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 as used for the determination of the holding time (7.2.4.16.16 and 7.2.4.16.17) shall be determined by calculation. Upon completion of the vessel, the correctness of the calculation shall be checked by means of a heat balance test. The calculation and test shall be performed under supervision by the recognized classification society which classified the vessel.

The heat transmission coefficient shall be documented and kept on board. The heat transmission coefficient shall be verified at every renewal of the certificate of approval.

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, 9.3.1.27.1 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 and 9.3.1.30 *(Reserved)*

9.3.1.31 ***Engines***

9.3.1.31.1 Only internal combustion engines running on fuel with having a flashpoint above 55 °C are allowed. This provision does not apply to internal combustion engines which are part of propulsion and auxiliary systems. These systems shall meet the requirements of Chapter 30 and Annex 8, Section II, Chapter 1, and Section III, Chapter 2 of the European Standard laying down Technical Requirements for Inland Navigation vessels (ES-TRIN) as amended.[2]

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 and 9.3.1.31.4 *(Deleted)*

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 The open ends of the air pipes of each oil fuel tanks shall extend to not less than 0.5 m above the open deck. These open ends and the open ends of overflow pipes leading to 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 which are installed in the cargo area.

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2 *As available on the website of the Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure – CESNI, https://www.cesni.eu/en/documents/es-trin/.*

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 to 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 jet/spray nozzles having a diameter of not less than 12 mm shall be provided. Alternatively one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12 mm. 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, wheelhouse 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;

– The water supply system shall be capable of being put into operation from the wheelhouse and from the deck;

– Measures shall be taken to prevent the freezing of fire-mains and hydrants.

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);

(e) (*Reserved*)

(f) K_2CO_3 (potassium carbonate).

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 have a facility for extracting the extinguishing agent and the combustion gases. Such facilities shall be capable of being operated from positions outside the protected rooms and which must not be made inaccessible by a fire within such spaces. If there are permanently installed extractors, it shall not be possible for these to be switched on while the fire is being extinguished.

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 their fittings 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 also in the event of a fire, and that the required quantity of extinguishing agent can still be provided in the space to be protected in the event of a fire or of damage caused by a fire or an explosion.

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 or, if there are no such requirements, to those of a recognized classification society.

(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 vessel 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 degree 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.

* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

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 degree 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.

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* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

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 degree 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 *(Reserved)*

9.3.1.40.2.15 *Fire-fighting systems using K_2CO_3 as the extinguishing agent*

In addition to the requirements laid down in 9.3.1.40.2.1 to 9.3.1.40.2.3, 9.3.1.40.2.5, 9.3.1.40.2.6 and 9.3.1.40.2.9, fire-fighting systems using K_2CO_3 as the extinguishing agent shall comply with the following provisions:

(a) The fire-fighting system shall have a type-approval pursuant to Directive 2014/90/EU[3] or to MSC/Circ. 1270;[4]

(b) Each room shall be provided with its own firefighting system;

(c) The extinguishing agent must be stored in specially provided unpressurised tanks in the room to be protected. These tanks shall be fitted in such a way that the extinguishing agent is dispensed evenly in the room. In particular the extinguishing agent shall also work underneath the deck plates;

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* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

3 *Official Journal of the European Union, L 257 of 28 August 2014, p.146.*

4 *International Maritime Organization Circular MSC/Circ. 1270 and corrigenda — Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas extinguishing systems, as referred to in SOLAS 1974, for machinery spaces — adopted on 4 June 2008.*

(d) Each tank is separately connected with the triggering device;

(e) The quantity of dry aerosol-forming extinguishing agent relative to the room to be protected shall be at least 120 g per m^3 of the net volume of this room. This net volume is calculated according to Directive 2014/90/EU[3] or to MSC/Circ. 1270;[4]. It shall be possible to supply the extinguishing agent within 120 s.

9.3.1.40.2.16 *Permanently installed fire-extinguishing systems for protecting objects*

(a) Permanently installed fire-extinguishing systems for protecting objects are permitted for the protection of installations and equipment.

The action of the fire-extinguishing systems must be aimed directly at the objects to be protected. The range of action of fire-extinguishing systems may be limited in space by means of structural measures.

Permanently installed fire-extinguishing systems for protecting objects may already be structurally integrated into the objects concerned.

Permanently installed fire-extinguishing systems for protecting objects must be independent of the systems referred to in 9.3.1.40.2.2 to 9.3.1.40.2.16 in respect of their supply of extinguishing agent.

(b) The following requirements apply to permanently installed fire-extinguishing systems for protecting objects:

(i) 9.3.1.40.2.2, if the extinguishing agent used requires the range of action to be limited by structural measures;

(ii) 9.3.1.40.2.3 and 9.3.1.40.2.4;

(iii) 9.3.1.40.2.5 (b) and (c), in addition to the provisions of (c) of the present section;

(iv) 9.3.1.40.2.6, (a) to (e), and at each entrance to a room or in the immediate vicinity of an encapsulated object, a suitable sign for the fire-extinguishing system for physical protection must be prominently displayed;

(v) 9.3.1.40.2.7 to 9.3.1.40.2.13;

(vi) *(Reserved)*;

(vii) 9.3.1.40.2.15, (b) to (e).

Only extinguishing agents suitable for extinguishing a fire on or in the object to be protected and which are mentioned in 9.3.1.40.2.1 may be used in permanently installed fire-extinguishing systems for protecting objects.

The competent authority may authorize exemptions concerning the extinguishing agent for permanently installed fire-extinguishing systems for protecting objects which are based on a fire protection concept.

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3 *Official Journal of the European Union, L 257 of 28 August 2014, p.146.*

4 *International Maritime Organization Circular MSC/Circ. 1270 and corrigenda — Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas extinguishing systems, as referred to in SOLAS 1974, for machinery spaces — adopted on 4 June 2008.*

(c) Permanently installed fire-extinguishing systems for protecting objects must be capable of being triggered manually. Manual triggering must be possible in the immediate vicinity of the protected object. They may be triggered automatically if the triggering signal is emitted by two fire detectors with different means of detection. The triggering must occur without delay. If the fire-extinguishing system is intended to protect several spaces, it shall comprise a separate and clearly-marked triggering device for each space.

The activation of the fire-extinguishing system shall be displayed in the wheelhouse and at the entrance to the room in which the object to be protected is located. In the case of encapsulated objects, the display at the room entrance can be omitted if another display is attached to the object itself.

For manual activation, operating instructions in accordance with 9.3.1.40.2.5 (e) shall be displayed next to each triggering device, taking into account the location and nature of the object.

(d) The type and place of installation of permanently installed fire-extinguishing systems for protecting objects shall be entered in the ship's certificate.

(e) The provisions of this section do not apply to water spray systems in accordance with 9.3.1.28, 9.3.2.28 and 9.3.3.28.

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 lamps are permitted.

9.3.1.42 to 9.3.1.49 *(Reserved)*

9.3.1.50 *(Deleted)*

9.3.1.51 ***Surface temperatures of installations and equipment***

(a) Surface temperatures of electrical and non-electrical installations and equipment shall not exceed 200 °C.

(b) Surface temperatures of the outer parts of engines and of their air inlets and exhaust ducts shall not exceed 200 °C;

(c) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which the temperature classes T4, T5 or T6 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones on board shall not exceed 135 °C (T4), 100 °C (T5) or 85 °C (T6) respectively;

(d) (a) and (b) do not apply if the following requirements are met (see also 7.2.3.51.4):

(i) Accommodation, wheelhouse and service spaces where surface temperatures higher than those mentioned in (a) and (b) occur are equipped with a ventilation system according to 9.3.1.12.4 (b); or

(ii) Installations and equipment which generate surface temperatures higher than those set out in (a) or (b), respectively, must be capable of being shut down. Such installations and equipment shall be marked in red.

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

9.3.1.52.1 Electrical installations and equipment shall be of at least the 'limited explosion risk' type.

This provision does not apply to:

(a) Lighting installations in the accommodation and the wheelhouse, except for switches near to the entrances;

(b) Mobile phones, fixed telephone installations, stationary and portable computers and loading instruments in the accommodation or the wheelhouse;

(c) Electrical installations and equipment which, during a stay in the immediate vicinity of or within a shoreside assigned zone:

(i) Are extinguished; or

(ii) Are placed in premises equipped with a ventilation system according to 9.3.1.12.4;

(d) To radiotelephone installations and inland AIS (automatic identification systems) stations in the accommodation and the wheelhouse, if no part of an aerial for radiotelephone installations or AIS stations is situated above or within 2.00 m of the cargo area.

9.3.1.52.2 In the cofferdams, double-hull spaces, double bottoms and hold spaces, only hermetically sealed echo sounding devices are allowed, the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck.

9.3.1.52.3 The fixed electrical installations and equipment which do not meet the requirements set out in 9.3.1.51 (a), 9.3.1.51 (b) and 9.3.1.52.1 above and their switches shall be marked in red. The disconnection of such equipment shall be controlled from a centralized location on board.

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

9.3.1.52.5 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:

- Active cathodic corrosion protection;
- Certain limited sections of the installations situated outside the cargo area (e.g., connections of starters of diesel engines);
- The device for checking the insulation level referred to in 9.3.1.52.4.

9.3.1.52.6 An electric generator which is permanently driven by an engine and which does not meet the requirements of 9.3.1.52.1 above, shall be fitted with a multipolar switch capable of shutting down the generator. A notice board with the operating instructions shall be displayed near the switch.

9.3.1.52.7 Failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals in the wheelhouse and on the deck. The alarm must be relayed to the accommodation automatically if it has not been switched off.

9.3.1.52.8 Electrical switches, sockets and cables on deck shall be protected against mechanical damage.

9.3.1.52.9 Sockets for the connection of signal lights and gangway lighting shall be solidly fitted to the vessel close to the signal mast or the gangway. The sockets used in this area shall be designed so as to prevent connection or disconnection except when they are not live.

9.3.1.52.10 Accumulators shall be located outside the cargo area.

9.3.1.53 ***Type and location of electrical and non-electrical installations and equipment intended to be used in explosion hazardous areas***

9.3.1.53.1 On board vessels covered by the classification of zones as defined in 1.2.1, electrical and non-electrical installations and equipment used in explosion hazardous areas shall meet at least the requirements for use in the area concerned.

They shall be selected on the basis of the explosion groups/subgroups and temperature classes to which the substances to be carried belong (see columns (15) and (16) of Table C of Chapter 3.2).

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which temperature classes T4, T5 or T6 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones shall not exceed 135 °C (T4), 100 °C (T5) or 85 °C (T6).

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which temperature classes T1 or T2 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones shall not exceed 200 °C.

9.3.1.53.2 Except in the case of optical fibres, electrical cables shall be armoured or placed in a metallic sheath or in protective tubes.

Electrical cables for the active cathodic protection of the shell plating shall be led through thick-walled steel tubes with gastight connections up to the main deck.

9.3.1.53.3 Movable electric cables are prohibited in the explosion danger area, except for electric cables for intrinsically safe electric circuits or for connecting:

(a) Signal lights and lighting for gangways, provided the connection point (for example, the socket) is permanently fitted to the vessel close to the signal mast or gangway;

(b) The power network on a vessel to a land-based power network; provided

– The electric cables and the power supply unit conform with a valid standard (for example, EN 15869-03: 2010);

– The power supply unit and connectors are located outside of the explosion danger area.

Connecting and disconnecting sockets/connectors shall only be possible when they are not live.

9.3.1.53.4 Electrical cables of intrinsically safe circuits shall be separated from other cables not intended for use in such circuits and shall be marked (they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

9.3.1.53.5 For movable electrical cables permitted under 9.3.1.53.3, only sheathed cables of type H07RN-F in accordance with standard IEC 60245-4:2011[5] or electrical cables of at least equivalent design having conductors with a cross-section of not less than 1.50 mm^2 shall be used.

9.3.1.54 ***Earthing***

9.3.1.54.1 The metal parts of electrical installations and equipment in the cargo area which are not live, as well as the 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.

9.3.1.54.2 The provisions of 9.3.1.54.1 also apply to installations with a voltage of less than 50 Volts.

9.3.1.54.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

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

9.3.1.55 *(Reserved)*

9.3.1.56 *(Deleted)*

9.3.1.57 to 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. The water shall meet the minimum quality requirements applicable to drinking water on board vessels.

NOTE: *Additional decontamination substances for the purpose of avoiding corrosion of eyes and skin are allowed.*

[5] *Identical to EN 50525-2-21: 2011.*

A connection of this special equipment with the area outside the cargo zone is accepted.

A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the shower and the eye and face bath system outside the cargo area.

9.3.1.61 *(Reserved)*

9.3.1.62 *(Deleted)*

9.3.1.63 to 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 and 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 to 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 to 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***

9.3.2.0.1.1 The vessel's hull and the cargo tanks shall be constructed of shipbuilding steel or other at least equivalent metal, special provisions of the additional requirements/remarks of column (20) of Table C of Chapter 3.2 excepted.

9.3.2.0.1.2 Venting piping shall be protected against corrosion.

9.3.2.0.1.3 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.

9.3.2.0.2 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. In case it has not been possible to examine this during classification and inspection of the vessel a relevant reservation shall be entered in the vessel substance list according to 1.16.1.2.5.

9.3.2.0.3 Except where explicitly permitted in 9.3.2.0.4 below or in the certificate of approval, the use of wood, aluminium alloys, plastic materials, rubber, glass or composite within the cargo area is prohibited.

9.3.2.0.4 The use of wood, aluminium alloys, plastic materials, rubber, glass or composite in the cargo area is permitted as shown in the following table:

(X means "allowed")	***Wood***	***Aluminium alloys***	***Plastic material / Composite***	***Rubber***	***Glass***
Permanently installed materials					
Chocking of cargo tanks which are independent of the vessel's hull and chocking of installations and equipment	X		X		
Masts and similar round timber	X	X	X		
Engine parts		X	X		
Protective covers of engines and pumps			X		
Notice boards (Prohibition of admittance and smoking)		X	X		
Parts of the electrical installation		X	X		
	According to the applicable technical norms				
Parts of the loading and unloading installation, e.g., gaskets		X	X	X	
Supports and stops of any kind	X		X		
Ventilators, including hose assemblies for ventilation		X	X		
Parts of the water spray system, the shower and the eye and face bath		X	X		
Insulation of cargo tanks and of piping for loading and unloading, gas discharge pipes and heating pipes		X	X	X	
Coating of cargo tanks and of piping for loading and unloading		X	X	X	
Insulation of cargo tanks (Table C, Column (20), Remark 32)		X	X	X	
All kinds of gaskets		X	X	X	
	Subject to Table C, Column (20), Remark 39 a)				
Cables for electrical equipment			X	X	
	According to the applicable technical norms				
Boxes, cabinets or other receptacles placed on the deck for storage of disposal and recovery equipment, for capstans, extinguishers, fire hoses, etc.		X	X		
Boxes, cabinets or other receptacles placed on the deck for storage of disposal of waste		X	X		
	For oily and greasy wastes fire-resistant receptacles only (7.2.1.21.6)				

(X means "allowed")	***Wood***	***Aluminium alloys***	***Plastic material / Composite***	***Rubber***	***Glass***
Portable equipment					
Gangways	X	X	X	X	
External ladders and passageways (gangways)		X	X	X	
Outboard ladders		X	X	X	
Ladders		X	X	X	
Cleaning equipment, e.g. brooms	X	X	X	X	
Fire extinguishers, portable gas detectors,		X	X	X	
Rescue winches		X			
Personal protective and safety equipment, rescue equipment conforming to ES-TRIN		X	X	X	
Driptrays			X		
Fenders	X		X	X	
Mooring lines, ropes for tenders, etc.			X		
	Respecting 7.2.4.76				
Mat under hose assemblies for loading and unloading piping system			X	X	
Fire hoses, air hoses, hoses for cleaning the deck, etc.			X	X	
Other kinds of hoses	*In line with 8.1.6.2 and norms mentioned*				
Aluminium gauging rods		X			
	If fitted with brass feet or protected in another way to avoid sparking.				
Sampling equipment			X		
Receptables for oily and greasy wastes (7.2.4.1)		X	X		
		Fire-resistant receptables, (7.2.1.21.6)			
Receptables for residual products and receptables for slops		X	X		
	Respecting ADR, RID or IMDG-Code regarding the admission requirements of materials.				
Sampling bottles			X		X
	Respecting ADR, regarding the admission requirements of materials.				
Photo-optical copies of the certificate of approval according to 8.1.2.6 or 8.1.2.7, and of the vessel's certificate, the measurement certificate and the Rhine navigation membership certificate		X	X		
Aluminum basket for storing of mooring wires/lines		X			
Boot's hook	X	X	X		
Ship's boat		X	X		
(In case of 7.2.3.29.1 and 7.2.3.31.1 allowed in the cargo area)	*Only when the material shall not readily ignite*				

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

9.3.2.0.6 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.

9.3.2.1 ***Vessel record***

NOTE: *For the purpose of this paragraph, the term "owner" has the same meaning as in 1.16.0.*

The vessel record shall be retained by the owner who shall be able to provide this documentation at the request of the competent authority and the recognized classification society.

The vessel record shall be maintained and updated throughout the life of the vessel and shall be retained for 6 months after the vessel is taken out of service.

Should a change of owner occur during the life of the vessel the vessel record shall be transferred to the new owner.

Copies of the vessel record or all necessary documents shall be made available on request to the competent authority for the issuance of the certificate of approval and for the recognized classification society or inspection body for first inspection, periodic inspection, special inspection or exceptional checks.

9.3.2.2 to 9.3.2.7 *(Reserved)*

9.3.2.8 ***Classification***

9.3.2.8.1 The tank vessel shall be built under the survey of a recognised classification society and be classed in its highest class.

The vessel's highest class shall be continued. This shall be confirmed by an appropriate certificate issued by the recognized classification society (certificate of class).

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 recognized classification society shall draw up a vessel substance list mentioning all the dangerous goods accepted for carriage by the tank vessel (see also 1.16.1.2.5).

9.3.2.8.2 to 9.3.2.8.4 *(Deleted)*

9.3.2.9 *(Reserved)*

9.3.2.10 ***Protection against the penetration of dangerous gases and the spreading of dangerous liquids***

9.3.2.10.1 The vessel shall be designed so as to prevent dangerous gases and liquids from penetrating into the accommodation, wheelhouse and service spaces. None of the windows in these spaces shall be capable of being opened unless its intended use is as an emergency exit and it is marked as such.

9.3.2.10.2 Liquid-tight protective coamings shall be fitted on deck at the height of the external bulkheads of the cargo tanks, at a maximum distance of 0.60 m from the outer cofferdam bulkheads or the hold end bulkheads. The protective coamings shall either extend over the entire width of the vessel or be fixed between the longitudinal spill coamings so as to prevent liquids from entering the forepeak and afterpeak. The height of the protective coamings and the spill coamings shall be at least 0.075 m. The protective coaming may correspond to the protection wall prescribed in 9.3.2.10.3 if the protection wall extends across the entire width of the vessel.

9.3.2.10.3 If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the use of installations and equipment that are not of at least the 'limited explosion risk' type is not permitted during loading and unloading operations in parts of the deck outside the cargo area, unless those parts are protected against the penetration of gases and liquids by a gas- and liquid-tight protection wall. The wall must either extend over the full width of the vessel or surround the areas to be protected in a U-shaped form. The wall must cover the whole width of the area to be protected and at least 1.00 m in the direction opposite to the cargo area (see Classification of zones diagram). The height of the wall shall be at least 1.00 m above the adjacent cargo deck area in the cargo area. The outer wall and side walls of the accommodation can be considered as a protection wall if they do not include openings and if the dimensions are complied with.

A protection wall is not required where the distance between the areas to be protected and the high velocity vent valve, the shore connections of the piping for loading and unloading, the compressor on deck and the opening of the closest pressure tanks is at least 12.00 m.

9.3.2.10.4 On deck, the lower edges of door-openings in the sidewalls of superstructures 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 spaces and double bottoms.

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

9.3.2.11 ***Hold spaces and cargo tanks***

9.3.2.11.1 (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 in m 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.

(b) The relative density of the substances to be carried shall be taken into consideration in the design of the cargo tanks. The maximum relative density shall be indicated in the certificate of approval;

(c) When the vessel is provided with pressure cargo tanks, these tanks shall be designed for a working pressure of 400 kPa (4 bar);

(d) For vessels with a length of not more than 50.00 m, the length of a cargo tank shall not exceed 10.00 m; and

For vessels with a length of more than 50.00 m, the length of a cargo tank shall not exceed 0.20 L;

This provision does not apply to vessels with independent built–in cylindrical tanks having a length to diameter ratio ≤ 7.

9.3.2.11.2 (a) In the cargo area (except cofferdams) the vessel shall be designed as a flush–deck double-hull vessel, with double-hull spaces and double bottoms, but without a trunk;

Cargo tanks independent of the vessel's hull and refrigerated cargo tanks may only be installed in a hold space which is bounded by double-hull spaces and double bottoms in accordance with 9.3.2.11.8 below. The cargo tanks shall not extend beyond the deck;

(b) The cargo tanks independent of the vessel's hull shall be fixed so that they cannot float. Refrigerated cargo tank fastenings shall meet the requirements of a recognised classification society;

(c) The capacity of a suction well shall be limited to not more than 0.10 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;

(e) A local recess in the cargo deck, contained on all sides, with a depth greater than 0.10 m, designed to house the cargo pump, is permitted if it fulfils the following conditions:

- The recess shall not be greater than 1.00 m in depth;
- The recess shall be located not less than 6.00 m from entrances and openings to accommodation and service spaces outside the cargo area;
- The recess shall be located at a minimum distance from the side plating equal to one quarter of the vessel's breadth;
- All pipes linking the recess to the cargo tanks shall be fitted with shut-off devices fitted directly on the bulkhead;
- All the controls required for the equipment located in the recess shall be activated from the deck;
- It shall be possible to drain the recess using a system installed on deck in the cargo area and independent of any other system;
- The recess shall be provided with a level alarm device which activates the draining system and triggers a visual and audible alarm in the wheelhouse and on the deck when liquid accumulates at the bottom;

– When the recess is located above the cofferdam, the engine room bulkhead shall have an insulation of Class "A-60" as defined in SOLAS 74, Chapter II-2, Regulation 3;

– When the cargo area is fitted with a water-spray system, electrical equipment located in the recess shall be protected against infiltration of water;

– Pipes connecting the recess to the hull shall not pass through the cargo tanks;

(f) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2 and the recess is deeper than 0.50 m, then it shall be provided with a permanent gas detection system which automatically indicates the presence of flammable gases by means of direct-measuring sensors and actuates a visual and audible alarm when the gas concentration has reached 20% of the LEL of the cargo or 20% of the LEL of n-Hexane, whichever is the more critical value. The sensors of this system shall be placed at suitable positions at the bottom of the recess.

Measurement shall be continuous.

Visual and audible alarms shall be installed in the wheelhouse and on deck and, when the alarm is actuated, the vessel loading and unloading system shall be shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of visual and audible alarms.

The alarm shall be automatically relayed to the accommodation if it has not been switched off.

9.3.2.11.3 (a) The cargo tanks shall be separated by cofferdams of at least 0.60 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine rooms and service spaces, from the vessel's ends. Where the cargo tanks are installed in a hold space, a space of not less than 0.50 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead of Class "A-60" as defined in SOLAS 74, Chapter II-2, Regulation 3, shall be deemed equivalent to a cofferdam. For pressure cargo tanks, the 0.50 m distance may be reduced to 0.20 m;

(b) Hold spaces, cofferdams and cargo tanks shall be capable of being inspected;

(c) All spaces in the cargo area shall be capable of being ventilated. It has to be possible to check their gas-free condition.

9.3.2.11.4 The bulkheads bounding the cargo tanks, cofferdams and 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 cofferdam or service space in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 9.3.2.17.5.

The bulkhead between the cargo tank and the cargo pump room below deck may be fitted with penetrations provided that they conform to the provisions of 9.3.2.17.6. The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading or unloading piping are fitted with shut-off devices in the cargo tank from which they come. These shut-off devices shall be operable from the deck.

9.3.2.11.5 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 provisions of 9.3.2.32.

9.3.2.11.6 (a) A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. 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 piping for loading and unloading shall be fitted within the service space referred to under (a) above;

Piping for loading and unloading may be fitted in the cargo pump rooms below deck only when they conform to the provisions of 9.3.2.17.6.

9.3.2.11.7 For double-hull construction with the cargo tanks integrated in the vessel's structure, the distance between the side wall of the vessel and the longitudinal bulkhead of the cargo tanks shall be not less than 1.00 m. A distance of 0.80 m may however be permitted, provided that, compared with the scantling requirements specified in the rules for construction of a recognised classification society, the following reinforcements have been made:

(a) 25% increase in the thickness of the deck stringer plate;

(b) 15% increase in the side plating thickness;

(c) Arrangement of a longitudinal framing system at the vessel's side, where depth of the longitudinals shall be not less than 0.15 m and the longitudinals shall have a face plate with the cross-sectional area of at least 7.0 cm^2;

(d) The stringer or longitudinal framing systems shall be supported by web frames, and like bottom girders fitted with lightening holes, at a maximum spacing of 1.80 m. These distances may be increased if the longitudinals are strengthened accordingly.

When a vessel is built according to the transverse framing system, a longitudinal stringer system shall be arranged instead of (c) above. The distance between the longitudinal stringers shall not exceed 0.80 m and their depth shall be not less than 0.15 m, provided they are completely welded to the frames. The cross-sectional area of the facebar or faceplate shall be not less than 7.0 cm^2 as in (c) above. Where cut-outs are arranged in the stringer at the connection with the frames, the web depth of the stringer shall be increased with the depth of cut-outs.

The mean depth of the double bottoms shall be not less than 0.70 m. It shall, however, never be less than 0.60 m.

The depth below the suction wells may be reduced to 0.50 m.

Alternative constructions in accordance with 9.3.4 are permitted.

9.3.2.11.8 When a vessel is built with cargo tanks located in a hold space or refrigerated cargo tanks, the distance between the double walls of the hold space shall be not less than 0.80 m and the depth of the double bottom shall be not less than 0.60 m.

9.3.2.11.9 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 personal protective equipment 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 difficulties, if necessary by means of fixed equipment.

9.3.2.11.10 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so 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 difficulties. 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 an injured or unconscious person to be removed from the bottom of such a space 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.

9.3.2.12 ***Ventilation***

9.3.2.12.1 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.

9.3.2.12.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water, hold spaces and cofferdams shall be provided with ventilation systems.

9.3.2.12.3 (a) A service space located within the cargo area below deck shall be provided with a ventilation system. The capacity of the fans shall be sufficient to ensure 20 complete changes of air per hour based on the volume of the service 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.

(b) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then 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.

9.3.2.12.4 (a) Ventilation shall be provided for the accommodation, wheelhouse and service spaces.

(b) The ventilation system in such spaces shall meet the following requirements:

(i) The air intakes shall be located as far away as possible, and not less than 6.00 m from the cargo area and not less than 2.00 m above the deck;

(ii) Pressure of at least 0.1 kPa (0.001 bar) may be maintained in the premises;

(iii) A breakdown alarm is integrated;

(iv) The ventilation system, including the breakdown alarm, shall be at least of the 'limited explosion risk' type;

(v) A gas detection system conforming to conditions 1. to 4. below is connected to the ventilation system:

1. It is appropriate at least for use in zone 1, explosion group IIC and temperature class T4;
2. It is equipped with sensors;
   - On the suction inlets of the ventilation systems; and
   - Directly below the top edge of the sill of the entrance doors;
3. Its t90 response time is lower than or equal to 4 s;
4. Measurement shall be continuous;

(vi) In the service spaces, the ventilation system is linked to the emergency lighting, which shall be at least of the 'limited explosion risk' type;

This emergency lighting is not necessary if the lighting installations in the service spaces are of at least the 'limited explosion risk' type;

(vii) The suction of the ventilation system and installations and equipment that do not meet the requirements set out in 9.3.2.51 (a) and (b) and 9.3.2.52.1 must be shut down when a concentration of 20% of LEL of n-Hexane is reached;

The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;

(viii) In the event of failure of the ventilation system or the gas detection installations in the accommodation, installations and equipment in the accommodation that do not meet the requirements set out in 9.3.2.51 (a) and (b) and 9.3.2.52.1 must be stopped;

The failure shall be indicated in the accommodation, the wheelhouse and on the deck by visual and audible signals;

(ix) In the event of failure of the ventilation system or the gas detection installations in the wheelhouse or service spaces, installations and equipment in those spaces that do not meet the requirements set out in 9.3.2.51 (a) and (b) and 9.3.2.52.1 must be shut down;

The failure shall be indicated in the wheelhouse and on the deck by visual and audible signals. The alarm must be relayed to the accommodation automatically if it has not been switched off;

(x) Any switching-off shall take place immediately and automatically and, if necessary, shall activate the emergency lighting;

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

(c) If there is no ventilation system or the ventilation system of a space does not comply with all the requirements set out in (b) above, any installations or equipment present in that space that may, if switched on, give rise to surface temperatures higher than those mentioned in 9.3.2.51 (a) and (b) or that do not meet the requirements set out in 9.3.2.52.1 must be capable of being switched off.

9.3.2.12.5 *(Deleted)*

9.3.2.12.6 Notice boards shall be fitted at the ventilation inlets indicating the conditions under which they shall be closed. All ventilation inlets of accommodation, wheelhouse and service spaces leading to the open air outside the cargo area shall be fitted with devices permanently fixed according to 9.3.2.40.2.2 (c), enabling them to be closed rapidly. It shall be clear whether they are open or closed.

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 that area.

9.3.2.12.7 *(Deleted)*

9.3.2.13 ***Stability (general)***

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

9.3.2.13.2 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.

9.3.2.13.3 Proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.16.1.2.5.

For every loading operation, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements.

Intermediate stages during operations shall also be taken into consideration.

The proof of sufficient stability shall be shown for every operating, loading and ballast condition in the stability booklet, to be approved by the recognized classification society, which classes the vessel. If it is unpractical to pre-calculate the operating, loading and ballast conditions, a loading instrument approved by the recognised classification society which classes the vessel shall be installed and used which contains the contents of the stability booklet.

NOTE: *A stability booklet shall be worded in a form comprehensible for the responsible master and containing the following details:*

General description of the vessel:

- *General arrangement and capacity plans indicating the assigned use of compartments and spaces (cargo tanks, stores, accommodation, etc.);*
- *A sketch indicating the position of the draught marks referring to the vessel's perpendiculars;*
- *A scheme for ballast/bilge pumping and overflow prevention systems;*
- *Hydrostatic curves or tables corresponding to the design trim, and, if significant trim angles are foreseen during the normal operation of the vessel, curves or tables corresponding to such range of trim are to be introduced;*

- *Cross curves or tables of stability calculated on a free trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions, with an indication of the volumes which have been considered buoyant;*

- *Tank sounding tables or curves showing capacities, centres of gravity, and free surface data for all cargo tanks, ballast tanks and compartments, drinking water and sewage water tanks and tanks containing products for the operation of the vessel;*

- *Lightship data (weight and centre of gravity) resulting from an inclining test or deadweight measurement in combination with a detailed mass balance or other acceptable measures. Where the above-mentioned information is derived from a sister vessel, the reference to this sister vessel shall be clearly indicated, and a copy of the approved inclining test report relevant to this sister vessel shall be included;*

- *A copy of the approved test report shall be included in the stability booklet;*

- *Operating loading conditions with all relevant details, such as:*

  - *Lightship data, tank fillings, stores, crew and other relevant items on board (mass and centre of gravity for each item, free surface moments for liquid loads);*

  - *Draughts amidships and at perpendiculars;*

  - *Metacentric height corrected for free surfaces effect;*

  - *Righting lever values and curve;*

  - *Longitudinal bending moments and shear forces at read–out points;*

  - *Information about openings (location, type of tightness, means of closure); and*

  - *Information for the master;*

- *Calculation of the influence of ballast water on stability with information on whether fixed level gauges for ballast tanks and compartments have to be installed or whether the ballast tanks or compartments shall be completely full or completely empty when underway.*

9.3.2.13.4 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.

9.3.2.14 ***Stability (intact)***

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

9.3.2.14.2 For vessels with cargo tanks of more than 0.70 B in width, proof shall be furnished that the following stability requirements have been complied with:

(a) In the positive area of the righting lever curve up to immersion of the first non-weathertight opening there shall be a righting lever (GZ) of not less than 0.10 m;

(b) The surface of the positive area of the righting lever curve up to immersion of the first non-weathertight opening and in any event up to an angle of heel $\leq 27°$ shall not be less than 0.024 m.rad;

(c) The metacentric height (GM) shall be not less than 0.10 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

9.3.2.14.3 The most stringent requirement of 9.3.2.14.1 and 9.3.2.14.2 is applicable to the vessel.

9.3.2.15 ***Stability (damaged condition)***

9.3.2.15.1 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 inboard from the vessel's side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, the distance allowed by section 9.3.4, reduced by 0.01 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 sump 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%.

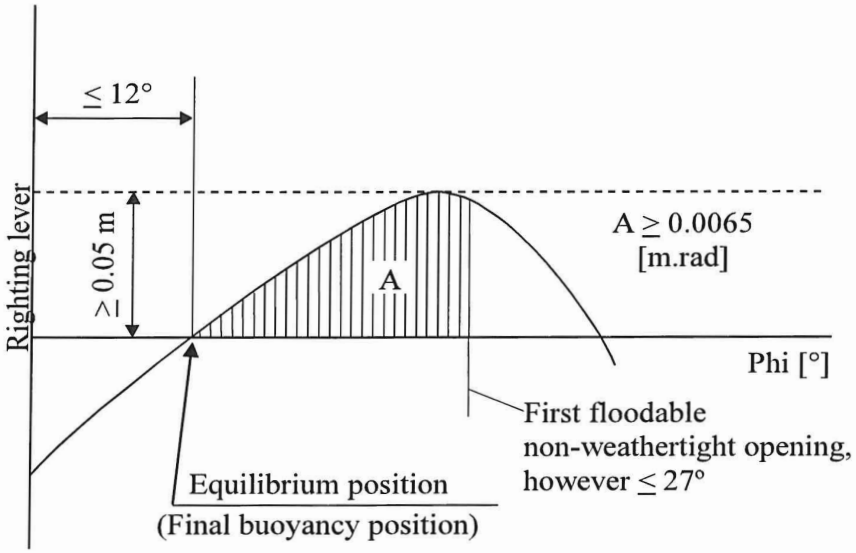
For the main engine room only the one–compartment standard need be taken into account, i.e. the end bulkheads of the engine room shall be assumed as not damaged.

9.3.2.15.2 For the intermediate stage of flooding the following criteria have to be fulfilled:

GZ ≥ 0.03m
Range of positive GZ: 5°.

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 the stability calculation.

The positive range of the righting lever curve beyond the stage of equilibrium shall have a righting lever 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-watertight opening and in any event up to an angle of heel ≤ 27°. If non-weathertight openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.



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

9.3.2.15.4 Where 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.

9.3.2.16 ***Engine rooms***

9.3.2.16.1 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.

9.3.2.16.2 The engine rooms shall be accessible from the deck; the entrances shall not face the cargo area. Where 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.

9.3.2.17 ***Accommodation and service spaces***

9.3.2.17.1 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 the 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.

9.3.2.17.2 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 face the cargo area.

9.3.2.17.3 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, unloading and degassing
without the permission of the master.
Close immediately.

9.3.2.17.4 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.

9.3.2.17.5

(a) Driving shafts of the bilge or ballast pumps in the cargo area may penetrate through the bulkhead between the service space and the engine room, provided the arrangement of the service space is in compliance with 9.3.2.11.6.

(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 and piping for measuring, control and alarm systems, provided that the penetration have been approved by a recognised classification society. The penetrations shall be gastight. Penetrations through a bulkhead of Class "A-60" as defined in SOLAS 74, Chapter II-2, Regulation 3, shall have an equivalent fire protection.

(e) Pipes may penetrate 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 9.3.2.11.4, 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.

9.3.2.17.6 A service space located within the cargo area below deck shall not be used as a cargo pump room for the loading and unloading system, except where:

- The cargo pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an insulation of Class "A-60" as defined in 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 9.3.2.17.5 (a);
- Ventilation exhaust outlets are located not less than 6.00 m from entrances and openings of the accommodation, wheelhouse and service spaces outside the cargo area;
- The access hatches and ventilation inlets can be closed from the outside;
- All piping for loading and unloading as well as that of stripping systems is provided with shut-off devices at the pump suction side in the cargo pump room immediately at the bulkhead. The necessary operation of the control devices in the pump room, starting of pumps and control of the liquid flow rate shall be effected from the deck;
- The bilge of the cargo pump room is equipped with a gauging device for measuring the filling level which activates a visual and audible alarm in the wheelhouse when liquid is accumulating in the cargo pump room bilge;
- The cargo pump room is provided with a permanent oxygen detection system which automatically indicates the amount of oxygen and which actuates a visual and audible alarm when the oxygen concentration has reached 19.5% by volume. The sensors of this system shall be placed at suitable positions at the bottom and at a height of 2.00 m. Measurement shall be continuous and displayed near to the entrance. Audible and visual alarms shall be installed in the wheelhouse and in the cargo pump room and, when the alarm is actuated, the loading and unloading system shall be shut down;
- Failure of the oxygen measuring system shall activate a visual and audible alarm in the wheelhouse and on deck. The alarm must be relayed to the accommodation automatically if it has not been switched off;
- The ventilation system prescribed in 9.3.2.12.3 has a capacity sufficient to ensure not less than 30 changes of air per hour based on the total volume of the service space.

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the cargo pump room shall also be provided with a permanent gas detection system which automatically indicates the presence of flammable gases and actuates a visual and audible alarm when the gas concentration has reached 20% of the LEL of n-Hexane or of the calibration gas prescribed by the system's manufacturer.

The sensors of this gas detection system shall be placed at suitable positions at the bottom and directly below the deck. Measurement shall be continuous and displayed near to the entrance.

Audible and visual alarms shall be installed in the wheelhouse and in the cargo pump room and, when the alarm is actuated, the loading and unloading system shall be shut down.

Any failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by a visual and audible warning. The alarm must be relayed to the accommodation automatically if it has not been switched off.

9.3.2.17.7 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.

9.3.2.18 ***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.

9.3.2.19 *(Reserved)*

9.3.2.20 ***Arrangement of cofferdams***

9.3.2.20.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 9.3.2.11.6 shall be accessible through an access hatch.

9.3.2.20.2 Cofferdams shall be capable of being filled with water and emptied by means of a pump. Filling shall be effected within 30 minutes. These requirements are not applicable when the bulkhead between the engine room and the cofferdam comprises fire-protection insulation "A-60" in accordance with SOLAS 74, Chapter II-2, Regulation 3, or has been fitted out as a service space. The cofferdams shall not be fitted with inlet valves.

9.3.2.20.3 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

9.3.2.20.4 If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2 then the ventilation openings of cofferdams shall be fitted with a flame arrester capable of withstanding a deflagration. The flame arresters shall be chosen according to the explosion groups/subgroups of the substances foreseen for inclusion in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2).

9.3.2.21 ***Safety and control installations***

9.3.2.21.1 Cargo tanks shall be provided with the following equipment:

(a) a mark inside the tank indicating the degree of filling of the cargo tank of 95%;

(b) a level gauge;

(c) a level alarm device which is activated at the latest when a degree of filling of the cargo tank of 90% is reached;

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

(e) an instrument for measuring the pressure of the vapour phase inside the cargo tank;

(f) an instrument for measuring the temperature of the cargo, if in column (9) of Table C of Chapter 3.2, a cargo heating installation or a possibility of heating the cargo is required on board, or if a maximum temperature is indicated in column (20) of Table C of Chapter 3.2;

(g) a connection for a closed-type or partly closed-type sampling device, and/or at least one sampling opening as required in column (13) of Table C of Chapter 3.2. The connection shall be fitted with a shut-off device resistant to the internal pressure at the connection;

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the flame arrester plate stack capable of withstanding steady burning of the sampling opening shall be selected according to the explosion groups/subgroups of the substances foreseen for inclusion in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2).

9.3.2.21.2 When the degree of filling of the cargo tank 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.

9.3.2.21.3 The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The permissible maximum filling levels of 95% and 97%, as given in the list of substances, 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.

9.3.2.21.4 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.

9.3.2.21.5 (a) The high level sensor referred to in 9.3.2.21.1 (d) above 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 + A1:2007 + A2:2012 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 piping.

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 + A1:2007 + A2:2012, 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 piping.

(c) Vessels which may be delivering products required for operation of vessels shall be equipped with a transhipment facility compatible with European standard EN 12827:1999 and a rapid closing device enabling refuelling to be interrupted. It shall be possible to actuate this rapid closing device by means of an electrical signal from the overflow prevention system. The electrical circuits actuating the rapid closing device shall be secured according to the quiescent current principle or other appropriate error detection measures. The state of operation of electrical circuits which cannot be controlled using the quiescent current principle shall be capable of being easily checked.

It shall be possible to actuate the rapid closing device independently of the electrical signal.

The rapid closing device shall actuate a visual and audible alarm on board.

9.3.2.21.6 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 "intrinsically safe apparatus".

9.3.2.21.7 When the pressure or temperature exceeds a set value, instruments for measuring the vacuum or overpressure of the gaseous phase in the cargo tank or the temperature of the cargo shall activate a visual and audible alarm in the wheelhouse and on deck. The alarm must be relayed to the accommodation automatically if it has not been switched off.

When the pressure exceeds the set value during loading and unloading, the instrument for measuring the pressure shall, by means of the plug referred to in 9.3.2.21.5 above, immediately initiate an electrical contact which shall put into effect measures to interrupt the loading or unloading operation. When the vessel's own discharge pump is used, it shall be switched off automatically.

The instrument for measuring the overpressure or vacuum shall activate the alarm at latest when:

(a) An overpressure equal to 1.15 times the opening pressure of the pressure relief valves/high velocity vent valves is reached; or

(b) The lower threshold of the design pressure of the vacuum valves, but not exceeding a vacuum of 5 kPa (0.05 bar), is reached.

The maximum permissible temperature is indicated in column (20) of Table C of Chapter 3.2. The sensors for the alarms mentioned in this paragraph may be connected to the alarm device of the sensor.

When it is prescribed in column (20) of Table C of Chapter 3.2, the instrument for measuring the overpressure of the gaseous phase in the cargo tank shall actuate a visible and audible alarm in the wheelhouse when the overpressure exceeds 40 kPa (0.4 bar) during the voyage. The alarm must be relayed to the accommodation automatically if it has not been switched off. It shall be possible to read the gauges in direct proximity to the control for the water spray system.

9.3.2.21.8 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 9.3.2.21.1 (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.

9.3.2.21.9 The vessel shall be so equipped that loading or unloading operations can be interrupted by means of switches, i.e. the quick closing 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).

This provision applies only when prescribed in column (20) of Table C of Chapter 3.2.

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

9.3.2.21.10 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 9.3.2.27.

9.3.2.22 ***Cargo tank openings***

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

(b) Cargo tank openings with a cross-section of more than 0.10 m^2 and openings of safety devices for preventing overpressures shall be located not less than 0.50 m above deck.

9.3.2.22.2 Cargo tank openings shall be fitted with gastight closures capable of withstanding the test pressure in accordance with 9.3.2.23.2

9.3.2.22.3 Closures which are normally used during loading or unloading operations shall not cause sparking when operated.

9.3.2.22.4 (a) Each cargo tank or group of cargo tanks connected to a common venting piping shall be fitted with:

– A connection for the safe return ashore of gases expelled during loading;

– A safe depressurization device for the cargo tanks, on which the position of the shut-off valve indicates clearly whether it is open or shut;

– Safety devices for preventing unacceptable overpressures or vacuums.

The opening pressure of the safety valves shall be permanently marked on the valves;

The setting of the pressure relief valves shall be such that during the transport operation they do not blow off until the maximum permissible working pressure of the cargo tanks is reached;

The gases shall be discharged upwards;

The outlets of the pressure relief valves shall be located not less than 1.00 m above the deck and at a distance of not less than 6.00 m from the openings of accommodation, the wheelhouse and the service spaces outside the cargo area. No equipment shall be present in a circle of 1.00 m radius around the outlet of the pressure relief valve outlets. This area shall be marked as a danger zone;

(b) When the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which explosion protection is required in column (17) of Table C of Chapter 3.2:

– At the connection to each cargo tank, the venting piping shall be equipped with a flame arrester capable of withstanding a detonation and the vacuum valve shall be equipped with a flame arrester capable of withstanding a deflagration; and

– The device for the safe depressurization of cargo tanks shall be deflagration safe and capable of withstanding steady burning;

(c) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, or for which there is a T in column (3b) of Table C of Chapter 3.2, then the pressure relief valve shall be designed as a high velocity vent valve;

(d) If a shut-off device is to be mounted between the venting piping and the cargo tank, it shall be placed between the cargo tank and the flame arrester, and each cargo tank shall be equipped with pressure relief valves;

(e) The autonomous protection systems mentioned in (b) and (c) shall be chosen according to the explosion groups/subgroups of the substances foreseen for inclusion in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2). The outlets of the high-velocity vent valves shall be located not less than 2.00 m above the deck and at a distance of not less than 6.00 m from the openings of the accommodations, the wheelhouse and the service spaces outside the cargo area. This height may be reduced to 1.00 m when there is no drive unit within a radius of 1.00 m around the pressure relief valve outlet. This area shall be marked as a danger zone;

If the high velocity vent valve, the vacuum valve, the flame arresters and the venting piping are required to be heatable, the devices concerned shall be suitable for the relevant temperature.

9.3.2.22.5 ***Venting piping***

(a) When two or more cargo tanks are connected to common venting piping, it is sufficient that the equipment according to 9.3.2.22.4 (safety valves to prevent unacceptable overpressures and vacuums, high velocity vent valve, vacuum valve protected against deflagrations, safe pressure relief device for cargo tanks protected against deflagrations) is installed on the joint venting piping (see also 7.2.4.16.7);

(b) When each cargo tank is connected to its own venting piping, each cargo tank or the associated venting piping shall be equipped according to 9.3.2.22.4.

9.3.2.23 ***Pressure tests***

9.3.2.23.1 The cargo tanks, residual cargo tanks, cofferdams, piping for loading and unloading shall be subjected to initial tests before being put into service and thereafter at prescribed intervals.

Where a heating system is provided inside the cargo tanks, the heating coils shall be subjected to initial tests before being put into service and thereafter at prescribed intervals.

9.3.2.23.2 The test pressure for the cargo tanks and residual cargo tanks shall be not less than 1.3 times the construction pressure. The test pressure for the cofferdams and open cargo tanks shall be not less than 10 kPa (0.10 bar) gauge pressure.

9.3.2.23.3 The test pressure for piping for loading and unloading shall be not less than 1,000 kPa (10 bar) gauge pressure.

9.3.2.23.4 The maximum intervals for the periodic tests shall be 11 years.

9.3.2.23.5 The procedure for pressure tests shall comply with the provisions established by the competent authority or a recognised classification society.

9.3.2.24 ***Regulation of cargo pressure and temperature***

9.3.2.24.1 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 recognised classification society and shall ensure safety for a minimum time of three times the operation period;

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

9.3.2.24.2 The systems prescribed in 9.3.2.24.1 shall be constructed, installed and tested to the satisfaction of the recognised 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.

9.3.2.24.3 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.

9.3.2.25 ***Pumps and piping***

9.3.2.25.1 Pumps, compressors and accessory loading and unloading piping shall be placed in the cargo area. Cargo pumps shall be capable of being shut down from the cargo area and, in addition, from a position outside the cargo area. Cargo pumps 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.

9.3.2.25.2 (a) Piping 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 inside the cargo pump room.

(b) The piping for loading and unloading shall be arranged so that, after loading or unloading operations, the liquid remaining in these pipes may be safely removed and may flow either into the vessel's tanks or the tanks ashore.

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

(d) The piping for loading and unloading located on deck, with the exception of the shore connections, shall be located not less than a quarter of the vessel's breadth from the outer shell.

(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 venting piping and shore connections of the piping for loading and unloading, through which the loading or unloading operation is carried out, shall be fitted with a shut-off device. However, each shore connection shall be fitted with a blind flange when it is not in operation.

(g) *(Deleted)*

(h) The flanges and stuffing boxes shall be provided with a spray protection device.

(i) Piping for loading and unloading, and venting piping, shall not have flexible connections fitted with sliding seals.

9.3.2.25.3 *(Deleted)*

9.3.2.25.4 (a) Every component of the piping for loading and unloading shall be electrically connected to the hull.

(b) The piping for loading shall extend down to the bottom of the cargo tanks.

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

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

9.3.2.25.7 The piping for loading and unloading shall be fitted with pressure gauges at the outlet of the pumps. The permissible maximum overpressure or vacuum value shall be indicated on each measuring device. Readings shall be possible in all weather conditions.

9.3.2.25.8 (a) When piping for loading and unloading are used for supplying the cargo tanks with washing or ballast water, the suctions of these pipes shall be located within the cargo area but outside the cargo tanks.

Pumps for tank washing systems with associated connections may be located outside the cargo area, provided the discharge side of the system is arranged in such a way that the suction is not possible through that part.

A spring-loaded non-return valve shall be provided to prevent any gases from being expelled from the cargo area through the tank washing system.

(b) A non-return valve shall be fitted at the junction between the water suction pipe and the cargo loading pipe.

9.3.2.25.9 The permissible loading and unloading flows shall be calculated.

Calculations concern the permissible maximum loading and unloading flow for each cargo tank or each group of cargo tanks, taking into account the design of the ventilation system. These calculations shall take into consideration the fact that in the event of an unforeseen cut–off of the vapour return piping of the shore facility, the safety devices of the cargo tanks will prevent pressure in the cargo tanks from exceeding the following values:

over–pressure: 1.15 times the opening pressure of the pressure relief valve/high velocity vent valve;

vacuum pressure: not more than the design pressure, but not exceeding a vacuum of 5 kPa (0.05 bar).

The main factors to be considered are the following:

1. Dimensions of the ventilation system of the cargo tanks;

2. Gas formation during loading: multiply the largest loading flow by a factor of not less than 1.25;

3. Density of the vapour mixture of the cargo based on 50% volume vapour and 50% volume air;

4. Loss of pressure through ventilation pipes, valves and fittings. Account will be taken of a 30% clogging of the mesh of the flame-arrester;

5. Chocking pressure of the safety valves.

Instructions concerning the permissible maximum loading and unloading flows for each cargo tank or for each group of cargo tanks shall be carried on board.

9.3.2.25.10 Compressed air generated outside the cargo area can be used in the cargo area subject to the installation of a spring-loaded non-return valve to ensure that no gases can escape from the cargo area through the compressed air system into accommodation, wheelhouse or service spaces outside the cargo area.

9.3.2.25.11 If the vessel is carrying several dangerous substances liable to react dangerously with each other, a separate pump with its own piping for loading and unloading shall be installed for each substance. The piping shall not pass through a cargo tank containing dangerous substances with which the substance in question is liable to react.

9.3.2.26 ***Residual cargo tanks and receptacles for residual products***

9.3.2.26.1 When vessels are provided with tanks for residual products or receptacles for residual products, they shall be located in the cargo area and comply with the provisions of 9.3.2.26.2 and 9.3.2.26.3. Receptacles for residual products shall be located only in the cargo area on deck and not less than a quarter of the vessel's breadth from the outer shell.

9.3.2.26.2 Tanks for residual products shall be equipped with:

– A level gauge;

– Connections, with stop valves, for pipes and hose assemblies;

– A pressure relief/vacuum valve;

The pressure relief valve shall be sized so that, during the transport operation, it does not open when in normal operation. This condition is met when the opening pressure of the valve meets the conditions required in column (10) of Table C of Chapter 3.2 for the substances to be carried.

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the vacuum valve shall be designed so as to be capable of withstanding a deflagration. The deflagration safety may also be ensured by a flame arrester.

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, or for which there is a T in column (3b) of Table C of Chapter 3.2, then the pressure relief valve shall be designed as a high velocity vent valve.

The pressure relief valve shall be sized so that, during the transport operation, it does not open when in normal operation. This condition is met when the opening pressure of the valve meets the conditions required in column (10) of Table C of Chapter 3.2 for the substance to be carried.

The high velocity vent valve and the deflagration safe vacuum valve shall be chosen according to the explosion groups/subgroups of the substances listed in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2).

The maximum permissible capacity is 30 m^3.

9.3.2.26.3 The receptacles for residual products shall be equipped with:

– A possibility of indicating the degree of filling;

– Connections, with stop valves, for pipes and hose assemblies;

A connection enabling gases released during filling to be evacuated safely.

9.3.2.26.4 *(Deleted)*

9.3.2.27 ***Refrigeration system***

9.3.2.27.1 The refrigeration system referred to in 9.3.2.24.1 (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 recognised 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.

9.3.2.27.2 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.

9.3.2.27.3 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 9.3.2.27.1, 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.

9.3.2.27.4 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.

9.3.2.27.5 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.

9.3.2.27.6 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.

9.3.2.27.7 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.

9.3.2.27.8 When the refrigeration system is installed in a separate service space, this service space shall meet the requirements of 9.3.2.17.6.

9.3.2.27.9 For all cargo systems, the heat transmission coefficient as used for the determination of the holding time (7.2.4.16.16 and 7.2.4.16.17) shall be determined by calculation. Upon completion of the vessel, the correctness of the calculation shall be checked by means of a heat balance test. The calculation and test shall be performed under supervision by the recognized classification society which classified the vessel.

The heat transmission coefficient shall be documented and kept on board. The heat transmission coefficient shall be verified at every renewal of the certificate of approval.

9.3.2.27.10 A certificate from a recognised classification society stating that 9.3.2.24.1 to 9.3.2.24.3, 9.3.2.27.1 and 9.3.2.27.4 above have been complied with shall be submitted together with the application for issue or renewal of the certificate of approval.

9.3.2.28 ***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 to enable gas emissions from loading to be precipitated or to cool the tops of cargo tanks by spraying water over the whole surface so as to avoid safely the activation of the pressure relief valves/high velocity vent valves at 50 kPa (0.5 bar).

The gas precipitation system shall be fitted with a connection device for supply from a shore installation.

The spray nozzles shall be so installed that the entire cargo deck area is covered and the gases released are precipitated safely.

The system shall be capable of being put into operation from the wheelhouse and from the deck. Its capacity shall be such that when all the spray nozzles are in operation, the outflow is not less than 50 litres per square metre of deck area and per hour.

9.3.2.29 and 9.3.2.30 *(Reserved)*

9.3.2.31 ***Engines***

9.3.2.31.1 Only internal combustion engines running on fuel with having a flashpoint above 55 °C are allowed. This provision does not apply to internal combustion engines which are part of propulsion and auxiliary systems. These systems shall meet the requirements of Chapter 30 and Annex 8, Section II, Chapter 1, and Section III, Chapter 2 of the European Standard laying down Technical Requirements for Inland Navigation vessels (ES-TRIN) as amended.[2]

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

9.3.2.31.3 and 9.3.2.31.4 *(Deleted)*

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2 *As available on the website of the Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure – CESNI, https://www.cesni.eu/en/documents/es-trin/.*

9.3.2.31.5 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.

9.3.2.32 ***Oil fuel tanks***

9.3.2.32.1 Where the vessel is provided with hold spaces, the double bottoms within these spaces 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.

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

9.3.2.33 (*Reserved*)

9.3.2.34 ***Exhaust pipes***

9.3.2.34.1 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 2.00 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.

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

9.3.2.35 ***Bilge pumping and ballasting arrangements***

9.3.2.35.1 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, double-hull spaces, hold spaces and double bottoms where ballasting is carried out using the piping of the fire-fighting system in the cargo area and bilge-pumping is performed using eductors which are installed in the cargo area.

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

9.3.2.35.3 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 but outside the cargo tanks.

9.3.2.35.4 A cargo pump room below deck shall be capable of being drained in an emergency by an installation located in the cargo area and independent from any other installation. This installation shall be provided outside the cargo pump room.

9.3.2.36 to 9.3.2.39 (*Reserved*)

9.3.2.40 ***Fire-extinguishing arrangements***

9.3.2.40.1 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 jet/spray nozzles having a diameter of not less than 12 mm shall be provided. Alternatively one or more of the hose assemblies may be substituted by directable jet/spray nozzles having a diameter of not less than 12 mm. 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, wheelhouse 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;

– The water supply system shall be capable of being put into operation from the wheelhouse and from the deck;

– Measures shall be taken to prevent the freezing of fire-mains and hydrants.

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

9.3.2.40.2.1 *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);

(e) (*Reserved*)

(f) K_2CO_3 (potassium carbonate).

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

9.3.2.40.2.2 *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 have a facility for extracting the extinguishing agent and the combustion gases. Such facilities shall be capable of being operated from positions outside the protected rooms and which must not be made inaccessible by a fire within such spaces. If there are permanently installed extractors, it shall not be possible for these to be switched on while the fire is being extinguished.

9.3.2.40.2.3 *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.

9.3.2.40.2.4 *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 their fittings 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.

9.3.2.40.2.5 *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 also in the event of a fire, and that the required quantity of extinguishing agent can still be provided in the space to be protected in the event of a fire or of damage caused by a fire or an explosion.

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.

9.3.2.40.2.6 *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!

9.3.2.40.2.7 *Pressurised tanks, fittings and piping*

(a) Pressurised tanks, fittings and piping shall conform to the requirements of the competent authority or, if there are no such requirements, to those of a recognized classification society.

(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.

9.3.2.40.2.8 *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.

9.3.2.40.2.9 *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 9.3.2.40.2.

(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 vessel certificate.

9.3.2.40.2.10 *Fire-extinguishing system operating with CO_2*

In addition to the requirements contained in 9.3.2.40.2.1 to 9.3.2.40.2.9, 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: 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 degree 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 9.3.2.40.2.6 (b) shall be not less than 20 seconds. A reliable installation shall ensure the timing of the diffusion of CO_2.

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

In addition to the requirements of 9.3.2.40.2.1 to 9.3.2.40.2.9, 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;

* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

(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 degree 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.

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

In addition to the requirements of 9.3.2.40.2.1 to 9.3.2.40.2.9, 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.

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

In addition to the requirements of 9.3.2.40.2.1 to 9.3.2.40.2.9, 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;

* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

(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 degree 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%.

9.3.2.40.2.14 *(Reserved)*

9.3.2.40.2.15 *Fire-fighting systems using K_2CO_3 as the extinguishing agent*

In addition to the requirements laid down in 9.3.2.40.2.1 to 9.3.2.40.2.3, 9.3.2.40.2.5, 9.3.2.40.2.6 and 9.3.2.40.2.9, fire-fighting systems using K_2CO_3 as the extinguishing agent shall comply with the following provisions:

(a) The fire-fighting system shall have a type-approval pursuant to Directive 2014/90/EU[3] or to MSC/Circ. 1270;[4]

(b) Each room shall be provided with its own firefighting system;

(c) The extinguishing agent must be stored in specially provided unpressurised tanks in the room to be protected. These tanks shall be fitted in such a way that the extinguishing agent is dispensed evenly in the room. In particular the extinguishing agent shall also work underneath the deck plates;

(d) Each tank is separately connected with the triggering device;

(e) The quantity of dry aerosol-forming extinguishing agent relative to the room to be protected shall be at least 120 g per m^3 of the net volume of this room. This net volume is calculated according to Directive 2014/90/EU[3] or to MSC/Circ. 1270[4]. It shall be possible to supply the extinguishing agent within 120 s.

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* *As this text has been taken from ES-TRIN, the definition of 'Degree of filling' provided in 1.2.1 of these Regulations is not applicable.*

3 *Official Journal of the European Union, L 257 of 28 August 2014, p.146.*

4 *International Maritime Organization Circular MSC/Circ. 1270 and corrigenda — Revised Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas extinguishing systems, as referred to in SOLAS 1974, for machinery spaces — adopted on 4 June 2008.*

9.3.2.40.2.16 *Permanently installed fire-extinguishing systems for protecting objects*

(a) Permanently installed fire-extinguishing systems for protecting objects are permitted for the protection of installations and equipment.

The action of the fire-extinguishing systems must be aimed directly at the objects to be protected. The range of action of fire-extinguishing systems may be limited in space by means of structural measures.

Permanently installed fire-extinguishing systems for protecting objects may already be structurally integrated into the objects concerned.

Permanently installed fire-extinguishing systems for protecting objects must be independent of the systems referred to in 9.3.2.40.2.2 to 9.3.2.40.2.16 in respect of their supply of extinguishing agent.

(b) The following requirements apply to permanently installed fire-extinguishing systems for protecting objects:

(i) 9.3.2.40.2.2, if the extinguishing agent used requires the range of action to be limited by structural measures;

(ii) 9.3.2.40.2.3 and 9.3.2.40.2.4;

(iii) 9.3.2.40.2.5 (b) and (c), in addition to the provisions of (c) of the present section;

(iv) 9.3.2.40.2.6, (a) to (e), and at each entrance to a room or in the immediate vicinity of an encapsulated object, a suitable sign for the fire-extinguishing system for physical protection must be prominently displayed;

(v) 9.3.2.40.2.7 to 9.3.2.40.2.13;

(vi) *(Reserved)*;

(vii) 9.3.2.40.2.15, (b) to (e).

Only extinguishing agents suitable for extinguishing a fire on or in the object to be protected and which are mentioned in 9.3.2.40.2.1 may be used in permanently installed fire-extinguishing systems for protecting objects.

The competent authority may authorize exemptions concerning the extinguishing agent for permanently installed fire-extinguishing systems for protecting objects which are based on a fire protection concept.

(c) Permanently installed fire-extinguishing systems for protecting objects must be capable of being triggered manually. Manual triggering must be possible in the immediate vicinity of the protected object. They may be triggered automatically if the triggering signal is emitted by two fire detectors with different means of detection. The triggering must occur without delay. If the fire-extinguishing system is intended to protect several spaces, it shall comprise a separate and clearly-marked triggering device for each space.

The activation of the fire-extinguishing system shall be displayed in the wheelhouse and at the entrance to the room in which the object to be protected is located. In the case of encapsulated objects, the display at the room entrance can be omitted if another display is attached to the object itself.

For manual activation, operating instructions in accordance with 9.3.2.40.2.5 (e) shall be displayed next to each triggering device, taking into account the location and nature of the object.

(d) The type and place of installation of permanently installed fire-extinguishing systems for protecting objects shall be entered in the ship's certificate.

(e) The provisions of this section do not apply to water spray systems in accordance with 9.3.1.28, 9.3.2.28 and 9.3.3.28.

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

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

9.3.2.41 ***Fire and naked light***

9.3.2.41.1 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.

9.3.2.41.2 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.

9.3.2.41.3 Only electrical lamps are permitted.

9.3.2.42 ***Cargo heating system***

9.3.2.42.1 Boilers which are used for heating the cargo shall be fuelled with a liquid fuel having a flashpoint of more than 55 °C. They shall be placed either in the engine room or in another separate space below deck and outside the cargo area, which is accessible from the deck or from the engine room.

9.3.2.42.2 The cargo heating system shall be designed so that the cargo cannot penetrate into the boiler in the case of a leak in the heating coils. A cargo heating system with artificial draught shall be ignited electrically.

9.3.2.42.3 The ventilation system of the engine room shall be designed taking into account the air required for the boiler.

9.3.2.42.4 Where the cargo heating system is used during loading, unloading or degassing with a concentration given off by the cargo of 10% of the LEL or above, the service space which contains this system shall fully comply with the requirements of 9.3.2.52.1. This requirement does not apply to the inlets of the ventilation system. These inlets shall be located at a minimum distance of 2 m from the cargo area and 6 m from the openings of cargo tanks or residual cargo tanks, loading pumps situated on deck, openings of high velocity vent valves, pressure relief devices and shore connections of loading and unloading piping and must be located not less than 2 m above the deck.

The requirements of 9.3.2.52.1 are not applicable to the unloading of substances having a flash point of 60 °C or more when the temperature of the product is at least 15 K lower at the flash point.

9.3.2.43 to 9.3.2.49 (*Reserved*)

9.3.2.50 *(Deleted)*

9.3.2.51 ***Surface temperatures of installations and equipment***

(a) Surface temperatures of electrical and non-electrical installations and equipment shall not exceed 200 °C.

(b) Surface temperatures of the outer parts of engines and of their air inlets and exhaust ducts shall not exceed 200 °C;

(c) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which the temperature classes T4, T5 or T6 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones on board shall not exceed 135 °C (T4), 100 °C (T5) or 85 °C (T6) respectively;

(d) (a) and (b) do not apply if the following requirements are met (see also 7.2.3.51.4):

(i) Accommodation, wheelhouse and service spaces where surface temperatures higher than those mentioned in (a) and (b) occur are equipped with a ventilation system according to 9.3.2.12.4 (b); or

(ii) Installations and equipment which generate surface temperatures higher than those set out in (a) or (b), respectively, must be capable of being shut down. Such installations and equipment shall be marked in red.

9.3.2.52 ***Type and location of electrical installations and equipment***

9.3.2.52.1 Electrical installations and equipment shall be of at least the 'limited explosion risk' type.

This provision does not apply to:

(a) Lighting installations in the accommodation and the wheelhouse, except for switches near to the entrances;

(b) Mobile phones, fixed telephone installations, stationary and portable computers and loading instruments in the accommodation or the wheelhouse;

(c) Electrical installations and equipment which, during a stay in the immediate vicinity of or within a shoreside assigned zone:

(i) Are extinguished; or

(ii) Are placed in premises equipped with a ventilation system according to 9.3.2.12.4;

(d) To radiotelephone installations and inland AIS (automatic identification systems) stations in the accommodation and the wheelhouse, if no part of an aerial for radiotelephone installations or AIS stations is situated above or within 2.00 m of the cargo area.

9.3.2.52.2 In the cofferdams, double-hull spaces, double bottoms and hold spaces, only hermetically sealed echo sounding devices are allowed, the cables of which are led through thick-walled steel tubes with gastight connections up to the main deck.

9.3.2.52.3 The fixed electrical installations and equipment which do not meet the requirements set out in 9.3.2.51 (a), 9.3.2.51 (b) and 9.3.2.52.1 above and their switches shall be marked in red. The disconnection of such equipment shall be controlled from a centralized location on board.

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

9.3.2.52.5 Only distribution systems without return connection to the hull are permitted. This provision does not apply to:

- Active cathodic corrosion protection;
- Certain limited sections of the installations situated outside the cargo area (e.g., connections of starters of diesel engines);
- The device for checking the insulation level referred to in 9.3.2.52.4.

9.3.2.52.6 An electric generator which is permanently driven by an engine and which does not meet the requirements of 9.3.2.52.1 above, shall be fitted with a multipolar switch capable of shutting down the generator. A notice board with the operating instructions shall be displayed near the switch.

9.3.2.52.7 Failure of the power supply for the safety and control equipment shall be immediately indicated by visual and audible signals in the wheelhouse and on the deck. The alarm must be relayed to the accommodation automatically if it has not been switched off.

9.3.2.52.8 Electrical switches, sockets and cables on deck shall be protected against mechanical damage.

9.3.2.52.9 Sockets for the connection of signal lights and gangway lighting shall be solidly fitted to the vessel close to the signal mast or the gangway. The sockets used in this area shall be designed so as to prevent connection or disconnection except when they are not live.

9.3.2.52.10 Accumulators shall be located outside the cargo area.

9.3.2.53 ***Type and location of electrical and non-electrical installations and equipment intended to be used in explosion hazardous areas***

9.3.2.53.1 On board vessels covered by the classification of zones as defined in 1.2.1, electrical and non-electrical installations and equipment used in explosion hazardous areas shall meet at least the requirements for use in the area concerned.

They shall be selected on the basis of the explosion groups/subgroups and temperature classes to which the substances to be carried belong (see columns (15) and (16) of Table C of Chapter 3.2).

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which temperature classes T4, T5 or T6 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones shall not exceed 135 °C (T4), 100 °C (T5) or 85 °C (T6).

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances for which temperature classes T1 or T2 are indicated in column (15) of Table C of Chapter 3.2, then the corresponding surface temperatures within the assigned zones shall not exceed 200 °C.

9.3.2.53.2 Except in the case of optical fibres, electrical cables shall be armoured or placed in a metallic sheath or in protective tubes.

Electrical cables for the active cathodic protection of the shell plating shall be led through thick-walled steel tubes with gastight connections up to the main deck.

9.3.2.53.3 Movable electric cables are prohibited in the explosion danger area, except for electric cables for intrinsically safe electric circuits or for connecting:

(a) Signal lights and lighting for gangways, provided the connection point (for example, the socket) is permanently fitted to the vessel close to the signal mast or gangway;

(b) The power network on a vessel to a land-based power network; provided

– The electric cables and the power supply unit conform with a valid standard (for example, EN 15869-03: 2010);

– The power supply unit and connectors are located outside of the explosion danger area.

Connecting and disconnecting sockets/connectors shall only be possible when they are not live.

9.3.2.53.4 Electrical cables of intrinsically safe circuits shall be separated from other cables not intended for use in such circuits and shall be marked (they shall not be installed together in the same string of cables and they shall not be fixed by the same cable clamps).

9.3.2.53.5 For movable electrical cables permitted under 9.3.2.53.3, only sheathed cables of type H07RN-F in accordance with standard IEC 60245-4:2011[5] or electrical cables of at least equivalent design having conductors with a cross-section of not less than 1.50 mm^2 shall be used.

9.3.2.54 ***Earthing***

9.3.2.54.1 The metal parts of electrical installations and equipment in the cargo area which are not live, as well as the 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.

9.3.2.54.2 The provisions of 9.3.2.54.1 also apply to installations with a voltage of less than 50 Volts.

9.3.2.54.3 Independent cargo tanks, metal intermediate bulk containers and tank-containers shall be earthed.

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

9.3.2.55 (*Reserved*)

9.3.2.56 *(Deleted)*

9.3.2.57 to 9.3.2.59 (*Reserved*)

9.3.2.60 ***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. The water shall meet the minimum quality requirements applicable to drinking water on board vessels.

NOTE: *Additional decontamination substances for the purpose of avoiding corrosion of eyes and skin are allowed.*

[5] *Identical to EN 50525-2-21: 2011.*

A connection of this special equipment with the area outside the cargo zone is accepted.

A spring-loaded non-return valve shall be fitted to ensure that no gases can escape through the shower and the eye and face bath system outside the cargo area.

9.3.2.61 (*Reserved*)

9.3.2.62 ***Additional vacuum valve for degassing to reception facilities***

An opening in the loading and unloading piping or in the venting piping, used at reception facilities to take in ambient air to prevent exceedance of the maximum permissible vacuum (see 7.2.3.7.2.3), shall be fitted with an additional portable vacuum valve or an additional permanently installed vacuum valve. When the intake of ambient air is done with a hose ending shoreside, the open end of the hose shall be equipped with such a valve in the same manner.

The trigger pressure of the additional vacuum valve shall be adjusted so that under normal working conditions the vacuum valve referred to in 9.3.x.22.4 is not activated during degassing.

If the vessel's substance list according to 1.16.1.2.5 contains substances for which explosion protection is required in column (17) of Table C of Chapter 3.2, the valve shall be fitted with a flame arrester capable of withstanding a deflagration. When the vessel is not degassing to a reception facility, the permanently installed valve or the opening to which a portable valve is connected shall be closed with a blind flange.

NOTE: *7.2.4.22.1 applies for the opening of this opening.*

9.3.2.63 to 9.3.2.70 (*Reserved*)

9.3.2.71 ***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.

9.3.2.72 and 9.3.2.73 (*Reserved*)

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

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

9.3.2.74.2 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.

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

9.3.2.75 to 9.3.2.91 (*Reserved*)

9.3.2.92 ***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 requirement does not apply to forepeak and afterpeak.

9.3.2.93 to 9.3.2.99 (*Reserved*)

9.3.3 Rules for construction of type N tank vessels

The rules for construction of 9.3.3.0 to 9.3.3.99 apply to type N tank vessels.

9.3.3.0 ***Materials of construction***

9.3.3.0.1.1 The vessel's hull and the cargo tanks shall be constructed of shipbuilding steel or other at least equivalent metal, special provisions of the additional requirements/remarks of column (20) of Table C of Chapter 3.2 excepted.

9.3.3.0.1.2 Inside venting piping shall be protected against corrosion.

9.3.3.0.1.3 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.

9.3.3.0.2 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. In case it has not been possible to examine this during classification and inspection of the vessel a relevant reservation shall be entered in the vessel substance list according to 1.16.1.2.5.

9.3.3.0.3 Except where explicitly permitted in 9.3.3.0.4 below or in the certificate of approval, the use of wood, aluminium alloys, plastic materials, rubber, glass or composite within the cargo area is prohibited.

9.3.3.0.4 The use of wood, aluminium alloys, plastic materials, rubber, glass or composite in the cargo area is permitted as shown in the following table:

(X means "allowed")	***Wood***	***Aluminium alloys***	***Plastic material / Composite***	***Rubber***	***Glass***
Permanently installed materials					
Chocking of cargo tanks which are independent of the vessel's hull and chocking of installations and equipment	X		X		
Masts and similar round timber	X	X	X		
Engine parts		X	X		
Protective covers of engines and pumps			X		
Notice boards (Prohibition of admittance and smoking)		X	X		
Parts of the electrical installation		X	X		
	According to the applicable technical norms				
Parts of the loading and unloading installation, e.g., gaskets		X	X	X	
Supports and stops of any kind	X		X		
Ventilators, including hose assemblies for ventilation		X	X		
Parts of the water spray system, the shower and the eye and face bath		X	X		
Insulation of cargo tanks and of piping for loading and unloading, gas discharge pipes and heating pipes		X	X	X	
Coating of cargo tanks and of piping for loading and unloading		X	X	X	
Insulation of cargo tanks (Table C, Column (20), Remark 32)		X	X	X	
All kinds of gaskets		X	X	X	
	Subject to Table C, Column (20), Remark 39 a)				
Cables for electrical equipment			X	X	
	According to the applicable technical norms				
Boxes, cabinets or other receptacles placed on the deck for storage of disposal and recovery equipment, for capstans, extinguishers, fire hoses, etc.		X	X		
Boxes, cabinets or other receptacles placed on the deck for storage of disposal of waste		X	X		
	For oily and greasy wastes fire-resistant receptacles only (7.2.1.21.6)				

(X means "allowed")	***Wood***	***Aluminium alloys***	***Plastic material / Composite***	***Rubber***	***Glass***
Portable equipment					
Gangways	X	X	X	X	
External ladders and passageways (gangways)		X	X	X	
Outboard ladders		X	X	X	
Ladders		X	X	X	
Cleaning equipment, e.g. brooms	X	X	X	X	
Fire extinguishers, portable gas detectors,		X	X	X	
Rescue winches		X			
Personal protective and safety equipment, rescue equipment conforming to ES-TRIN		X	X	X	
Driptrays			X		
Fenders	X		X	X	
Mooring lines, ropes for tenders, etc.			X		
	Respecting 7.2.4.76				
Mat under hose assemblies for loading and unloading piping system			X	X	
Fire hoses, air hoses, hoses for cleaning the deck, etc.			X	X	
Other kinds of hoses	*In line with 8.1.6.2 and norms mentioned*				
Aluminium gauging rods		X			
	If fitted with brass feet or protected in another way to avoid sparking.				
Sampling equipment			X		
Receptables for oily and greasy wastes (7.2.4.1)		X	X		
		Fire-resistant receptables, (7.2.1.21.6)			
Receptables for residual products and receptables for slops		X	X		
	Respecting ADR, RID or IMDG-Code regarding the admission requirements of materials.				
Sampling bottles			X		X
	Respecting ADR, regarding the admission requirements of materials.				
Photo-optical copies of the certificate of approval according to 8.1.2.6 or 8.1.2.7, and of the vessel's certificate, the measurement certificate and the Rhine navigation membership certificate		X	X		
Aluminum basket for storing of mooring wires/lines		X			
Boot's hook	X	X	X		
Ship's boat (In case of 7.2.3.29.1 and 7.2.3.31.1 allowed in the cargo area)		X	X		
	Only when the material shall not readily ignite				

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

9.3.3.0.6 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.

9.3.3.1 Vessel record

NOTE: *For the purpose of this paragraph, the term "owner" has the same meaning as in 1.16.0.*

The vessel record shall be retained by the owner who shall be able to provide this documentation at the request of the competent authority and the recognized classification society.

The vessel record shall be maintained and updated throughout the life of the vessel and shall be retained for 6 months after the vessel is taken out of service.

Should a change of owner occur during the life of the vessel the vessel record shall be transferred to the new owner.

Copies of the vessel record or all necessary documents shall be made available on request to the competent authority for the issuance of the certificate of approval and for the recognized classification society or inspection body for first inspection, periodic inspection, special inspection or exceptional checks.

9.3.3.2 to 9.3.3.7 *(Reserved)*

9.3.3.8 *Classification*

9.3.3.8.1 The tank vessel shall be built under the survey of a recognised classification society and be classed in its highest class.

The vessel's highest class shall be continued. This shall be confirmed by an appropriate certificate issued by the recognized classification society (certificate of class).

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 recognized classification society shall draw up a vessel substance list mentioning all the dangerous goods accepted for carriage by the tank vessel (see also 1.16.1.2.5).

9.3.3.8.2 to 9.3.3.8.4 *(Deleted)*

9.3.3.9 *(Reserved)*

9.3.3.10 *Protection against the penetration of dangerous gases and the spreading of dangerous liquids*

9.3.3.10.1 The vessel shall be designed so as to prevent dangerous gases and liquids from penetrating into the accommodation, wheelhouse and service spaces. None of the windows in these spaces shall be capable of being opened unless its intended use is as an emergency exit and it is marked as such.

9.3.3.10.2 Liquid-tight protective coamings shall be fitted on deck at the height of the external bulkheads of the cargo tanks, at a maximum distance of 0.60 m from the outer cofferdam bulkheads or the hold end bulkheads. The protective coamings shall either extend over the entire width of the vessel or be fixed between the longitudinal spill coamings so as to prevent liquids from entering the forepeak and afterpeak. The height of the protective coamings and the spill coamings shall be at least 0.075 m. The protective coaming may correspond to the protection wall prescribed in 9.3.3.10.3 if the protection wall extends across the entire width of the vessel.

9.3.3.10.3 If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the use of installations and equipment that are not of at least the 'limited explosion risk' type is not permitted during loading and unloading operations in parts of the deck outside the cargo area, unless those parts are protected against the penetration of gases and liquids by a gas- and liquid-tight protection wall. The wall must either extend over the full width of the vessel or surround the areas to be protected in a U-shaped form. The wall must cover the whole width of the area to be protected and at least 1.00 m in the direction opposite to the cargo area (see Classification of zones diagram). The height of the wall shall be at least 1.00 m above the adjacent cargo deck area in the cargo area. The outer wall and side walls of the accommodation can be considered as a protection wall if they do not include openings and if the dimensions are complied with.

A protection wall is not required where the distance between the areas to be protected and the high velocity vent valve, the shore connections of the piping for loading and unloading, the compressor on deck and the opening of the closest pressure tanks is at least 12.00 m.

9.3.3.10.4 On deck, the lower edges of door-openings in the sidewalls of superstructures 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 spaces and double bottoms.

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

9.3.3.10.6 Open Type N vessels are only required to meet the requirements of 9.3.3.10.1 if the vessel remains in the immediate vicinity of or within a shoreside assigned zone.

9.3.3.11 ***Hold spaces and cargo tanks***

9.3.3.11.1 (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) The relative density of the substances to be carried shall be taken into consideration in the design of the cargo tanks. The maximum relative density shall be indicated in the certificate of approval.

(c) When the vessel is provided with pressure tanks, these tanks shall be designed for a working pressure of 400 kPa (4 bar).

(d) For vessels with a length of not more than 50.00 m, the length of a cargo tank shall not exceed 10.00 m; and

For vessels with a length of more than 50.00 m, the length of a cargo tank shall not exceed 0.20 L.

This provision does not apply to vessels with independent built–in cylindrical tanks having a length to diameter ratio ≤ 7.

9.3.3.11.2 (a) The cargo tanks independent of the vessel's hull shall be fixed so that they cannot float.

Refrigerated cargo tank fastenings shall meet the requirements of a recognised classification society.

(b) The capacity of a suction well shall be limited to not more than 0.10 m^3.

(c) (*Reserved*)

(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.

9.3.3.11.3 (a) The cargo tanks shall be separated by cofferdams of at least 0.60 m in width from the accommodation, engine rooms and service spaces outside the cargo area below deck or, if there are no such accommodation, engine room and service spaces, from the vessel's ends. Where the cargo tanks are installed in a hold space, a space of not less than 0.50 m shall be provided between such tanks and the end bulkheads of the hold space. In this case an end bulkhead of Class "A-60" as defined in SOLAS 74, Chapter II-2, Regulation 3, shall be deemed equivalent to a cofferdam. For pressure cargo tanks, the 0.50 m distance may be reduced to 0.20 m.

(b) Hold spaces, cofferdams and cargo tanks shall be capable of being inspected.

(c) All spaces in the cargo area shall be capable of being ventilated. It has to be possible to check their gas-free condition.

9.3.3.11.4 The bulkheads bounding the cargo tanks, cofferdams and 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 cofferdam or service space in the cargo area or between the engine room and a hold space may be fitted with penetrations provided that they conform to the provisions of 9.3.3.17.5.

The bulkhead between the cargo tank and the cargo pump room below deck may be fitted with penetrations provided that they conform to the provisions of 9.3.3.17.6. The bulkheads between the cargo tanks may be fitted with penetrations provided that the loading and unloading piping are fitted with shut-off devices in the cargo tank from which they come. These pipes shall be fitted at least 0.60m above the bottom. The shut-off devices shall be capable of being activated from the deck.

9.3.3.11.5 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 provisions of 9.3.3.32.

9.3.3.11.6 (a) A cofferdam, the centre part of a cofferdam or another space below deck in the cargo area may be arranged as a service space, provided the bulkheads bounding the service space extend vertically to the bottom. 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 piping for loading and unloading shall be fitted within the service space referred to under 9.3.3.11.4 above.

Piping for loading and unloading may be fitted in the cargo pump rooms below deck only when they conform to the provisions of 9.3.3.17.6.

9.3.3.11.7 Where independent cargo tanks are used, or for double-hull construction where the cargo tanks are integrated in the vessel's structure, the space between the wall of the vessel and wall of the cargo tanks shall be not less than 0.60 m.

The space between the bottom of the vessel and the bottom of the cargo tanks shall be not less than 0.50 m. The space may be reduced to 0.40 m under the pump sumps.

The vertical space between the suction well of a cargo tank and the bottom structures shall be not less than 0.10 m.

When a hull is constructed in the cargo area as a double hull with independent cargo tanks located in hold spaces, the above values are applicable to the double hull. If in this case the minimum values for inspections of independent tanks referred to in 9.3.3.11.9 are not feasible, it must be possible to remove the cargo tanks easily for inspection.

9.3.3.11.8 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 personal protective equipment 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 difficulties, if necessary by means of fixed equipment.

9.3.3.11.9 Cofferdams, double-hull spaces, double bottoms, cargo tanks, hold spaces and other accessible spaces within the cargo area shall be arranged so that they may be completely inspected and cleaned. 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 difficulties. These openings shall have a minimum cross-section 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 personnel to be removed from the bottom of such a space without difficulties, if necessary by means of fixed equipment. In these spaces the free penetration width shall not be less than 0.50 m in the sector intended for the penetration. 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.

9.3.3.11.10 9.3.3.11.6 (c) above does not apply to open type N.

9.3.3.12 ***Ventilation***

9.3.3.12.1 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.

9.3.3.12.2 Double-hull spaces and double bottoms within the cargo area which are not arranged for being filled with ballast water, hold spaces and cofferdams shall be provided with ventilation systems.

9.3.3.12.3 (a) A service space located within the cargo area below deck shall be provided with a ventilation system. The capacity of the fans shall be sufficient to ensure 20 complete changes of air per hour based on the volume of the service 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.

(b) If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then 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.

(c) On board open Type N vessels, other suitable installations without ventilator fans shall be sufficient.

9.3.3.12.4 (a) Ventilation shall be provided for the accommodation, wheelhouse and service spaces.

(b) The ventilation system in such spaces shall meet the following requirements:

(i) The air intakes shall be located as far away as possible, and not less than 6.00 m from the cargo area and not less than 2.00 m above the deck;

(ii) Pressure of at least 0.1 kPa (0.001 bar) may be maintained in the premises;

(iii) A breakdown alarm is integrated;

(iv) The ventilation system, including the breakdown alarm, shall be at least of the 'limited explosion risk' type;

(v) A gas detection system conforming to conditions 1. to 4. below is connected to the ventilation system:

1. It is appropriate at least for use in zone 1, explosion group IIC and temperature class T4;
2. It is equipped with sensors;
   - On the suction inlets of the ventilation systems; and
   - Directly below the top edge of the sill of the entrance doors;
3. Its t90 response time is lower than or equal to 4 s;
4. Measurement shall be continuous;

(vi) In the service spaces, the ventilation system is linked to the emergency lighting, which shall be at least of the 'limited explosion risk' type;

This emergency lighting is not necessary if the lighting installations in the service spaces are of at least the 'limited explosion risk' type;

(vii) The suction of the ventilation system and installations and equipment that do not meet the requirements set out in 9.3.3.51 (a) and (b) and 9.3.3.52.1 must be shut down when a concentration of 20% of LEL of n-Hexane is reached;

The switching-off shall be indicated in the accommodation and wheelhouse by visual and audible signals;

(viii) In the event of failure of the ventilation system or the gas detection installations in the accommodation, installations and equipment in the accommodation that do not meet the requirements set out in 9.3.3.51 (a) and (b) and 9.3.3.52.1 must be stopped;

The failure shall be indicated in the accommodation, the wheelhouse and on the deck by visual and audible signals;

(ix) In the event of failure of the ventilation system or the gas detection installations in the wheelhouse or service spaces, installations and equipment in those spaces that do not meet the requirements set out in 9.3.3.51 (a) and (b) and 9.3.3.52.1 must be shut down;

The failure shall be indicated in the wheelhouse and on the deck by visual and audible signals. The alarm must be relayed to the accommodation automatically if it has not been switched off;

(x) Any switching-off shall take place immediately and automatically and, if necessary, shall activate the emergency lighting;

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

(c) If there is no ventilation system or the ventilation system of a space does not comply with all the requirements set out in (b) above, any installations or equipment present in that space that may, if switched on, give rise to surface temperatures higher than those mentioned in 9.3.3.51 (a) and (b) or that do not meet the requirements set out in 9.3.3.52.1 must be capable of being switched off.

9.3.3.12.5 *(Deleted)*

9.3.3.12.6 Notice boards shall be fitted at the ventilation inlets indicating the conditions under which they shall be closed. All ventilation inlets of accommodation, wheelhouse and service spaces leading to the open air outside the cargo area shall be fitted with devices permanently fixed according to 9.3.3.40.2.2 (c), enabling them to be closed rapidly. It shall be clear whether they are open or closed.

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 that area.

9.3.3.12.7 Open Type N vessels are only required to meet the requirements of 9.3.3.12.4 (b) or (c) if the vessel remains in the immediate vicinity of or within a shoreside assigned zone.

9.3.3.12.8 9.3.3.12.6 does not apply to open type N.

9.3.3.13 ***Stability (general)***

9.3.3.13.1 Proof of sufficient stability shall be furnished. This proof is not required for single hull vessels with cargo tanks the width of which is not more than 0.70 B.

9.3.3.13.2 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.

9.3.3.13.3 Proof of sufficient intact stability shall be furnished for all stages of loading and unloading and for the final loading condition for all the relative densities of the substances transported contained in the vessel substance list according to 1.16.1.2.5.

For every loading operation, taking account of the actual fillings and floating position of cargo tanks, ballast tanks and compartments, drinking water and sewage tanks and tanks containing products for the operation of the vessel, the vessel shall comply with the intact and damage stability requirements.

Intermediate stages during operations shall also be taken into consideration.

The proof of sufficient stability shall be shown for every operating, loading and ballast condition in the stability booklet, to be approved by the recognized classification society, which classes the vessel. If it is unpractical to pre-calculate the operating, loading and ballast conditions, a loading instrument approved by the recognised classification society which classes the vessel shall be installed and used which contains the contents of the stability booklet.

NOTE: *A stability booklet shall be worded in a form comprehensible for the responsible master and containing the following details:*

General description of the vessel:

- *General arrangement and capacity plans indicating the assigned use of compartments and spaces (cargo tanks, stores, accommodation, etc.);*
- *A sketch indicating the position of the draught marks referring to the vessel's perpendiculars;*
- *A scheme for ballast/bilge pumping and overflow prevention systems;*

- *Hydrostatic curves or tables corresponding to the design trim, and, if significant trim angles are foreseen during the normal operation of the vessel, curves or tables corresponding to such range of trim are to be introduced;*

- *Cross curves or tables of stability calculated on a free trimming basis, for the ranges of displacement and trim anticipated in normal operating conditions, with an indication of the volumes which have been considered buoyant;*

- *Tank sounding tables or curves showing capacities, centres of gravity, and free surface data for all cargo tanks, ballast tanks and compartments, drinking water and sewage water tanks and tanks containing products for the operation of the vessel;*

- *Lightship data (weight and centre of gravity) resulting from an inclining test or deadweight measurement in combination with a detailed mass balance or other acceptable measures. Where the above–mentioned information is derived from a sister vessel, the reference to this sister vessel shall be clearly indicated, and a copy of the approved inclining test report relevant to this sister vessel shall be included;*

- *A copy of the approved test report shall be included in the stability booklet;*

- *Operating loading conditions with all relevant details, such as:*

  - *Lightship data, tank fillings, stores, crew and other relevant items on board (mass and centre of gravity for each item, free surface moments for liquid loads);*

  - *Draughts amidships and at perpendiculars;*

  - *Metacentric height corrected for free surfaces effect;*

  - *Righting lever values and curve;*

  - *Longitudinal bending moments and shear forces at read–out points;*

  - *Information about openings (location, type of tightness, means of closure); and*

  - *Information for the master;*

- *Calculation of the influence of ballast water on stability with information on whether fixed level gauges for ballast tanks and compartments have to be installed or whether the ballast tanks or compartments shall only be completely full or completely empty when underway.*

9.3.3.13.4 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.

9.3.3.14 ***Stability (intact)***

9.3.3.14.1 For vessels with independent cargo tanks and for double-hull constructions with cargo tanks integrated in the frames of the vessel, the requirements for intact stability resulting from the damage stability calculation shall be fully complied with.

9.3.3.14.2 For vessels with cargo tanks of more than 0.70 B in width, proof shall be furnished that the following stability requirements have been complied with:

(a) In the positive area of the righting lever curve up to immersion of the first non-weathertight opening there shall be a righting lever (GZ) of not less than 0.10 m;

(b) The surface of the positive area of the righting lever curve up to immersion of the first non-weathertight opening and in any event up to an angle of heel $\leq 27°$ shall not be less than 0.024 m.rad;

(c) The metacentric height (GM) shall be not less than 0.10 m.

These conditions shall be met bearing in mind the influence of all free surfaces in tanks for all stages of loading and unloading.

9.3.3.15 ***Stability (damaged condition)***

9.3.3.15.1 For vessels with independent cargo tanks and for double-hull vessels with cargo tanks integrated in the construction of the vessel, 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:	0.59 m inboard from the vessel's side at right angles to the centreline at the level corresponding to the maximum draught, or when applicable, the distance allowed by section 9.3.4, reduced by 0.01 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 0.49 m upwards, the sump 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.

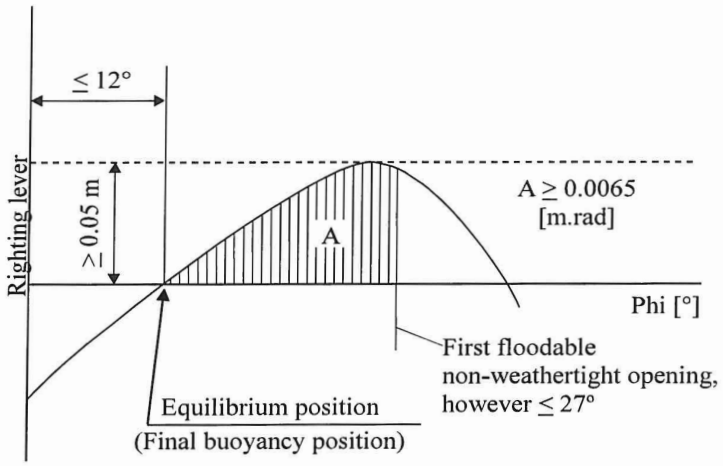
9.3.3.15.2 For the intermediate stage of flooding the following criteria have to be fulfilled:

GZ ≥ 0.03m

Range of positive GZ: 5°

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 the stability calculation.

The positive range of the righting lever curve beyond the stage of equilibrium shall have a righting lever 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-watertight opening and in any event up to an angle of heel ≤ 27°. If non-weathertight openings are immersed before that stage, the corresponding spaces shall be considered as flooded for the purposes of stability calculation.



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

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

9.3.3.16 ***Engine rooms***

9.3.3.16.1 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.

9.3.3.16.2 The engine rooms shall be accessible from the deck; the entrances shall not face the cargo area. Where 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.

9.3.3.16.3 The last sentence of 9.3.3.16.2 does not apply to oil separator or supply vessels.

9.3.3.17 ***Accommodation and service spaces***

9.3.3.17.1 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 the 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.

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

9.3.3.17.3 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, unloading and degassing
without the permission of the master.
Close immediately.

9.3.3.17.4 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.

9.3.3.17.5 (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 9.3.3.11.6.

(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 penetrate 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 9.3.3.11.4, 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.

9.3.3.17.6 A service space located within the cargo area below deck shall not be used as a cargo pump room for the loading and unloading system, except where:

– The cargo pump room is separated from the engine room or from service spaces outside the cargo area by a cofferdam or a bulkhead with an insulation of Class "A-60" as defined in 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 9.3.3.17.5 (a);

– Ventilation exhaust outlets are located not less than 6.00 m from entrances and openings of the accommodation, wheelhouse and service spaces outside the cargo area;

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

– All piping for loading and unloading as well as that of stripping systems is provided with shut-off devices at the pump suction side in the cargo pump room immediately at the bulkhead. The necessary operation of the control devices in the pump room, starting of pumps and control of the liquid flow rate shall be effected from the deck;

– The bilge of the cargo pump room is equipped with a gauging device for measuring the filling level which activates a visual and audible alarm in the wheelhouse when liquid is accumulating in the cargo pump room bilge;

– The cargo pump room is provided with a permanent oxygen detection system which automatically indicates the amount of oxygen and which actuates a visual and audible alarm when the oxygen concentration has reached 19.5% by volume. The sensors of this system shall be placed at suitable positions at the bottom and at a height of 2.00 m. Measurement shall be continuous and displayed near to the entrance. Audible and visual alarms shall be installed in the wheelhouse and in the cargo pump room and, when the alarm is actuated, the loading and unloading system shall be shut down;

– Failure of the oxygen measuring system shall activate a visual and audible alarm in the wheelhouse and on deck. The alarm must be relayed to the accommodation automatically if it has not been switched off;

– The ventilation system prescribed in 9.3.3.12.3 has a capacity sufficient to ensure not less than 30 changes of air per hour based on the total volume of the service space.

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the cargo pump room shall also be provided with a permanent gas detection system which automatically indicates the presence of flammable gases and actuates a visual and audible alarm when the gas concentration has reached 20% of the LEL of n-Hexane or of the calibration gas prescribed by the system's manufacturer.

The sensors of this gas detection system shall be placed at suitable positions at the bottom and directly below the deck. Measurement shall be continuous and displayed near to the entrance.

Audible and visual alarms shall be installed in the wheelhouse and in the cargo pump room and, when the alarm is actuated, the loading and unloading system shall be shut down.

Any failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by a visual and audible warning. The alarm must be relayed to the accommodation automatically if it has not been switched off.

9.3.3.17.7 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.

9.3.3.17.8 9.3.3.17.5 (g), 9.3.3.17.6 except for the permanent oxygen measuring system and 9.3.3.17.7 do not apply to open type N.

9.3.3.17.2, last sentence, 9.3.3.17.3, last sentence and 9.3.3.17.4 do not apply to oil separator and supply vessels.

9.3.3.18 ***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.

9.3.3.19 (*Reserved*)

9.3.3.20 ***Arrangement of cofferdams***

9.3.3.20.1 Cofferdams or cofferdam compartments remaining once a service space has been arranged in accordance with 9.3.3.11.6 shall be accessible through an access hatch.

9.3.3.20.2 Cofferdams shall be capable of being filled with water and emptied by means of a pump. Filling shall be effected within 30 minutes. These requirements are not applicable when the bulkhead between the engine room and the cofferdam has an "A-60" fire protection insulation according to SOLAS 74, Chapter II-2, Regulation 3.

The cofferdams shall not be fitted with inlet valves.

9.3.3.20.3 No fixed pipe shall permit connection between a cofferdam and other piping of the vessel outside the cargo area.

9.3.3.20.4 If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2 then the ventilation openings of cofferdams shall be fitted with a flame arrester capable of withstanding a deflagration. The flame arresters shall be chosen according to the explosion groups/subgroups of the substances foreseen for inclusion in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2).

9.3.3.20.5 9.3.3.20.2 above does not apply to oil separator and supply vessels.

9.3.3.21 ***Safety and control installations***

9.3.3.21.1 Cargo tanks shall be provided with the following equipment:

(a) a mark inside the tank indicating the degree of filling of the cargo tank of 97%;

(b) a level gauge;

(c) a level alarm device which is activated at the latest when a degree of filling of the cargo tank of 90% is reached;

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

(e) an instrument for measuring the pressure of the vapour phase inside the cargo tank;

(f) an instrument for measuring the temperature of the cargo, if in column (9) of Table C of Chapter 3.2, a cargo heating installation or a possibility of heating the cargo is required on board, or if a maximum temperature is indicated in column (20) of Table C of Chapter 3.2;

(g) A connection for a closed-type or partly closed-type sampling device, and/or at least one sampling opening as required in column (13) of Table C of Chapter 3.2. The connection shall be fitted with a shut-off device resistant to the internal pressure at the connection;

If the list of substances on the vessel according to 1.16.1.2.5 is going to include substances that require explosion protection in accordance with column (17) of Table C of Chapter 3.2, then the flame arrester plate stack capable of withstanding steady burning of the sampling opening shall be selected according to the explosion groups/subgroups of the substances foreseen for inclusion in the list of substances on the vessel (see column (16) of Table C of Chapter 3.2).

9.3.3.21.2 When the degree of filling of the cargo tank 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.

9.3.3.21.3 The level gauge shall allow readings from the control position of the shut-off devices of the particular cargo tank. The permissible maximum filling levels of 95% and 97%, as given in the list of substances, 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.

9.3.3.21.4 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.

9.3.3.21.5 (a) The high level sensor referred to in 9.3.3.21.1 (d) above 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 + A1:2007 + A2:2012 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 piping.

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) On board oil separator vessels the sensor referred to in 9.3.3.21.1 (d) shall activate a visual and audible alarm and switch off the pump used to evacuate bilge water.

(c) Supply vessels and other vessels which may be delivering products required for operation shall be equipped with a transshipment facility compatible with European standard EN 12827:1999 and a rapid closing device enabling refuelling to be interrupted. It shall be possible to actuate this rapid closing device by means of an electrical signal from the overflow prevention system. The electrical circuits actuating the rapid closing device shall be secured according to the quiescent current principle or other appropriate error detection measures. The state of operation of electrical circuits which cannot be controlled using the quiescent current principle shall be capable of being easily checked.

It shall be possible to actuate the rapid closing device independently of the electrical signal.

The rapid closing device shall actuate a visual and an audible alarm on board.

(d) 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 + A1:2007 + A2:2012, 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 piping.

9.3.3.21.6 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 intrinsically safe apparatus.

9.3.3.21.7 When the pressure or temperature exceeds a set value, instruments for measuring the vacuum or overpressure of the gaseous phase in the cargo tank or the temperature of the cargo shall activate a visual and audible alarm in the wheelhouse and on deck. The alarm must be relayed to the accommodation automatically if it has not been switched off.

When the pressure exceeds the set value during loading and unloading, the instrument for measuring the pressure shall, by means of the plug referred to in 9.3.3.21.5 above, immediately initiate an electrical contact which shall put into effect measures to interrupt the loading or unloading operation. When the vessel's own discharge pump is used, it shall be switched off automatically.

The instrument for measuring the overpressure or vacuum shall activate the alarm at latest when:

(a) An overpressure equal to 1.15 times the opening pressure of the pressure relief valves/high velocity vent valves is reached; or

(b) The lower threshold of the design pressure of the vacuum valves, but not exceeding a vacuum of 5 kPa (0.05 bar), is reached.

The maximum permissible temperature is indicated in column (20) of Table C of Chapter 3.2. The sensors for the alarms mentioned in this paragraph may be connected to the alarm device of the sensor.

When it is prescribed in column (20) of Table C of Chapter 3.2, the instrument for measuring the overpressure of the gaseous phase in the cargo tank shall actuate a visible and audible alarm in the wheelhouse when the overpressure exceeds 40 kPa (0.4 bar) during the voyage. The alarm must be relayed to the accommodation automatically if it has not been switched off. It shall be possible to read the gauges in direct proximity to the control for the water spray system.

9.3.3.21.8 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 9.3.3.21.1 (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.

9.3.3.21.9 9.3.3.21.1 (e), 9.3.3.21.7 as regards measuring the pressure, do not apply to open type N with flame-arrester and to open type N.

9.3.3.21.1 (b), (c) and (g), 9.3.3.21.3 and 9.3.3.21.4 do not apply to oil separator and supply vessels.

A flame arrester plate stack in sampling openings is not required on board open type N tank vessels.

9.3.3.21.1 (f) and 9.3.3.21.7 do not apply to supply vessels.

9.3.3.21.5 (a) does not apply to oil separator vessels.

9.3.3.21.10 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 9.3.3.27.