.

9.3.1.40.2.5 *Triggering device*

(a) Automatically activated fire-extinguishing systems are not permitted.

(b) It shall be possible to activate the fire-extinguishing system from a suitable point located outside the space to be protected.

(c) Triggering devices shall be so installed that they can be activated in the event of a fire and so that the risk of their breakdown in the event of a fire or an explosion in the space to be protected is reduced as far as possible.

Systems which are not mechanically activated shall be supplied from two energy sources independent of each other. These energy sources shall be located outside the space to be protected. The control lines located in the space to be protected shall be so designed as to remain capable of operating in the event of a fire for a minimum of 30 minutes. The electrical installations are deemed to meet this requirement if they conform to the IEC 60331-21:1999 standard.

When the triggering devices are so placed as not to be visible, the component concealing them shall carry the "Fire-fighting system" symbol, each side being not less than 10 cm in length, with the following text in red letters on a white ground:

Fire-extinguishing system

(d) If the fire-extinguishing system is intended to protect several spaces, it shall comprise a separate and clearly-marked triggering device for each space.

(e) The instructions shall be posted alongside all triggering devices and shall be clearly visible and indelible. The instructions shall be in a language the master can read and understand and if this language is not English, French or German, they shall be in English, French or German. They shall include information concerning:

(i) the activation of the fire-extinguishing system;

(ii) the need to ensure that all persons have left the space to be protected;

(iii) The correct behaviour of the crew in the event of activation and when accessing the space to be protected following activation or diffusion, in particular in respect of the possible presence of dangerous substances;

(iv) the correct behaviour of the crew in the event of the failure of the fire-extinguishing system to function properly.

(f) The instructions shall mention that prior to the activation of the fire-extinguishing system, combustion engines installed in the space and aspirating air from the space to be protected, shall be shut down.

9.3.1.40.2.6 *Alarm device*

(a) Permanently fixed fire-extinguishing systems shall be fitted with an audible and visual alarm device.

(b) The alarm device shall be set off automatically as soon as the fire-extinguishing system is first activated. The alarm device shall function for an appropriate period of time before the extinguishing agent is released; it shall not be possible to turn it off.

(c) Alarm signals shall be clearly visible in the spaces to be protected and their access points and be clearly audible under operating conditions corresponding to the highest possible sound level. It shall be possible to distinguish them clearly from all other sound and visual signals in the space to be protected.

(d) Sound alarms shall also be clearly audible in adjoining spaces, with the communicating doors shut, and under operating conditions corresponding to the highest possible sound level.

(e) If the alarm device is not intrinsically protected against short circuits, broken wires and drops in voltage, it shall be possible to monitor its operation.

(f) A sign with the following text in red letters on a white ground shall be clearly posted at the entrance to any space the extinguishing agent may reach:

Warning, fire-extinguishing system!
Leave this space immediately when the … (description) alarm is activated!

9.3.1.40.2.7 *Pressurised tanks, fittings and piping*

(a) Pressurised tanks, fittings and piping shall conform to the requirements of the competent authority.

(b) Pressurised tanks shall be installed in accordance with the manufacturer's instructions.

(c) Pressurised tanks, fittings and piping shall not be installed in the accommodation.

(d) The temperature of cabinets and storage spaces for pressurised tanks shall not exceed 50 °C.

(e) Cabinets or storage spaces on deck shall be securely stowed and shall have vents so placed that in the event of a pressurised tank not being gastight, the escaping gas cannot penetrate into the vessel. Direct connections with other spaces are not permitted.

9.3.1.40.2.8 *Quantity of extinguishing agent*

If the quantity of extinguishing agent is intended for more than one space, the quantity of extinguishing agent available does not need to be greater than the quantity required for the largest of the spaces thus protected.

9.3.1.40.2.9 *Installation, maintenance, monitoring and documents*

(a) The mounting or modification of the system shall only be performed by a company specialised in fire-extinguishing systems. The instructions (product data sheet, safety

data sheet) provided by the manufacturer of the extinguishing agent or the system shall be followed.

(b) The system shall be inspected by an expert:

(i) before being brought into service;

(ii) each time it is put back into service after activation;

(iii) after every modification or repair;

(iv) regularly, not less than every two years.

(c) During the inspection, the expert is required to check that the system conforms to the requirements of 9.3.1.40.2.

(d) The inspection shall include, as a minimum:

(i) an external inspection of the entire system;

(ii) an inspection to ensure that the piping is leakproof;

(iii) an inspection to ensure that the control and activation systems are in good working order;

(iv) an inspection of the pressure and contents of tanks;

(v) an inspection to ensure that the means of closing the space to be protected are leakproof;

(vi) an inspection of the fire alarm system;

(vii) an inspection of the alarm device.

(e) The person performing the inspection shall establish, sign and date a certificate of inspection.

(f) The number of permanently fixed fire-extinguishing systems shall be mentioned in the inspection certificate.

9.3.1.40.2.10 *Fire-extinguishing system operating with CO_2*

In addition to the requirements contained in 9.3.1.40.2.1 to 9.3.1.40.2.9, fire-extinguishing systems using CO_2 as an extinguishing agent shall conform to the following provisions:

(a) Tanks of CO_2 shall be placed in a gastight space or cabinet separated from other spaces. The doors of such storage spaces and cabinets shall open outwards; they shall be capable of being locked and shall carry on the outside the symbol "Warning: general danger", not less than 5 cm high and "CO_2" in the same colours and the same size;

(b) Storage cabinets or spaces for CO_2 tanks located below deck shall only be accessible from the outside. These spaces shall have an artificial ventilation system with extractor hoods and shall be completely independent of the other ventilation systems on board;

(c) The level of filling of CO_2 tanks shall not exceed 0.75 kg/l. The volume of depressurised CO_2 shall be taken to be 0.56 m^3/kg;

(d) The concentration of CO_2 in the space to be protected shall be not less than 40% of the gross volume of the space. This quantity shall be released within 120 seconds. It shall be possible to monitor whether diffusion is proceeding correctly;

(e) The opening of the tank valves and the control of the diffusing valve shall correspond to two different operations;

(f) The appropriate period of time mentioned in 9.3.1.40.2.6 (b) shall be not less than 20 seconds. A reliable installation shall ensure the timing of the diffusion of CO_2.

9.3.1.40.2.11 *Fire-extinguishing system operating with HFC-227 ea (heptafluoropropane)*

In addition to the requirements of 9.3.1.40.2.1 to 9.3.1.40.2.9, fire-extinguishing systems using HFC-227 ea as an extinguishing agent shall conform to the following provisions:

(a) Where there are several spaces with different gross volumes, each space shall be equipped with its own fire-extinguishing system;

(b) Every tank containing HFC-227 ea placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;

(c) Every tank shall be fitted with a device permitting control of the gas pressure;

(d) The level of filling of tanks shall not exceed 1.15 kg/l. The specific volume of depressurised HFC-227 ea shall be taken to be 0.1374 m^3/kg;

(e) The concentration of HFC-227 ea in the space to be protected shall be not less than 8% of the gross volume of the space. This quantity shall be released within 10 seconds;

(f) Tanks of HFC-227 ea shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of propellant gas. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;

(g) After discharge, the concentration in the space to be protected shall not exceed 10.5% (volume);

(h) The fire-extinguishing system shall not comprise aluminium parts.

9.3.1.40.2.12 *Fire-extinguishing system operating with IG-541*

In addition to the requirements of 9.3.1.40.2.1 to 9.3.1.40.2.9, fire-extinguishing systems using IG-541 as an extinguishing agent shall conform to the following provisions:

(a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;

(b) Every tank containing IG-541 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank

are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;

(c) Each tank shall be fitted with a device for checking the contents;

(d) The filling pressure of the tanks shall not exceed 200 bar at a temperature of +15 °C;

(e) The concentration of IG-541 in the space to be protected shall be not less than 44% and not more than 50% of the gross volume of the space. This quantity shall be released within 120 seconds.

9.3.1.40.2.13 *Fire-extinguishing system operating with FK-5-1-12*

In addition to the requirements of 9.3.1.40.2.1 to 9.3.1.40.2.9, fire-extinguishing systems using FK-5-1-12 as an extinguishing agent shall comply with the following provisions:

(a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;

(b) Every tank containing FK-5-1-12 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;

(c) Every tank shall be fitted with a device permitting control of the gas pressure;

(d) The level of filling of tanks shall not exceed 1.00 kg/l. The specific volume of depressurized FK-5-1-12 shall be taken to be 0.0719 m^3/kg;

(e) The volume of FK-5-1-12 in the space to be protected shall be not less than 5.5% of the gross volume of the space. This quantity shall be released within 10 seconds;

(f) Tanks of FK-5-1-12 shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of extinguishing agent. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;

(g) After discharge, the concentration in the space to be protected shall not exceed 10.0%.

9.3.1.40.2.14 *Fixed fire-extinguishing system for physical protection*

In order to ensure physical protection in the engine rooms, boiler rooms and pump rooms, permanently fixed fire-extinguishing systems are accepted solely on the basis of recommendations by the Administrative Committee.

9.3.1.40.3 The two hand fire-extinguishers referred to in 8.1.4 shall be located in the cargo area.

9.3.1.40.4 The fire-extinguishing agent and the quantity contained in the permanently fixed fire-extinguishing system shall be suitable and sufficient for fighting fires.

9.3.1.41 *Fire and naked light*

9.3.1.41.1 The outlets of funnels shall be located not less than 2.00 m from the cargo area. Arrangements shall be provided to prevent the escape of sparks and the entry of water.

9.3.1.41.2 Heating, cooking and refrigerating appliances shall not be fuelled with liquid fuels, liquid gas or solid fuels.

The installation in the engine room or in another separate space of heating appliances fuelled with liquid fuel having a flash-point above 55 °C is, however, permitted.

Cooking and refrigerating appliances are permitted only in the accommodation.

9.3.1.41.3 Only electrical lighting appliances are permitted.

9.3.1.42- (*Reserved*)
9.3.1.49

9.3.1.50 ***Documents concerning electrical installations***

9.3.1.50.1 In addition to the documents required by the Regulations referred to in 1.1.4.6, the following documents shall be on board:

(a) a drawing indicating the boundaries of the cargo area and the location of the electrical equipment installed in this area;

(b) a list of the electrical equipment referred to in (a) above including the following particulars:

machine or appliance, location, type of protection, type of protection against explosion, testing body and approval number;

(c) a list of or general plan indicating the electrical equipment outside the cargo area which may be operated during loading, unloading or gas-freeing. All other electrical equipment shall be marked in red. See 9.3.1.52.3 and 9.3.1.52.4.

9.3.1.50.2 The documents listed above shall bear the stamp of the competent authority issuing the certificate of approval.

9.3.1.51 ***Electrical installations***

9.3.1.51.1 Only distribution systems without return connection to the hull are permitted.

This provision does not apply to:

- active cathodic corrosion protection;

– local installations outside the cargo area (e.g. connections of starters of diesel engines);

– the device for checking the insulation level referred to in 9.3.1.51.2 below.

9.3.1.51.2 Every insulated distribution network shall be fitted with an automatic device with a visual and audible alarm for checking the insulation level.

9.3.1.51.3 For the selection of electrical equipment to be used in zones presenting an explosion risk, the explosion groups and temperature classes assigned to the substances carried in the list of substances shall be taken into consideration (See columns (15) and (16) of Table C of Chapter 3.2).

9.3.1.52 ***Type and location of electrical equipment***

9.3.1.52.1 (a) Only the following equipment may be installed in cargo tanks and pipes for loading and unloading (comparable to zone 0):

– measuring, regulation and alarm devices of the EEx (ia) type of protection.

(b) Only the following equipment may be installed in the cofferdams, double-hull spaces, double bottoms and hold spaces (comparable to zone 1):

– measuring, regulation and alarm devices of the certified safe type;

– lighting appliances of the "flame-proof enclosure" or "apparatus protected by pressurization" type of protection;

– hermetically sealed echo sounding devices the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck;

– cables for the active cathodic protection of the shell plating in protective steel tubes such as those provided for echo sounding devices.

(c) Only the following equipment may be installed in the service spaces in the cargo area below deck (comparable to zone 1):

– measuring, regulation and alarm devices of the certified safe type;

– lighting appliances of the "flame-proof enclosure" or "apparatus protected by pressurization" type of protection;

– motors driving essential equipment such as ballast pumps; they shall be of the certified safe type.

(d) The control and protective equipment of the electrical equipment referred to in (a), (b) and (c) above shall be located outside the cargo area if they are not intrinsically safe.

(e) The electrical equipment in the cargo area on deck (comparable to zone 1) shall be of the certified safe type.

9.3.1.52.2 Accumulators shall be located outside the cargo area.

9.3.1.52.3 (a) Electrical equipment used during loading, unloading and gas-freeing during berthing and which are located outside the cargo area (comparable to zone 2) shall be at least of the "limited explosion risk" type.

(b) This provision does not apply to:

(i) lighting installations in the accommodation, except for switches near entrances to accommodation;

(ii) radiotelephone installations in the accommodation or the wheelhouse;

(iii) mobile and fixed telephone installations in the accommodation or the wheelhouse;

(iv) electrical installations in the accommodation, the wheelhouse or the service spaces outside the cargo areas if:

1. These spaces are fitted with a ventilation system ensuring an overpressure of 0.1 kPa (0.001 bar) and none of the windows is capable of being opened; the air intakes of the ventilation system located as far away as possible, however, not less than 6.00 m from the cargo area and not less than 2.00 m above the deck;

2. The spaces are fitted with a gas detection system with sensors:

   – at the suction inlets of the ventilation system;

   – directly at the top edge of the sill of the entrance doors of the accommodation and service spaces;

3. The gas concentration measurement is continuous;

4. When the gas concentration reaches 20% of the lower explosive limit, the ventilators shall be switched off. In such a case and when the overpressure is not maintained or in the event of failure of the gas detection system, the electrical installations which do not comply with (a) above, shall be switched off. These operations shall be performed immediately and automatically and activate the emergency lighting in the accommodation, the wheelhouse and the service spaces, which shall comply at least with the "limited explosion risk" type. The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;

5. The ventilation system, the gas detection system and the alarm of the switch-off device fully comply with the requirements of (a) above;

6. The automatic switch-off device is set so that no automatic switching-off may occur while the vessel is under way.

9.3.1.52.4 The electrical equipment which does not meet the requirements set out in 9.3.1.52.3 above together with its switches shall be marked in red. The disconnection of such equipment shall be operated from a centralised location on board.

9.3.1.52.5 An electric generator which is permanently driven by an engine and which does not meet the requirements of 9.3.1.52.3 above, shall be fitted with a switch capable of shutting down the excitation of the generator. A notice board with the operating instructions shall be displayed near the switch.

9.3.1.52.6 Sockets for the connection of signal lights and gangway lighting shall be permanently fitted to the vessel close to the signal mast or the gangway. Connecting and disconnecting shall not be possible except when the sockets are not live.

9.3.1.52.7 The failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals at the locations where the alarms are usually actuated.

9.3.1.53 ***Earthing***

9.3.1.53.1 The metal parts of electrical appliances in the cargo area which are not live as well as protective metal tubes or metal sheaths of cables in normal service shall be earthed, unless they are so arranged that they are automatically earthed by bonding to the metal structure of the vessel.

9.3.1.53.2 The provisions of 9.3.1.53.1 above apply also to equipment having service voltages of less than 50 V.

9.3.1.53.3 Independent cargo tanks shall be earthed.

9.3.1.53.4 Receptacles for residual products shall be capable of being earthed.

9.3.1.54-
9.3.1.55 (*Reserved*)

9.3.1.56 ***Electrical cables***

9.3.1.56.1 All cables in the cargo area shall have a metallic sheath.

9.3.1.56.2 Cables and sockets in the cargo area shall be protected against mechanical damage.

9.3.1.56.3 Movable cables are prohibited in the cargo area, except for intrinsically safe electric circuits or for the supply of signal lights and gangway lighting.

9.3.1.56.4 Cables of intrinsically safe circuits shall only be used for such circuits and shall be separated from other cables not intended for being used in such circuits (e.g. they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

9.3.1.56.5 For movable cables intended for signal lights and gangway lighting, only sheathed cables of type H 07 RN-F in accordance with standard IEC 60 245-4:1994 or cables of at least equivalent design having conductors with a cross-section of not less than 1.5 mm^2 shall be used.

These cables shall be as short as possible and installed so that damage is not likely to occur.

9.3.1.56.6 The cables required for the electrical equipment referred to in 9.3.1.52.1 (b) and (c) are accepted in cofferdams, double-hull spaces, double bottoms, hold spaces and service spaces below deck.

9.3.1.57-
9.3.1.59 (*Reserved*)

9.3.1.60 ***Special equipment***

A shower and an eye and face bath shall be provided on the vessel at a location which is directly accessible from the cargo area.

9.3.1.61-
9.3.1.70 (*Reserved*)

9.3.1.71 ***Admittance on board***

The notice boards displaying the prohibition of admittance in accordance with 8.3.3 shall be clearly legible from either side of the vessel.

9.3.1.72-
9.3.1.73 (*Reserved*)

9.3.1.74 ***Prohibition of smoking, fire or naked light***

9.3.1.74.1 The notice boards displaying the prohibition of smoking in accordance with 8.3.4 shall be clearly legible from either side of the vessel.

9.3.1.74.2 Notice boards indicating the circumstances under which the prohibition is applicable shall be fitted near the entrances to the spaces where smoking or the use of fire or naked light is not always prohibited.

9.3.1.74.3 Ashtrays shall be provided close to each exit of the accommodation and the wheelhouse.

9.3.1.75-9.3.1.91 (*Reserved*)

9.3.1.92 ***Emergency exit***

Spaces the entrances or exits of which are likely to become partly or completely immersed in the damaged condition shall have an emergency exit which is situated not less than 0.10 m above the damage waterline. This does not apply to forepeak and afterpeak.

9.3.1.93-9.3.1.99 (*Reserved*)

~~**9.3.2** ***Rules for construction of type C tank vessels***~~

~~The rules for construction of 9.3.2.0 to 9.3.2.99 apply to type C tank vessels.~~

~~**9.3.2.0** ***Materials of construction***~~

~~9.3.2.0.1~~ ~~(a) The vessel's hull and the cargo tanks shall be constructed of shipbuilding steel or other at least equivalent metal.~~

~~The independent cargo tanks may also be constructed of other materials, provided these have at least equivalent mechanical properties and resistance against the effects of temperature and fire.~~

~~(b) Every part of the vessel including any installation and equipment which may come into contact with the cargo shall consist of materials which can neither be dangerously affected by the cargo nor cause decomposition of the cargo or react with it so as to form harmful or hazardous products.~~

~~(c) Vapour pipes and gas discharge pipes shall be protected against corrosion.~~

~~9.3.2.0.2 Except where explicitly permitted in 9.3.2.0.3 below or in the certificate of approval, the use of wood, aluminium alloys or plastic materials within the cargo area is prohibited.~~

~~9.3.2.0.3 (a) The use of wood, aluminium alloys or plastic materials within the cargo area is only permitted for:~~

~~– gangways and external ladders;~~

~~– movable items of equipment (aluminium gauging rods are, however permitted, provided that they are fitted with brass feet or protected in another way to avoid sparking);~~