CHAPTER 7

FIXED FIRE EXTINGUISHING INSTALLATIONS

Key Changes

Minor revision which incorporates the latest IMO SOLAS amendments and Circulars, and new EN / ISO standards for these systems/equipment.

All amendments are highlighted in yellow.

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7.1 General

7.1.1 The Regulations, MSN 1666 and the Fire Safety Systems (FSS) Code contain the general requirements for fixed fire extinguishing installations. Details regarding design and construction of these systems are discussed below.

7.1.2 For the periodic inspection, testing and maintenance of transportable gas containers reference should be made to MGN 374. Surveyors should note that Section 3 of BS EN 1968-2002, referred to in the MGN, states "Provided the cylinder has been subjected to normal conditions of use and has not been subjected to abusive and abnormal conditions rendering the cylinder unsafe, there is no general requirement for the user to return a gas cylinder before the contents have been used even though the test interval may have lapsed. However, it is recommended that cylinders are retested within a period not exceeding twice the time interval". Cylinders which are not normally emptied and filled, such as those for fixed CO_2 extinguishing systems, may make use of this provision but should be re-tested before twice the time interval has passed, i.e. all CO_2 cylinders must be tested within a 20 year maximum period.
For the application of IMO MSC/Circular 1318, see 7.3.7.3.

7.1.3 Where an M notice, these instructions, IMO MSC/Circular 850 or, from 31 May 2013, MSC/Circular 1432 specify “annual” inspection or servicing of equipment a variation of ± 1 month may be considered acceptable. Where a 5 yearly interval is specified a variation of ± 3 months may be accepted. This general principle may be applied unless the manufacturer’s instructions contradict it where upon the manufacturer’s schedule applies.

7.1.4 Separation of spaces

> *Two spaces can be considered as separated spaces where fire divisions as required by SOLAS II-2 regulations 9.2.2, 9.2.3 and 9.2.4, as appropriate, or divisions of steel are provided between them.*

(Unified Interpretation - MSC/Circular 1120)

7.1.5 Location of closing devices

> *Openings which may admit air to, or allow gas to escape from, a protected space should be capable of being closed from outside the protected space.*

(Unified Interpretation - MSC/Circular 847)

7.2 Gas Installations - General

7.2.1 Any gas used as a fire smothering medium in cargo spaces and in boiler and machinery spaces must not either by itself or under expected conditions of use give off toxic or anaesthetic vapours such as to endanger persons. Gases carried in liquid form should, after discharge into the space for which they are provided, readily evaporate into the gaseous form. Gas systems

approved under the Marine Equipment Directive (MED) should normally be considered acceptable to the MCA, as they were to the sponsoring State.

7.2.2 On ships fitted with an emergency generator one engine room fan should be arranged to be powered from it so that the room can be ventilated after the fire is extinguished. On other ships the contents of MGN 354 will be relevant.

7.2.3 CO_2 and other fire extinguishing gases should not be used for inerting purposes in spaces which may contain an explosive mixture of flammable gases or vapours where there is no fire, as there is evidence to show that the action has resulted in an explosion caused by electrostatic sparks generated by the CO_2 discharge.

7.2.4 Operating instructions and signage should be as per MGN 389

7.3 Carbon dioxide systems – High pressure

7.3.1 Carbon dioxide cylinders

7.3.1.1 Gas cylinders should be constructed in accordance with a recognised standard e.g. BS EN ISO 9809-1-2-3:2010; BS ISO 3500:2005. The tare weight and the water capacity should be stamped on it. The weight of CO_2 permitted in each cylinder should not exceed two-thirds of a kilogram for every litre of water capacity of the cylinder at 15^{o}C. Each cylinder head discharge valve assembly must be fitted with a bursting disc designed to rupture at a pressure of between 177 and 193 bar. The arrangements should permit the free escape of gas from a cylinder when the bursting disc is ruptured but not allowed to depress the oxygen level in the CO_2 room. Bursting discs which do not release gas into the discharge manifold should be piped to open air and not allowed to vent into the room.

7.3.1.2 Non-return valves should be provided at the discharge manifold to allow any cylinder or flexible discharge pipe to be disconnected without affecting the use of other cylinders in the system, and to reduce the risk of a discharge to the CO_2 cylinder storage room when the system is put into operation to smother a fire.

7.3.1.4 Cylinder head discharge valves, if arranged for remote release, should preferably be capable of being opened manually in the event of malfunction of the remote release system.

7.3.1.4 As the discharge must be maintained from the liquid content of the cylinder, a suitable internal pipe must be fitted for this purpose. Cylinders fitted with such internal pipes should be marked such that they can be easily distinguished from CO_2 cylinders not fitted with an internal pipe and used for refrigeration purposes. It should be noted that small CO_2 or N_2 cylinders used for providing the actuation pressure for gas operated discharge systems are not provided with internal pipes.

7.3.1.5 Gas cylinders should be installed in the vertical position.

7.3.2 Carbon dioxide storage rooms

7.3.2.1 The following requirements are applicable only for the storage rooms for fire-extinguishing media of fixed gas fire-extinguishing systems:

.1 the storage room should be used for no other purposes;
.2 if the storage space is located below deck, it should be located no more than one deck below the open deck and should be directly accessible by a stairway or ladder from the open deck;
.3 spaces which are located below deck or spaces where access from the open deck is not provided, should be fitted with a mechanical ventilation system designed to take exhaust air from the bottom of the space and should be sized to provide at least 6 air changes per hour; and
.4 access doors should open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjacent enclosed spaces, should be gas tight.

(Unified Interpretation - MSC/Circular 1120)

7.3.2.2 The CO_2 storage room should provide access in an emergency for personnel wearing breathing apparatus, be well illuminated and dry. Storage rooms should not be accessible directly from boiler, machinery, accommodation or cargo spaces.

7.3.2.3 All storage rooms should be well ventilated. In all but small rooms, forced ventilation at a rate of at least 6 air changes an hour should be provided, preferably as extraction from low level with air balance at high level. Suitable notices should be placed at the entrance to inform personnel that the fan must be run for a suitable period before going into the room.

7.3.2.4 The storage room will normally meet the definition of a control station. Structural fire protection should be installed accordingly, even if a retro-fit to an existing ship.

7.3.2.5 The ambient temperature should not exceed 60°C and where adjacent spaces are likely to be at higher temperatures, special precautions such as insulation of boundaries or power assisted ventilation should be provided to prevent the overheating. The space should permit inspection, testing, maintenance and operation of the system to be carried out easily and safely.

7.3.2.6 CO_2 contents checking:

CO_2 cylinders are normally filled up to 2/3rds of the height of the cylinder, however, the level will change according to the ambient temperature.

Means should be provided to verify the liquid level in all the cylinders, either by weighing the cylinders or by using a suitable liquid level detector. Attention is drawn to the inability of liquid level detectors to operate satisfactorily when the

ambient temperature is near or above the critical temperature which for CO_2 is 30.5°C.

If the weighing method is used, each cylinder weight and the ambient

be made at the next check interval.

If the liquid level detection method is used, the level should be marked on each

check interval.

Cylinders containing less than 90% of the nominal charge should be refilled.

> *Means for checking the quantity of medium in containers should be so arranged that it is not necessary to move the containers completely from their fixing position. This is achieved, for instance, by providing hanging bars above each bottle row for a weighing device or by using suitable surface indicators.*

(Unified Interpretation - MSC/Circular 1120)

7.3.2.7 Longitudinal location of CO_2 room:

> *Fire-extinguishing media protecting the cargo holds may be stored in a room located forward the cargo holds, but aft of the collision bulkhead or aft its imaginary vertical line, provided that both the local manual release mechanism and remote control(s) for the release of the media are fitted, and that the latter is of robust construction or so protected as to remain operable in case of fire in the protected spaces. The remote controls should be placed in the accommodation area in order to facilitate their ready accessibility by the crew. The capability to release different quantities of fire-extinguishing media into different cargo holds so protected should be included in the remote release arrangement.*

(Unified Interpretation MSC/Circular 1240)

7.3.2.8 The above also applies to the location of extinguishing media for engine rooms and other spaces.

7.3.3 Distribution and release arrangements and test requirements

7.3.3.1 On new systems the FSS Code requirement (ch 5.2.2.2 as amended by IMO Resolution MSC.206(81) which entered into force on 1 July 2010) for 2 separate release controls should be applied, except as described below. The discharge pipes should be connected to an accessible distribution manifold clearly marked to indicate each space to which discharge can be made. The distribution valves should be of approved type to avoid wire drawing and consequent freezing. All power and automatically operated valves should preferably be capable of being manually controlled from a local position in case of malfunction.

7.3.3.2 Release Operation of the CO_2 System (FSS Code, Ch 5, 2.2.2)

The requirements of FSS Code, Ch 5, 2.2.2 apply to the spaces identified in Ch 5, 2.1.3.2 of FSS Code as interpreted by MSC/Circ.1120.

(IACS Unified Interpretation SC132)

The pre-discharge alarm may be activated before the two separate system release controls are operated (e.g. by a micro-switch that activates the pre-discharge alarm upon opening the release cabinet door as per paragraph 2.1.3.2). Therefore, the two separate controls for releasing carbon dioxide into the protected space (i.e. one control to open the valve of the piping which conveys the gas into the protected space and a second control used to discharge the gas from its storage containers) as per paragraph 2.2.2 can be independent of the control for activating the alarm.

(IACS Unified Interpretation SC252)

7.3.3.3 Where gas pressure from main cylinders is used as a means of releasing the remaining cylinders, at least two such cylinders should be used simultaneously for such operation where possible. This does not apply to cylinders used for remote release by gas pressure. Where practical, especially when remote release station is distant from the bottle storage room, sufficient gas should be available at the remote release station to operate the system twice so that minor leakage may be overcome.

7.3.3.4 Effective safeguards should be provided against the gas being accidentally released when a CO_2 system is being serviced on board, and to guard against the inadvertent and, as far as practicable, the malicious use of the controls after the system has been installed or serviced. To achieve this, the discharge of CO_2 from the storage cylinders should be isolated from the machinery space by means of a sector valve and, preferably, arranged that the control cabinet door cannot be closed unless the sector valve is in the fully closed position. In installations where the sector valves are gas operated, equivalent means of safeguarding the system against inadvertent discharge should preferably be provided on the actuation position.

7.3.3.5 The release arrangements should give an indication if the system has been operated. Where automatic time delays are incorporated in any of the release arrangements for the system, these should preferably have a means of bypassing the delay. Where any delay device is fitted, this should be clearly marked on the operating instructions and include the time delay setting so that the operator can distinguish between intentional delay and malfunction of the system. Systems compromising automatic stopping of fans, closure of fire dampers or remote closing valves, which are activated by the release of the CO_2 in the event of a fire, should be supplemented with a manual override, see also 7.3.3.13 .

7.3.3.6 Remote activation cables or pipes must not pass through the protected space.

7.3.3.7 Distribution piping systems should be of steel or other fire resistant material, permanently installed and properly supported. It should be arranged so that CO_2 is effectively distributed throughout the protected spaces through approved nozzles which should meet the requirements of BS EN 12094, Part 7 that states:

- Metal parts of nozzles shall be made of stainless steel, copper, copper alloy or galvanised steel
- All materials shall be resistant to media with which they come into contact
- Nozzles shall be designed so that the function cannot be adversely affected by ageing or environmental influences
- Non-metallic materials and elastomers shall be selected to be stable and not alter their performance over the working life recommended by the manufacturer
- The nozzles shall withstand both the high temperatures generated during a fire and the cold shock caused by the extinguishant as it is discharged

The arrangements should be such that approximately 15% of the charge is distributed below the floor plates and over the tank top.

7.3.3.8 The regulations require that 85 per cent of the required concentrations for machinery spaces and cargo pump rooms are achieved in such spaces within two minutes. However the arrangements should additionally provide for a discharge of at least 50 per cent of the required amount of gas in the first minute of operation.

7.3.3.9 CO_2 Discharge Time (Reg. II-2/20.6.1.1.1, FSS Code, Ch. 5, 2.2.1.5)

These requirements may be checked by suitable calculations.
(IACS Unified Interpretation SC128)

7.3.3.10 Where discharge time is not determined by a test discharge distribution pipe and nozzle sizes should be determined in accordance with a recognised flow calculation programme e.g. compliant with BS 5306: Part 4: 2001 or NFPA 12 (Standard on CO_2 Extinguishing Systems). Sufficient data output should be submitted to enable the designs to be checked to verify that the modelled system is the same as that proposed for installation. Otherwise surveyors may accept distribution systems where the nominal bore of the supply pipes and associated valves to machinery and cargo pump rooms is not less than the commonly accepted values shown against gas throughput in the table below:

Maximum quantity of required CO_2 in kg	Nominal bore (mm)
45	12
100	20
135	25
270	32
450	40
1,100	50
1,600	65
2,000	80
3,200	90
4,700	100
7,000	125

7.3.3.11 Distribution pipes should normally be not less than 20mm nominal bore but short lengths of dual terminal pipes may be 12mm nominal bore. The pipework should extend at least 50mm beyond the last nozzle on the line to avoid blockages. Flexible hoses should be certified for use with CO_2 and have a burst pressure of at least 4 times maximum working pressure. Pipework should meet IACS Unified Requirement P1:

IACS Unified Requirement P1 –
Minimum wall thickness for steel pipes for CO_2 fire extinguishing

External diameter (mm)	From bottles to distribution station	From distribution station to nozzles
21,3 - 26,9	3,2	2,6
30 - 48,3	4	3,2
51 - 60,3	4,5	3,6
63,5 - 76,1	5	3,6
82,5 - 88,9	5,6	4
101,6	6,3	4
108 - 114,3	7,1	4,5
127	8	4,5
133 - 139,7	8	5
152,4 - 168,3	8,8	5,6

NOTES
1. Pipes are to be galvanized at least inside, except those fitted in the engine room where galvanizing may not be required at the discretion of the Classification Society.
2. For threaded pipes, where allowed, the minimum wall thickness is to be measured at the bottom of the thread.
3. The external diameters and thicknesses have been selected from ISO Recommendations R336 for smooth welded and seamless steel pipes. Diameter and thickness according to other national or international standards may be accepted.
4. For larger diameters the minimum wall thickness will be subject to special consideration by the Classification Society.
5. In general the minimum thickness is the nominal wall thickness and no allowance need be made for negative tolerance or reduction in thickness due to bending.

7.3.3.12 The distribution manifolds and the pipes between the cylinders and the distribution manifolds should be certified by the makers or suppliers to have been satisfactorily tested to a pressure of at least 190 bar. Any fittings in this section of pipework should be of steel or acceptable non-ferrous material and be capable of withstanding the same test pressure.

7.3.3.13 Surveyors should ensure that gas from the CO_2 manifold is not used to operate fan and pump stops, quick closing valves or fire flaps via pipework extensions to the manifold as tested. Pressure switches, suitable for the maximum safe working pressure of 122 bar, may be installed into manifold sockets.

7.3.3.14 Where there is a risk of liquid CO_2 entrapment in pipework then a relief valve should be provided set at a pressure of around 150 bar.

7.3.3.15 The makers or suppliers should guarantee that not less than 10% of the pipes from the distribution manifolds to the spaces to be protected have been satisfactorily tested to a hydraulic pressure of at least 122 bar. Any fittings in the open ended pipework downstream of the distribution valves should be capable of withstanding the same test pressure and be suitable for their intended duty.

7.3.3.16 Carbon dioxide pipes to cargo holds should not pass through machinery spaces where this can possibly be avoided. When CO_2 pipes have to pass through machinery spaces no objection need be raised subject to the following:

(a) the suppliers should confirm that all CO_2 pipes used within the machinery space have been tested to 122 bar; and

(b) the surveyor should satisfy himself, e.g. by testing a sample joint to 122 bar or by other means, that the jointing arrangements are sufficient for the intended service.

7.3.3.17 Construction of pipelines passing through accommodation

The pipelines may pass through accommodation providing that they are of substantial thickness and that their tightness is verified with a pressure test, after their installation, at a pressure head not less than 5 N/mm^2 (50 bar). In addition, pipelines passing through accommodation areas should be joined only by welding and should not be fitted with drains or other openings within such spaces. The pipelines should not pass through refrigerated spaces.

(Unified Interpretation - MSC/Circular 847)

7.3.3.18 The pressure test should be carried out at a minimum of 122 bar (12.2 N/mm^2), not the 50 bar specified by IMO.

7.3.3.19 The joints of gas pipes should be made by suitable barrel couplings, cone connections, flanges or welding, as per Lloyd's rules for pipes (Part 5

chapter 12). The pipes should not be weakened by exposed screw threads, and running couplings (slip-on joints) are not acceptable.

Threaded joints in CO_2 systems shall be allowed only inside protected spaces and in CO_2 cylinder rooms.
(IACS Unified Rule P2)

7.3.3.20 If jointing material is used it should be as thin as practicable. After installation, all pipes should be tested, either by a discharge of the smothering gas into the pipes or with compressed air, to a pressure of about 7 bar with the discharge openings closed to ensure no leaking will occur.

7.3.3.21 A connection should be provided at the manifold to blow through the distribution system with compressed air for routine test purposes, but there should be no permanent connections between the CO_2 system and any compressed air system.

7.3.3.22 After the pressure tests have been completed, a blow through test should be carried out to ensure that all plugs and blank flanges have been removed from the distribution system and that all pipes are clear and correctly connected according to the marking on the distribution valve chest.

7.3.4 Operating instructions and alarms

7.3.4.1 Instructions for operating the installation must be displayed near the remote operating controls, distribution control valves and also near the gas cylinders in accordance with MGN 389. When the installation is used to protect the pump room or cargo tanks of a tanker and similar spaces, a notice should be displayed indicating that the system should not be used for inerting purposes, unless the compartment is gas free, since the injection of CO_2 may generate a static charge capable of igniting flammable atmospheres.

7.3.4.2 When the means for putting the system into operation are located within a compartment which may be locked, e.g. the CO_2 cylinder room, one key to such a compartment should be provided adjacent to the entrance in a suitably marked glass-fronted box. Normally, mechanical ventilation of the protected space should be capable of being shut down manually. Where this is achieved automatically on release of CO_2, over ride facilities that can be rapidly operated without entry into the protected space should be provided to enable spaces to be ventilated after the injection of CO_2. Suitable notices should be posted by the ventilation system controls to indicate that provisions for automatic ventilation shut down have been fitted and where these are located. Notices should be posted on the entrances to every space protected by CO_2, indicating that the space is so protected and that personnel should evacuate the space immediately on hearing the CO_2 alarm.

7.3.4.3 When a smothering gas system for cargo spaces is combined with a sample extraction smoke detection system, arrangements to prevent gas being admitted to the detecting cabinet should be provided.

7.3.4.4 In the general interests of safety, discharged or partially discharged CO_2 cylinders should have the valves tightly closed and be fitted with a protective cylinder valve cap whenever they are disconnected from the system.

7.3.4.5 The means provided for giving an audible alarm referred to in the regulations should be distinct from all other alarms, and comply with Code on Alerts and Indicators, 2009 (IMO Resolution A.1021(26)) and MSN 1763. Attention is drawn to requirements in part 4.2 of the Code on Alerts and Indicators for visual indication in addition to the audible alarm in many situations. When such means are electric, the power should be obtained from the emergency source batteries or through the emergency switchboard. Supplies for air operated devices should be taken from the main air receivers through a safeguarded supply system. When fitted in pump rooms, such alarms, if electric, should be intrinsically safe and, if of the air operated type, should be connected to a safeguarded moisture free supply. See 7.3.3.5 regarding interlocks or time delays.

7.3.4.6

> *Ordinary cargo holds need not comply with SOLAS II-2 regulation 2.1.3.2. However, ro-ro cargo spaces, holds in container ships equipped for integrated reefer containers and other spaces where personnel can be expected to enter and where the access is therefore facilitated by doors or manway hatches should comply with the above regulation.*

(Unified Interpretation - MSC/Circular 1120)

7.3.5 Installation tests

7.3.5.1 Where gas flow is specified by regulation, and has not been calculated using an accepted programme, then a discharge test is required to verify discharge rate. This is not required where the surveyor is satisfied that the system conforms to that modelled by the flow calculation programme and the results meet the regulation requirement.

7.3.5.2 In addition to any testing required in 7.3.3.12 – 7.3.3.21 the following tests should be carried out if considered appropriate:

- Remote release activation for cylinders and control valves
- Alarms and vent cut outs
- Effectiveness of storage room ventilation
- Exhausting arrangements following discharge
- Verification of structural fire protection

7.3.6 Records

File records should contain full system design including:

- Certificates for pressure testing of manifolds / pipework / safety valves
- Certificates of fill for each bottle

- Certificates showing burst pressure and temperature rating for any flexible hoses used
- Certificates of hydro test / structural soundness for bottles / containers
- Calculations to determine enclosure volume and quantity of extinguishing agent

7.3.7 Resurvey

7.3.7.1 Fixed CO_2 systems should be maintained and inspected in accordance with manufacturer's recommendations and the maintenance plan required by the regulations. Surveyors should satisfy themselves that:

- The CO_2 quantity has been checked at least biennially (intervals of 2 years ± 3 months) in passenger ships or at each intermediate, periodical or renewal survey in cargo ships
- Alarms and ventilation shut downs are functioning
- Pipework remains in good condition, free from damage and corrosion. Any copper pipes should be carefully checked for signs of work hardening
- Gas cylinders are in good condition and have been maintained as per MGN 374 or IMO MSC/Circular 1318, see 7.3.7.3
- All flexible hoses (if applicable) to be examined annually and tested or renewed in accordance with manufacturers recommendations
- Gas tightness of the protected space to be inspected annually

7.3.7.2 At periodic survey, or every 2 years, the system should be blown through to prove all lines and nozzles clear.

7.3.7.3 The information in 7.3.7.1 is currently valid, however, with the approval of IMO MSC/Circular 1318 the MCA adopts the following policy for this Circular:

i) Although the MSC/Circular 1318 guidelines are not mandatory, the MCA will accept them when inspecting fixed CO_2 systems on UK-flagged vessels.

ii) If the fixed CO_2 cylinders are found to be in a very good condition at the 10 year interval, then the MCA will accept the hydrostatic test requirements specified in MSC/Circular 1318 paragraph 6.1.2, provided that all cylinders are tested within a 20 year maximum period.

iii) If any CO_2 cylinders are found to be in a poor condition, (rusty, damaged, etc.), at the 10 year interval, then the MCA would insist that those cylinders be hydrostatically tested.

iv) Monthly inspections (MSC/Circular 1318 paragraph 4) - may be performed by competent crew members, e.g. crew who have undertaken an STCW Advanced Fire Fighting course.

v) Annual inspections (MSC/Circular 1318 paragraph 5) - it is recommended that this is performed by persons specially trained in the maintenance of such systems, e.g. manufacturer or recognised service company.

vi) Full maintenance (Circular 1318 paragraph 6) - should be performed by persons specially trained in the maintenance of such systems, e.g. manufacturer or recognised service company.

7.3.8 Exhaust ducts from galley ranges

7.3.8.1 Galley exhaust duct (SOLAS Reg. II-2/9.7.5.2.1)

Grease trap, fire damper, fan shut-off and fixed fire extinguishing are only required when a galley exhaust duct passes through accommodation spaces or spaces containing combustible materials. The term "spaces containing combustible materials" will normally apply to all spaces in accommodation.
(IACS Unified Interpretation SC106)

7.3.8.2 When CO_2 is to be used as the fixed means of extinguishing fires in galley ducts in compliance with paragraph 4(d) of Schedule 3 to MSN 1667(M), the following criteria are recommended:

- The system should comply with the appropriate recommendations set out in NFPA 12 (Standard on CO_2 Extinguishing Systems);

- The recommended flooding factor should be 2 kg/m^3 of duct volume, representing a concentration of 65%;

- The flooding factor of 2 kg/m^3 of duct volume is calculated as follows: - The minimum CO_2 design concentration for extinguishing hydrocarbon fires is 34%, at an average flooding factor of 1.055 kg/m^3 of duct volume between 1-1415 m^3. In NFPA 12 a Material Conversion Factors Chart shows a graph covering materials requiring a design concentration over 34%. From this graph, for a design concentration of 65%, the conversion factor is just over 2. The average flooding factor of 1.055 kg/m^3 at 34% design concentration is multiplied by the conversion factor to give the flooding factor at the required design concentration, i.e. 1.055 x 2 = 2.11 kg/m^3;

- The CO_2 requirement in NFPA 12 for deep-seated fires is that after the design concentration is reached, the concentration shall be maintained for a substantial period of time, but not less than 20 minutes. Any possible leakage shall be given special consideration because no allowance is included in the basic flooding factors;

- The total flooding system designed for an enclosed space deep-seated fire, such as galley hot exhaust ducts, should maintain an effective CO_2 concentration until the maximum temperature has been reduced below

the re-ignition point. Sheet metal ducting that can be heated quickly and substantially is an example of where maintaining the concentration for cooling can be necessary;

- The gas is meant to be trapped between upper and lower fire dampers and not spill out into the galley; and

- The resultant pressure in the duct after discharge of the CO_2 gas, with the dampers closed, should be considered to avoid damage to the system.

7.3.8.3 The cylinder storage location need not be outside the galley. Due consideration should be taken of the possibility of an oxygen deficient atmosphere in the event of the cylinder bursting disc operating when approving storage location.

7.3.8.4 Exhaust duct from galley ranges (Reg. II-2/9.7.5.1 and 9.7.5.2.1)

Fire dampers required by Reg. II-2/9.7.5.1 and 9.7.5.2.1 do not need to pass the fire test in Res. A 754(18), but should be of steel and capable of stopping the draught. The requirements to "A" class apply only to the part of the duct outside of the galley.

(IACS Unified Interpretation SC118)

7.3.8.5 Installation testing will depend upon scale of system but the following should be considered:

- Verification of gas tightness of duct boundaries
- Effective operation of fire dampers
- Blow through of lines and nozzles

7.3.9 Deep fat cooking equipment

7.3.9.1 Deep-fat cooking equipment shall be fitted with the following:

.1 an automatic or manual fire-extinguishing system tested to an international standard acceptable to the Organization,[*]

.2 a primary and backup thermostat with an alarm to alert the operator in the event of failure of either thermostat;

.3 arrangements for automatically shutting off the electrical power upon activation of the fire-extinguishing system;

.4 an alarm for indicating operation of the fire-extinguishing system in the galley where the equipment is installed; and

[*] Refer to the recommendations by the International Organization for Standardization, in particular publication ISO 15371:2009, Fire-extinguishing systems for protection of galley cooking equipment.

.5 controls for manual operation of the fire-extinguishing system which are clearly labelled for ready use by the crew.

7.3.9.3 Extinguishing systems for deep fat fryers should meet ISO 15371:2009, 'Fire-extinguishing systems for protection of galley cooking equipment'. This Standard also covers system activation and ventilation requirements for such systems.

7.4 Carbon dioxide systems – Low pressure

7.4.1 General

7.4.1.1 The general requirements for low pressure CO_2 installations can be found under IMO Resolution MSC.206(18) and MSC/Circular 1318.

7.4.1.2 The total charge must not be less than regulation capacity and may be contained in more than one tank. Because the availability of bulk CO_2 on a world-wide basis may be uncertain and that the inability to make good any leakage may cause the ship to be considered unseaworthy, the MCA recommends that about 5 per cent additional capacity be provided.

7.4.2 Design requirements

1 *The system control devices and the refrigerating plants should be located within the same room where the pressure vessels are stored.*

2 *The rated amount of liquid carbon dioxide should be stored in vessel(s) under the working pressure in the range of 1.8 to 2.2 N/mm^2. The normal liquid charge in the container should be limited to provide sufficient vapour space to allow for expansion of the liquid under the maximum storage temperatures than can be obtained corresponding to the setting of the pressure relief valves but should not exceed 95% of the volumetric capacity of the container.*

3 *Provision should be made for:*
- *pressure gauge;*
- *high pressure alarm: not more than setting of the relief valve;*
- *low pressure alarm: not less than 1.8 N/mm^2;*
- *branch pipes with stop valves for filling the vessel;*
- *discharge pipes;*
- *liquid CO_2 level indicator, fitted on the vessel(s);*
- *two safety valves.*

(Unified Interpretation - MSC/Circular 1120)

7.4.2.1 Duplicate means of ascertaining contents measurements should be fitted or supplied.

4 *The two safety relief valves should be arranged so that either valve can be shut off while the other is connected to the vessel. The*

setting of the relief valves should not be less than 1.1 times working pressure. The capacity of each valve should be such that the vapours generated under fire condition can be discharged with a pressure rise not more than 20% above the setting pressure. The discharge from the safety valves should be led to the open.

5 *The vessel(s) and outgoing pipes permanently filled with carbon dioxide should have thermal insulation preventing the operation of the safety valve in 24 hours after de-energizing the plant, at ambient temperature of 45°C and an initial pressure equal to the starting pressure of the refrigeration unit.*

6 *The vessel(s) should be serviced by two automated completely independent refrigerating units solely intended for this purpose, each comprising a compressor and the relevant prime mover, evaporator and condenser.*

7 *The refrigerating capacity and the automatic control of each unit should be so as to maintain the required temperature under conditions of continuous operation during 24 hours at sea temperatures up to 32°C and ambient air temperatures up to 45°C.*

8 *Each electric refrigerating unit should be supplied from the main switchboard busbars by a separate feeder.*

9 *Cooling water supply to the refrigerating plant (where required) should be provided from at least two circulating pumps one of which being used as a stand-by. The stand-by pump may be a pump used for other services so long as its use for cooling would not interfere with any other essential service of the ship. Cooling water should be taken from not less than two sea connections, preferably one port and one starboard.*

(Unified Interpretation - MSC/Circular 1120)

7.4.2.2 One complete refrigerating unit should be powered by the emergency source of power; cooling water to condensers may be obtained from the emergency fire pump through temporary connections from the fire main.

10 *Safety relief devices should be provided in each section of pipe that may be isolated by block valves and in which there could be a build-up of pressure in excess of the design pressure of any of the components.*

11 *The piping system should be designed in such a way that the CO_2 pressure at the nozzles should not be less than 1 N/mm^2.*

12 *Audible and visual alarms should be given in a central control station when:*

- *the pressure in the vessel(s) reaches the low and high values according to 2;*

- *any one of the refrigerating units fails to operate;*
- *the lowest permissible level of the liquid in the vessels is reached.*

(Unified Interpretation - MSC/Circular 1120)

7.4.2.3 An automatic alarm should be fitted to operate at not more than 2 per cent loss of contents.

7.4.2.4 The number of CO_2 leakage paths should be kept to a minimum and be monitored with audible and visual alarms where necessary.

7.4.2.5 Alarm systems should be powered from two sources, one of which should be the emergency source of electrical power.

13 If the system serves more than one space, means for control of discharge quantities of CO_2 should be provided, e.g. automatic timer or accurate level indicators located at the control position(s).

14 If a device is provided which automatically regulates the discharge of the rated quantity of carbon dioxide into the protected spaces, it should be also possible to regulate the discharge manually.

(Unified Interpretation - MSC/Circular 1120)

7.4.2.8 Calculations should be provided as per 7.3.3.7 above unless this pressure is to be measured during a discharge test after installation.

7.4.3 Installation tests

7.4.3.1 Distribution and test requirements should generally follow the instructions in paragraphs 7.3.3.1 to 7.3.3.10 and 7.3.3.14 to 7.3.5.2, above, except that the piping sizes given for guidance in paragraph 7.3.3.10 are too small for the discharge rates required by regulation in the case of bulk systems due to the lower initial pressure in the storage containers. As bulk CO_2 systems are not used for small spaces it is expected that flow calculations will be supplied to confirm whether adequate pipe diameters have been selected.

7.4.3.2 In addition the following tests should be carried out if considered appropriate:

- Remote release activation for cylinders and control valves
- Alarms and vent cut outs
- Effectiveness of storage room ventilation
- Exhausting arrangements following discharge
- Verification of structural fire protection

7.4.3.3 Instructions for use should meet requirements of 7.3.4, above.

7.4.4 Records

File records should contain full system design including:

- Certificates for pressure testing of manifolds / pipework / safety valves
- Certificates showing burst pressure and temperature rating for any flexible hoses used
- Certificates of hydro test / structural soundness for containers
- Calculations to determine enclosure volume and quantity of extinguishing agent

7.4.5 Resurvey

7.4.5.1 Systems should have been serviced in accordance with manufacturer's recommendations and the maintenance plan required by the regulations. Surveyors should satisfy themselves that:

- The two CO_2 quantity measurements methods agree. Loss of contents exceeding 5% must be made up;
- Alarms and ventilation shut downs are functioning;
- Pipework remains in good condition, free from damage and corrosion;
- Storage tank(s) are examined externally, especially in way of tank supports and pipe connections, which may require removal of small areas of the tank insulation;
- Storage tank(s) are examined internally at any time they are empty and at intervals not exceeding 10 years, (where an installation comprises more than one storage tank and not all tanks have been emptied, suitable precautions are to be taken to prevent the inadvertent admission of CO_2 into the tank opened up for examination);
- Pressure test of the storage tank(s) may be required at the Surveyor's discretion, depending on the results from internal or external survey;
- If the internal survey reveals corrosion damage, thickness measurements should be carried out. If thickness reduction at any point is found to exceed 10%, repairs of the tank or replacement is required;
- Storage tank(s) should be fitted with two safety valves, arranged so that either valve can be shut-off while the other is connected to the vessel. The safety valves should be tested every 2 years;
- All flexible hoses (if applicable) to be examined annually and tested or renewed in accordance with manufacturer's recommendations; and
- Gas tightness of the protected space to be inspected annually

7.4.5.2 At periodic survey, or every 2 years, the system should be blown through to prove all lines and nozzles clear and one safety valve overhauled.

7.5 Halogenated hydrocarbon systems (Halon)

7.5.1 Halon systems are prohibited on all EU ships. Any ships found with halon should be reported to Survey Branch who will notify DEFRA as they are responsible for enforcement action.

7.5.2 Where UK or EU vessels are found to be still fitted with halon, the owners should be advised as follows;

- Retaining halon on an EU flag vessel after 31 December 2003 is a contravention of EU Regulation 2037/2000 and UK Environmental Protection (Controls on Ozone-Depleting Substances) Regulations 2002.
- While MCA is not directly responsible for enforcement of this regulation, the halon should be replaced.
- Other authorities (in the UK or other EU countries) intend to take enforcement action if the halon is not replaced. In the UK we have instructions to inform DEFRA about vessels which still have halon so they may take appropriate action
- The supply of halon in Europe for marine use is illegal and should now be non-existent, and world-wide it will be increasingly difficult to obtain.
- Servicing of any halon system will be difficult, especially as the EU Regulation forbids anybody in the EU to work on such systems.

7.6 Halon replacement systems (approved under MSC/Circular 848, as amended)

7.6.1 General

7.6.1.1 While not necessarily specified in UK law, the MCA is prepared to accept systems approved under MSC/Circular 848 – "Revised Guidelines for the Approval of Equivalent Fixed Gas Fire-Extinguishing Systems, as referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-Rooms", as amended by MSC/Circular 1267, MSC/Circular 1316 and MSC/Circular 1317, as being equivalent to the fixed fire extinguishing systems specified in MSN 1666 for Machinery Spaces and Cargo Pump-Rooms, whether as halon system replacements or new installations. This being an internationally sanctioned equivalent the procedure in OAN 463 does not need to be followed and no exemption certificate is to be issued.

7.6.1.2 In all cases, approval of installations must be given on the basis of compliance with the conditions attached to the type approval certificate. The following highlights aspects of the design to be taken into account, and indicates the acceptable parameters to be used in the absence of data in the conditions to the type approval certificate.

7.6.1.3 For current product approvals and applications table, see Annex 1.

7.6.2 Applicable agents / gases

7.6.2.1 MSC/Circular 848, as amended, is intended for halocarbon clean agents (halon replacements) and inert gases other than CO_2.

7.6.2.2 Halocarbon clean agents are 'active' gases and break down the chemical reaction in the fire and typically only need 5 – 12% concentration to work. They include:

- FM 200 – CF_3CHFCF_3
- NOVEC 1230 – $CF_3CF_2C(O)CF(CF_3)_2$

- Halotron IIB – HFC 3-4-9 C2 (FS 49 C2 or R866)
- NAF S227 – CF_3C H F_2 (Pentafluoroethane or HFC 227)
- FE 13 - CHF_3

7.6.2.3 Inert gases work by reducing oxygen levels and typically require concentrations of 35 – 50% to work. They include:

- Argonite – Nitrogen (50%) + Argon (50%)
- Inergen - Nitrogen (52%) + Argon (40%) + Carbon dioxide (8%)

Note: these gases have been engineered to allow personnel to survive in atmospheres at design concentrations. While CO_2 is also an inert gas it cannot be approved under Circular 848 but, under SOLAS, it must meet the requirements of the Fire Safety Systems Code Chapter 5, 2.2. The same principle applies to non SOLAS ships.

7.6.2.4 It is usually for the flag State to determine whether gases are acceptable on the grounds of toxicity however, as these systems are covered by the Marine Equipment Directive (MED), provided the MED certification and testing standards are applicable to the age and type of vessel, this will be acceptable.

7.6.3 Information to be submitted

7.6.3.1 Working plans shall be submitted showing, at least, the following information and calculations:

- Quantity of agent – as per MSC/Circular 848 formulae (see 7.6.4.8)
- Container storage pressure
- Internal volume of the container
- Location, type and flow rate of each nozzle
- Location, size and lengths of pipe, fittings and hoses
- Net volume of protected space(s)

7.6.3.2 Circular 848 requires consideration of the potential hazard from decomposed extinguishing agents. Positions of muster stations should be considered in relation to the location of exhaust outlets from spaces protected by halocarbon gases.

7.6.3.3 In addition, the suppliers of the system should make recommendations as to the protection necessary for re-entry after a fire. This would typically be BA set and protective clothing, similar to that used for carriage of dangerous goods. Means to detect Hydrogen Fluoride (HF) and Hydrogen Chloride (HCL) solutions may be recommended by the suppliers in rare cases.

7.6.4 Temperature considerations

7.6.4.1 In these systems, sufficient agent / gas has to be provided to put out fires, but not so much that an accidental release would cause the No Observed

Adverse Effect Level (NOAEL) to be exceeded, so creating a danger to occupants. This is made more difficult with several gases because their specific volume varies significantly with temperature. Where controls, meeting the requirements of SOLAS (2002) regulations II-2/5.2.5.1 and 5.2.5.2, reduce the risk of accidental release gas, concentrations up to the Lowest Observed Adverse Effect Level (LOAEL) may be permitted.

7.6.4.2 Calculations should be submitted, showing that the minimum concentration is achieved at the minimum anticipated ambient temperature of the protected space. Surveyors should normally take 0°C (see 7.6.4.5) as minimum ambient temperature for all MSC/Circular 848 systems, as most SOLAS ships trading regularly in cold areas will keep the engine, and thus the engine room, warmed even in port. For smaller ships / code boats which start directly from cold, perhaps after several days inactivity, the engine room may be cold – around external ambient. In all but exceptional cases, the engine room will be maintained above 0°C or the cooling systems may freeze if not protected with anti-freeze.

7.6.4.3 Surveyors should note that Circular 848 agent containers may have insufficient pressure to operate correctly if stored below 0°C, and minimum operating temperature should be considered if the containers are to be stowed where temperatures may be below 0^{o}C in winter.

7.6.4.4 Similarly, higher ambient temperatures increase the chances that the NOAEL / LOAEL will be exceeded. The submitted calculations should normally show that NOAEL / LOAEL are not exceeded at an ambient temperature of 50°C.

7.6.4.5 Where the surveyor is satisfied that ambient temperatures in the protected space will not exceed a value higher than 50^{o}C, or fall to a value lower than 0^{o}C, then a smaller temperature range may be sanctioned by Headquarters after consideration of the evidence. The temperature range the system is approved for must be clearly stated on the ship's record of equipment.

7.6.4.6 As concentrations calculated above critically depend on accurate calculation of the free volume of the protected space, surveyors should satisfy themselves that the volumes of items specified in Circular 848 para 5.3 have been deducted with reasonable accuracy.

7.6.4.7 All approval letters should contain a paragraph to the effect that subsequent modifications to the protected space, which alter the net volume of the space, shall require the quantity of extinguishing agent to be adjusted to meet the requirements of MSC/Circular 848. Details of the changes must be submitted to the MCA for approval prior to alterations being carried out.

7.6.4.8 Most approved programs will have a function to include temperature in the calculations supplied to MCA however, the following can be used if necessary:

Mass of gas required is usually calculated by the formula:

$$M = \frac{V}{s} \times \frac{\{c\}}{\{100-c\}}$$

where
M = mass of gas, kg
V = net volume of space, m^3
c = design concentration in (% vol)
s = specific volume of vapour, kg/m^3
s = K1 + (K2 x T)

for FM 200 s = 0.12693 + (0.000514 x temperature in Celsius)
for Halotron s = 0.22515 + (0.000824 x temperature in Celsius)
for Novec 1230 s = 0.0664 + (0.000274 x temperature in Celsius)

Summary of normally accepted design parameters

Product	Delivery	NOAEL	LOAEL	Min Design Concentration
Novec 1230	95% in <10 sec	10%	>10%	5.5%
FM200	95% in <10 sec	9%	10.50%	8.7%
Halotron IIB	95% in <10 sec	13%	15%	12%
Carbon Dioxide	85% in <2 min			40%
Inergen	85% in <2 min	43%	52%	34.9%
Argonite	85% in <2 min	43%	52%	48%

Automatic release

Automatic release may be accepted for systems covering spaces of 170 m^3 or less
(NFPA 2001 Standard)

7.6.4.9 Automatic release is only acceptable for normally unmanned spaces fitted with automatically operated fan stops and fire dampers. A manual release must also be fitted.

7.6.5 System layout

Container storage arrangement for equivalent fixed gas fire extinguishing systems

7.6.5.1 ***FSS Code, Ch. 5.2.5 states:***
Fixed gas fire-extinguishing systems equivalent to those specified in paragraphs 2.2 to 2.4 shall be approved by the Administration based on the guidelines developed by the Organisation.

Interpretation:
Agent containers stored in a protected space shall be distributed throughout the space with bottles or groups of bottles located in at least six separate locations. Duplicate power release lines shall be arranged

to release all bottles simultaneously. The release lines shall be so arranged that in the event of damage to any power release line, five sixth of the fire extinguishing gas can still be discharged. The bottle valves are considered to be part of the release lines and a single failure shall include also failure of the bottle valve.

For systems that need less than six cylinders (using the smallest bottles available), the total amount of extinguishing gas on the bottles shall be such that in the event of a single failure to one of the release lines (including bottle valve), five sixth of the fire extinguishing gas can still be discharged. This may be achieved by for instance using more extinguishing gas than required so that if one bottle is not discharging due to a single fault, the remaining bottles will discharge the minimum five sixth of the required amount of gas. This can be achieved with minimum two bottles. However, NOAEL values calculated at the highest expected engine room temperature are not to be exceeded when discharging the total amount of extinguishing gas simultaneously.

Systems that can not comply with the above, for instance systems using only one bottle located inside the protected space, can not be accepted. Such systems shall be designed with the bottle(s) located outside the protected space, in a dedicated room in compliance with SOLAS Reg.II-2/10.4.3.

(IACS Unified Interpretation SC200)

7.6.5.2

When the agent containers are located outside a protected space, they shall be stored in a room that shall be situated in a safe and readily accessible location and shall be effectively ventilated so that the agent containers are not exposed to ambient temperatures in excess of 55°C. Common bulkheads and decks located between clean agent container storage rooms and protected spaces shall be protected with A-60 class structural insulation. Agent container storage rooms shall be accessible without having to pass through the space being protected. Access doors shall open outwards, and bulkheads and decks including doors and other means of closing any opening therein, which form the boundaries between such rooms and adjoining spaces, shall be gastight.

(NFPA 2001 Standard).

7.6.5.3 Minimum piping design pressure at 21°C :

- FM 200 - 40% above the agent container charging pressure at 21°C
- Novec 1230 - the same pressure as the agent container charging pressure at 21°C
- Inergen & Argonite - the same pressure as the agent container charging pressure at 21°C

(NFPA 2001 Standard)

7.6.5.4 Where these values are contradicted by a MED or type approval certificate, then the values on the MED or type approval certificate should be used.

7.6.5.5 Threaded, welded, brazed, flared, compression or flanged joints may be permitted

7.6.5.6 All piping shall be of non-combustible material. All piping, valves and fittings shall be of corrosion resistant ferrous material, (hot dipped galvanized steel or stainless steel). Piping shall extend to at least 50 mm beyond the last nozzle in each branch line to prevent clogging. Where used, flexible pipes, including connections, shall be of approved material and pressure ratings.

7.6.5.7 If the system incorporates a 2 valve release, i.e. incorporates a manifold, where overpressure of the bottles is not released down the discharge pipe, the bottle protection can be assumed to protect the manifold. In other cases, a safety valve piped to open deck should be fitted set at 110% of manifold design pressure or bottle agent container pressure at 50°C.

7.6.5.8 Typical pressures at 50°C are:

- FM 200 - 34.5 bar
- Novec 1230 - 28 bar
- Halotron IIB - 52 or 90 bar

However, the actual pressures will vary dependent upon the specific agent container charging pressure at 21°C, which should be stamped on the container.

7.6.5.9 Failure of a container overpressure device should not cause a gas level over NOAEL in the surrounding space. In case of discharge down the line to a protected space, the NOAEL should not be exceeded. If the overpressure device vents into space containing the bottle, it should be piped to open deck if NOAEL would be exceeded in the surrounding space.

7.6.5.10 In order to ensure that escape routes, etc., are not to be rendered hazardous during or after discharge of the agent, adequate positive pressure ventilation should be provided in these spaces.

7.6.6 System monitoring

7.6.6.1

The containers shall be monitored for decrease in pressure due to leakage or discharge. Visual and audible signals in the protected area and either on the navigating bridge or in the space where the fire control equipment is centralized shall be provided to indicate a low-pressure condition

(NFPA 2001 Standard)

7.6.6.2

Electrical detection, signalling, control and actuation system(s) shall have at least two sources of power. The primary source shall be from the vessel's emergency bus. For vessels with an emergency bus or battery, the backup source shall be either the vessel's general alarm battery or an internal battery within the system. Internal batteries shall be capable of operating the system for a minimum of 24 hours. All power sources shall be supervised.

For vessels without an emergency bus or battery, the primary source shall be permitted to be the main electrical supply.

(NFPA 2001 Standard)

7.6.6.3 'Supervised' in the above means monitored for failure with visual and audible alarm.

7.6.7 Installation tests

- Manifolds should be pressure tested to a minimum of 150% of design pressure or bottle pressure at 50°C. A higher test pressure may be required by the approval certification
- Distribution pipework should be pressure tested in a closed circuit for a period of 10 minutes to 3 bar to test for leaks. At the end of 10 minutes, the pressure drop should not exceed 20% of the test pressure. The pressure test can be omitted if the total piping contains no more than one change in direction fitting between the storage container and the discharge nozzle, and where all piping is physically checked for tightness
- Distribution pipework should be blown through using nitrogen or an inert gas to prove clear passage
- Pneumatic or electric actuators should be demonstrated working, as far as practicable. Electric detonators may be disconnected while tests are carried out to prove the correct voltage is being supplied via the cable
- Ventilation shut down on release box opening should be tested
- Power failure alarms and backup power supplies should be tested on electronic control boxes

7.6.8 Records

7.6.8.1 File records should contain, where applicable:

- Certificates for pressure testing of manifolds / pipework / safety valves
- Certificates of fill for each bottle
- Certificates showing burst pressure and temperature rating for any flexible hoses used
- Certificates of hydro test / structural soundness for bottles / containers
- Calculations to determine enclosure volume and quantity of extinguishing agent

7.6.8.2 Quantity and type of extinguishing agent should be recorded on the record of safety equipment.

7.6.9 Resurvey

7.6.9.1 Systems should have been serviced annually by manufacturer's agent. Surveyors should satisfy themselves that:

- The bottle pressures are acceptable for the ambient temperature
- The liquid level agent quantity has been checked at least biennially (intervals of 2 years ± 3 months)
- Bottles should be recharged if weight loss >5% or temperature corrected pressure drop >10%
- Alarms and ventilation shut downs are functioning
- Pipework remains in good condition, free from damage and corrosion
- Agent cylinders are in good condition and have been hydrostatically tested as per fixed system CO_2 cylinders
- All system hoses (if applicable) to be examined annually and tested or renewed every 5 years
- Space protected by the clean agent to be thoroughly inspected annually to check if any penetrations have occurred that could lead to agent leakage, and/or other changes have occurred that could change the volume of the hazard
- Any explosive initiators have been changed after the manufacturers recommended service life. Flash cubes, or similar, may be used to prove firing circuits without damaging the initiators

7.6.9.2 At periodic survey, or every 2 years, the system should be blown through to prove all lines and nozzles clear to the surveyor's satisfaction.

7.7 Aerosol Systems

7.7.1 General

7.7.1.1 Aerosols systems usually comprise a fine potassium powder, which is held inside a container or 'generator' until activation causes the powder to be dispersed as an aerosol around the protected space. The potassium molecules attack the fire physically and chemically, inhibiting the chain chemical reaction present in combustion.

7.7.1.2 There are 2 types:

- Condensed aerosols – created in pyrotechnical generators
- Dispersed aerosols – not pyrotechnically generated, but stored in containers with carrier agents (inert gases / halocarbon agents)

7.7.1.3 The MCA is prepared to accept systems:

a) approved by the MCA for small vessels; or

b) approved under MSC/Circular 1270 – "Revised Guidelines for the Approval of Fixed Aerosol Fire-Extinguishing Systems as equivalent to Gas Fire-Extinguishing Systems, as Referred to in SOLAS 74, for Machinery Spaces" as being equivalent to the fixed fire extinguishing systems specified in MSN 1666 for Machinery Spaces, whether as halon system replacements or new installations. This being an internationally sanctioned equivalent the procedure in OAN 463 does not need to be followed and no exemption certificate is to be issued.

7.7.2 Applicable agents

7.7.2.1 The MCA has approved:

Pyrogen Aerosol	Approval MS 22/3/904
FirePro Aerosol	Approval MS 22/3/910
Stat-Ex Aerosol	Approval MS 47/11/1042

for use on vessels under 24m in length.

7.7.2.2 Currently, the following aerosol system is MED approved under MSC/Circular 1270:

FirePro Aerosol	MED Cert: BSI/A.1/3.46/560436

7.7.3 Information to be submitted

The manufacturer should submit full system specification, in accordance with approval certification. These should show the following information and calculations:

- Quantity of agent – as per relevant approval
- Container numbers, locations and types
- Net volume of protected space(s)
- Layout of triggering circuits, control panels and power supplies

7.7.4 System layout

7.7.4.1 For SOLAS ships, systems must meet the requirements of Circular 1270, plus any interpretations below. For ships <24m length the following should be applied, except where contradicted by the conditions on the MED or Type Approval certificate for the aerosol agent under consideration.

7.7.4.2 For vessels constructed of steel / wood / GRP / aluminium, the agent design application density shall be determined for the 'fuel' requiring the greatest design application density. MSC/Circular 1270 requires this to be calculated based upon net volume at the minimum expected ambient temperature. This should be taken as 0°C, as for MSC/Circular 848 systems.

7.7.4.3 All approval letters should contain a paragraph to the effect that subsequent modifications to the protected space, which alter the net volume of the space, shall require the quantity of extinguishing agent to be adjusted to meet the requirements of MSC/Circular 848. Details of the changes must be submitted to the MCA for approval prior to alterations being carried out.

7.7.4.4 The minimum quantity should not be greatly exceeded as powdered aerosols are typically composed of multiple soluble and insoluble compounds. Acute inhalation exposure to very high concentrations of these compounds can induce a variety of adverse effects in humans, such as eye irritation and inhalation toxicity. Unnecessary exposure to aerosol media, even at concentrations below an adverse effect level, should be avoided.

7.7.4.5 Aerosol particles cause obscuration and possible hazards resulting from being unable to see while evacuating the space. In addition accidental exposure to the aerosol should be limited to 5 minutes as high levels of carbon monoxide may be generated. For these reasons aerosols may have approval for 'normally unoccupied spaces' only.

7.7.4.6 In addition, where a halocarbon agent or inert gas is used to disperse an aerosol, the concentrations must not exceed those allowed by MSC Circular 1270.

7.7.4.7 Aerosols are typically non-corrosive, non-toxic and non-conductive.

7.7.4.8 Condensed aerosols are supplied in various standard container sizes (usually by weight), so filling ratio is not relevant. Dispersed aerosols are not widely available but may have varied filling ratios. These should be in accordance with the approval conditions.

7.7.4.9 Condensed aerosol canisters are not pressurised and they may not need overpressure protection. Dispersed aerosols are normally pressurised in which case overpressure precautions should be fitted, e.g. bursting disc or relief valve. In systems using pressure operated container valves, means shall be provided to vent any container leakage that could build up pressure in the pilot system, and cause unwanted opening of the container valve. This could be a safety valve piped to open deck, set at 110% of bottle pressure.

7.7.4.10 If the protected space includes a bilge, the volume of this area shall be included in the net volume calculation, and attention must be taken to ensure this area is covered when locating the aerosol containers.

7.7.4.11 Aerosol systems used to protect normally occupied spaces shall have a time delay, and audible and visual predischarge alarms that sound in the protected space for at least 20 seconds prior to discharge. It is preferable that the alarms should continue to operate after agent discharge until positive action has been taken to acknowledge the alarms.

Automatic operation

Automatic operation may be accepted for any space of 170 m³ or less
(NFPA 2010 Standard)

7.7.4.12 Automatic release is only acceptable for normally unmanned spaces. A manual release must also be fitted.

7.7.4.13 An isolation switch should be fitted near the door to any protected space large enough to enter, so that any automatic system can be isolated before entry. Systems for larger spaces, and all normally occupied spaces, should employ two separate controls for releasing the extinguishing medium.

7.7.4.14 Interlocks shall be provided to shut down pressurised fuel systems and power operated ventilation systems, including fire dampers, serving the protected space prior to agent discharge.

Power supplies

7.7.4.15 At least two independent power supplies, with automatic changeover, are required for the controls and alarm system. The primary source shall be from the vessel's emergency supply. For vessels with an emergency supply or battery, the backup source shall be either the vessel's general alarm battery or an internal battery within the system. Internal batteries shall be capable of operating the system for a minimum of 24 hours. For vessels under 24m which are not required to have an emergency supply or battery, the primary source may be permitted to be the main electrical supply.

7.7.4.16

The discharge time should not exceed 120 seconds. Systems may need to discharge in a shorter time for other reasons than for fire extinguishing performance

(MSC/Circular 1270)

7.7.4.17

Condensed aerosol systems – discharge time required to achieve 95% of the design application density shall not exceed 60 seconds.

Dispersed aerosol systems using halocarbon agents as the dispersing means – discharge time required to achieve 95% of the design application density shall not exceed 10 seconds.

Dispersed aerosol systems using inert gas as the dispersing agent – discharge time required to achieve 95% of the minimum design application density, including a 30% safety factor, shall not exceed 60 seconds

(NFPA 2010 Standard)

7.7.5 System monitoring

All power sources shall be monitored for faults which should be indicated by visual and audible alarms.

7.7.6 Installation tests

- Manifolds (between 2 release valves, if applicable) should be pressure tested to 150% of the maximum system working pressure or bottle pressure
- Distribution pipework, if applicable, should be pressure tested in a closed circuit for a period of 10 minutes at 150% of the maximum system working pressure. At the end of 10 minutes, the pressure drop should not exceed 20% of the test pressure
- The pressure test can be omitted if the total piping contains no more than one change in direction fitting between the storage container and the discharge nozzle, and where all piping is physically checked for tightness
- Distribution pipework should be blown through using nitrogen or an inert gas to prove clear passage
- Pneumatic or electric actuators should be demonstrated working, as far as practicable. Electric detonators may be disconnected while tests are carried out to prove the correct voltage is being supplied via the cable
- Ventilation shut down on release box opening should be tested
- Power failure alarms and backup power supplies should be tested on electronic control boxes
- Space integrity test – similar to that for halocarbon agents.
- Verify correct operation of detection system, if fitted
- Verify that manual release system operates correctly

7.7.7 Records

7.7.7.1 File records should contain where applicable:

- Certificates for pressure testing of manifolds / pipework / safety valves
- Certificates showing burst pressure rating for any flexible hoses used
- Certificates of hydro test / structural soundness for bottles / containers
- Calculations to determine enclosure volume and quantity of extinguishing agent

7.7.7.2 Quantity and type of extinguishing agent should be recorded on the record of safety equipment.

7.7.8 Resurvey

7.7.8.1 Each condensed aerosol generator shall have a permanent marking that indicates the mass of the aerosol forming compound contained within, the manufacturer, date of manufacture and date of mandatory replacement of the

generator. If a generator shows a loss in weight of more than 5%, it must be replaced.

7.7.8.2 Each dispersed aerosol container shall have a permanent marking that indicates the mass of the aerosol forming compound contained within, the type and weight of halocarbon or inert gas dispersing medium, the manufacturer, date of manufacture and date of mandatory replacement of the contents. A means of indication shall be provided to determine the pressure in refillable pressurised containers, if pressure loss (adjusted for temperature) is more than 10%, it shall be refilled or replaced.

7.7.8.3 In systems using pressure operated container valves, means shall be provided to vent any container leakage that could build up pressure in the pilot system and cause unwanted opening of the container valve. This could be a safety valve piped to open deck, set at 110% of bottle pressure.

- Nozzles should be clear
- Verify correct operation of detection system, if fitted
- Pneumatic or electric actuators should be demonstrated working, as far as practicable. Electric detonators may be disconnected while tests are carried out to prove the correct voltage is being supplied via the cable
- Ventilation shut down on release box opening should be tested
- Power failure alarms and backup power supplies should be tested on electronic control boxes
- Verify that manual release system operates correctly

7.7.8.3 Space protected by the clean agent to be thoroughly inspected annually to check if any penetrations have occurred that could lead to agent leakage, and/or other changes have occurred that could change the volume of the hazard.

7.8 Inert gas installations

The general requirements for inert gas installations can be found under ItoS Fire Protection Arrangements chapter 8

7.9 Foam installations – Low expansion

The specification for low expansion foam systems is in chapter 6 of the FSS Code, as amended by IMO Resolution MSC.217(82).

7.9.1 Machinery spaces

7.9.1.1 Low expansion foam systems are no longer permitted to be installed as the sole fixed fire fighting system for machinery spaces however, when fitted as additional protection or on existing ships, the following should be observed.

7.9.1.2 As the present tendency in machinery space arrangements is to site items of machinery on flats, especially in vessels having aft engine room

installations, the arrangements for distributing foam in connection with oil-fired boilers, oil fuel units, etc., should be considered in relation to the possibility of fire spreading from one place to another, or of oil spraying from a burst pipe being ignited.

7.9.1.3 The provision of coamings in way of boilers, diesel generators, etc., whilst preventing the spread of fire in some instances, cannot always be guaranteed to do so, e.g. oil spraying from leaking flanges, and the flats on which such items are situated should therefore be protected by the foam installation, and their areas included with the tank top area in the assessment of the required quantity of foam. The emergency fire pump capacity should be suitably increased if it is necessary to maintain water supply from that source. Distribution pipes should be constructed of corrosion resistant materials such as stainless steel, or equivalent, and provision for flushing with fresh water, and dry compressed air or nitrogen, should be incorporated to allow checking of the pipework and nozzles to ensure they are clear of any obstructions, debris and contamination. This may require the removal of nozzles, if applicable.
Distribution pipework shall have self draining capability.

7.9.2 Pre-mix foam systems

7.9.2.1 In systems of the gas operated premix type, the system shall be capable of discharging through fixed discharge outlets in no more than 5 min, a quantity of foam sufficient to produce an effective foam blanket over the largest single area over which oil fuel is liable to spread.

7.9.3 Induction type systems

7.9.3.1 In a system employing an induction or similar device for the introduction of foam compound into a water supply from an independent source, usually the emergency fire pump, the system shall be capable of discharging through fixed discharge outlets in no more than 5 min, a quantity of foam sufficient to produce an effective foam blanket over the largest single area over which oil fuel is liable to spread.

7.9.4 Foam liquid storage tanks

7.9.4.1 Such tanks subjected to pressure should have been manufactured and certificated as pressure vessels of the appropriate class, equivalent to LR Rules Part 5 Chapter 11. Means for ascertaining the quantity of liquid in the tank should be provided and also means for rapidly isolating any water supply forming part of the system after the tank contents are exhausted. Foam compounds are now covered by the Marine Equipment Directive.

7.9.5 Installation tests

The following should be tested where practical:

- Eductor or foam supply pump proved operational, ideally by;

- Test discharge of a small amount of foam. Where this is not carried out the distribution pipework should be subjected to a pressure test equal to the maximum working pressure +10%
- That the required fire hose supplies can be maintained during foam system use
- Discharge lines proved clear

7.9.6 Records

7.9.6.1 Full system details should be placed on file.

7.9.6.2 Quantity and type of foam solution should be recorded on the record of safety equipment.

7.9.7 Resurvey

- Discharge lines proved clear
- Foam concentrates tested according to MSC/Circular 1312 (low expansion foam), MSC/Circular 798 (medium expansion foam) or MSC/Circular 670 (high expansion foam), as applicable
- Foam concentrate quantity sufficient
- Pressurised gas cylinders maintained as per 7.1.2
- Foam tanks which are pressurised should be treated as for other pressure vessels

7.10 Foam installations – High expansion

7.10.1 The specification for high expansion foam systems is in chapter 6 of the FSS Code and, for pre 2002 ships, in Schedule 8 of MSN 1666. Applications for approval of systems to MSC/Circular 1384 "Guidelines for the Testing and Approval of Fixed High-Expansion Foam Systems" should be referred to Headquarters.

7.10.2 In FSS Code installations, sufficient foam-generating capacity shall be

10 min.

7.10.3 Ducts should preferably be arranged to apply foam directly to areas of high fire risk in order to minimise delays in extinguishing.

7.10.4 The provisions of 7.9.3 to 7.9.7, above, will also apply.

7.11 Foam installations - Deck

7.11.1.1 The general requirements for fixed deck foam systems are contained in the FSS Code chapter 14 and Schedule 7 of MSN 1666(M). In the case of any chemical tanker which requires a Certificate of Fitness, the provisions of the Code for the Construction and Equipment of Ships Carrying Dangerous

Chemicals in Bulk, or the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, as appropriate, are also relevant.

7.11.1.2 In any chemical tanker, the type of foam concentrate should be appropriate for the chemicals listed on the Certificate of Fitness, i.e. either a regular foam or an alcohol resistant foam. In cases where a foam concentrate of each type is required, an all-purpose foam should be used.
7.11.1.3 Foam mains should be routed clear of tanker pump rooms. When this is impracticable, details of alternative arrangements should be submitted to Headquarters for consideration.

7.11.1.4 Fixed deck foam fire-extinguishing systems (SOLAS Reg. II-2/10.8.1)

Where an enclosed pipe trunk is situated within the cargo tanks deck area, the pipe trunk:

.1 should be protected by a fixed fire-extinguishing system in accordance with regulation II-2/10.9. The extinguishing system should be operated from a readily accessible position outside the pipe trunk;

.2 is not considered part of the cargo tanks deck area;

.3 the area of the pipe trunk need not be included in the calculation of the foam solution rate of supply for the deck foam system required by regulation II-2/10.8;

.4 should be adequately ventilated and protected in accordance with regulations II-2/4.5.10.1.2 and II-2/4.5.10.1.3; and

.5 should contain no flammable gas sources other than pipes and flanges. If the pipe trunk contains any other source of flammable gas, i.e. valves and pumps, it should be regarded as a cargo pump-room.

(Unified Interpretations - MSC/Circular 1276)

7.11.1.5 Location and separation of spaces (SOLAS Reg. II-2/4.5.2.2)

An access to a deck foam system room (including the foam tank and the control station) can be permitted within the limits mentioned in Reg. II-2/4.5.2.1, provided that the conditions listed in Reg. II-2/4.5.2.2 are satisfied and that the door is located flush with the bulkhead.

(IACS Unified Interpretation SC 55)

7.11.1.6 Fixed deck foam systems (FSS Code, Ch. 14, 2.1.3)

A common line for fire main and deck foam line can only be accepted provided it can be demonstrated that the hose nozzles can be effectively controlled by one person when supplied from the common line at a

pressure needed for operation of the monitors. Additional foam concentrate is to be provided for operation of 2 hose nozzles for the same period of time required for the foam system.

The simultaneous use of the minimum required jets of water should be possible on deck over the full length of the ship, in the accommodation, service spaces, control stations and machinery spaces.
(Unified Interpretation - MSC/Circular 1120)

7.11.1.7 Foam systems positions of aft monitors (FSS Code Ch.14.2.3.2.3)

Port and starboard monitors required by this regulation may be located in the cargo area as defined in Reg. II-2/3.6, provided they are aft of cargo tanks and that they protect below and aft of each other.
(IACS Unified Interpretation SC169)

7.11.1.8 On tankers under 4000 dwt, applicators may be accepted in place of fixed monitors however, the practicality of small crews being able to hold hoses, and maintain foam concentrate supplies while the applicators are used should be considered. Note the requirement for the foam and fire main systems to be able to operate simultaneously, infers that boundary cooling is expected to take place during foam application.

7.11.1.9 Fixed deck foam systems (FSS Code; Ch. 14, 2.2.2.1)

2.2.2.3 and 2.3.3 of Ch. 14 of the FSS Code apply to all tankers regardless of size.
(IACS Unified Interpretation SC 60)

7.11.1.10 Location of the foam system equipment (FSS Code, Ch. 14, 2.1.2 and 2.3.1)

The major equipment such as the foam concentrate tank and the pumps may be located in the engine room. The controls of the system are to be located in accordance with FSS Code, Ch. 14, 2.3.1.
(IACS Unified Interpretation SC150)

7.11.1.11 The provisions of 7.9.3 to 7.9.7, above, will also apply.

Testing

7.11.1.12 The arrangement of fire hydrants, foam hose lengths, firemain and access should be demonstrated to be suitable for the rapid production of foam over the cargo tank area. At initial surveys, tests should be conducted to verify the required foam discharge rate is achieved by the system, that the monitors achieve their designed range, and the proportioning devices for the foam concentrate maintain the correct dilution rates, necessary for the production of the stipulated quality of foam for the smallest monitor or applicator permitted, up to the maximum design capability of the system.

7.11.1.13 During re-surveys, foam monitors should be tested with water to ensure the pipes are clear and the throw from the monitors has not been impaired. Foam proportioning devices and measuring pumps should be tested, preferably by the discharge of foam from one of the monitors. The foam compound test certificates should be inspected.

7.12 Foam installations – Helideck

7.12.1 New helideck foam systems should comply with IMO Resolution 855(20) or SOLAS II-2 Regulation 18, as appropriate.

From 21 May 2013, new helideck foam systems should also comply with MSC/Circular 1431.

7.12.2 It is a requirement that the foam must be delivered to all parts of the helideck in "all weather conditions that helicopters can operate", and the weather criteria will have to be obtained from the ship designers. Where monitors are placed all around the landing circle, wind may be expected to assist monitors on one side, whilst hindering those on the other. Where monitors are placed on one side only, allowance will need to be made for adverse winds, noting also that foam solution may not achieve the same throw as plain water.

7.12.3 In addition to this, the monitors should be capable of applying foam to the top of the helicopter rotor shaft of the largest helicopter to be used, so that the gearbox and engine can be covered.

7.12.4 The initial installation testing should be carried out using foam solution.

7.12.5 At resurveys, testing monitors with water may be accepted, provided that records of foam quality testing are satisfactory and the surveyor is satisfied that the induction, proportioning and mixing arrangements on the monitors remain effective.

7.13 Water application systems

7.13.1 General

Accommodation sprinkler and alarm systems are covered in I for S MSIS12 chapter 4.

7.13.1.1 Water-based fire-extinguishing systems (FSS Code)

> *SOLAS Regulation II-2/10.5.1.1, 10.5.2.1, 10.5.6 and 10.6 require the installation of fixed pressure water-spraying fire-extinguishing systems for the protection of different areas of the ship. These systems are to comply with the performance standards set out in the FSS Code and to the requirements set out in the regulation itself, which do not specifically address combining systems which protect different types of spaces.*

Water mist systems protecting accommodation (including cabin balcony) and service spaces, control stations, machinery spaces (total flooding and local application), and other specific fire hazards (such as deep fat fryers) using the same pump units may be accepted provided that:

a) the performance standards required for each single hazard (i.e. Res. A.800(19), MSC/Circ.1165, MSC/Circ.913, ISO 15371:2000) are met.

b) failure of any one component in the power and control system should not result in a reduction of the total pump capacity below that required by any of the areas the system is required to protect (e.g. MSC/Circ.1165, Annex, Definitions 20: "In all cases the capacity and design of the system should be based on the complete protection of the space demanding the greatest volume of water" or IMO/Res A.800(19) Annex 3.22: "Pumps and alternative supply components should be sized so as to be capable of maintaining the required flow to the hydraulically most demanding area of not less than 280 m^2" except that for sprinkler systems such a failure should not result in a reduction of the automatic release capability or reduction of sprinkler pump capacity by more than 50%[†].). Pump units arranged as 2x100%, 3x50%, etc. with a dedicated starter cabinet or equivalent arrangements will be accepted. Back-up arrangements are not required for the remote release controls. However, alarms for typical faults in the power and control system shall be provided in a continuously manned control station. Means shall be provided to ensure that the system can be operated manually from positions outside the protected area(s) in case of such faults.

c) the system shall be arranged to avoid a single failure (including pipe rupture) in one protected area resulting in the system being inoperable in another protected area.

d) redundant arrangements[‡] for power and water supply shall be located in different compartments separated by A class divisions.

Note: This Unified Interpretation is to be applied by all Members and Associates on ships contracted for construction on or after 1 January 2008.

(IACS Unified Interpretation SC216 [§])

[†] Hydraulic calculations shall be conducted for sprinkler systems to assure that sufficient flow and pressure are delivered to the hydraulically most remote 140 m^2 in the event of the failure of any one component.

[‡] The term "redundant arrangements for power and water supply" identifies the need to guarantee the function of the system by means of separate source of power and water inlets

[§] SC 216 was withdrawn in August 2008 and is currently awaiting the outcome from the IMO FP Correspondence Group regarding the interpretation of the number, and configuration, of pumps required. In the interim this interpretation is considered to remain useful.

7.13.1.2 In general, system components should not be of a type that may be "readily rendered ineffective by fire", i.e. should be treated as if for a fire main – see chapter 5.

7.13.2 Fixed pressure water spray and mist systems for machinery spaces and cargo pumprooms

7.13.2.1 The general requirements for fixed pressure water spraying systems for machinery spaces and cargo pumprooms are contained in the FSS Code chapter 7, as amended by IMO Resolution MSC.817(82) and Schedule 2 of MSN 1666(M).

Areas for increased application rates

7.13.2.2 An indication of areas for which increased application rates may be required is given below:

Protected Area	***Application rate***
Boiler fronts or roof, firing areas, oil fuel units, centrifugal separators (not oily water separators), oil purifiers, and clarifiers.	*20 l/min/m^2*
Hot oil fuel pipes near exhausts or similar heated surfaces on main or auxiliary diesel engines	*10 l/min/m^2*

(Unified Interpretation - MSC/Circular 1120)

7.13.2.3 Installation tests

The following should be tested where practical:

- Discharge lines and nozzles proved clear
- Alarms and pump cut in proven
- Emergency power supply verified
- Control valves operation demonstrated
- Supply pump proved operational

7.13.2.4 Records

Full system details should be placed on file.

Water application rate and pump discharge capacity should be recorded on record of safety equipment.

7.13.2.5 Resurvey

- Discharge lines proved clear
- Alarms and pump cut in proven
- Control valves operation demonstrated
- Pressurised gas cylinders maintained as per 7.1.2, above

- Tanks which are pressurised should be treated as for other pressure vessels

7.13.3 Fixed local application water spray systems

7.13.3.1 The general requirements for fixed local application water spray systems for use in Category A machinery spaces are contained in MSC/Circular 1387, which has superseded MSC/Circular 913.

7.13.3.2 Installation tests

The following should be tested where practical:

- Discharge lines and nozzles proved clear
- Alarms and pump cut in proven
- Control valves operation demonstrated
- Supply pump proved operational on at least 1 area

7.13.3.3 Records

Full system details should be placed on file.

7.13.3.4 Resurvey

- Discharge lines proved clear
- Alarms and pump cut in proven
- Control valves operation demonstrated
- Tanks which are pressurised should be treated as for other pressure vessels

7.13.4 Fixed pressure water spraying system for cargo spaces

7.13.4.1 The requirements for fixed pressure water spraying systems for ro-ro and special category spaces are contained in IMO Resolution A.123(V), MSC/Circular 1430, (which replaces MSC/Circular 914 and MSC/Circular 1270), or Schedule 3 of MSN 1666(M), as appropriate.

7.13.4.2 Proposals for automatic operation, as allowed by MSC/Circular 1430, should be forwarded to Headquarters for consideration.

7.13.4.3 MSC/Circular 1430 specifies a level of redundancy of pump capacity, which is intended to ensure that 100% of capacity can be maintained in the event of failure of 1 pump or other source of water. Pump power supplies are not required to be duplicated.

7.13.4.4 In addition, automatic systems are required to maintain at least 50% water delivery capacity to closed heads in the event of failure of one power / control system component. For open head systems, total power / control system failure can be accepted following failure of one component as the system can be manually activated.

7.13.4.5 Care should be taken to ensure that water applied during fire fighting does not cause stability problems, see MSC/Circular 1234 "Drainage of Fire Fighting Water from Enclosed Vehicle and Ro-Ro Spaces…" and MSC/Circular 1320 "Guidelines for the Drainage of Fire Fighting Water from Closed Vehicle and Ro-Ro Spaces…". It is particularly important to verify that drainage aspects are being dealt with by Class, where they are carrying out approvals for Safety Construction survey, if the application rates are being approved by MCA as part of Safety Equipment survey.

7.13.4.6 Sizing of scuppers and drainage pumps

> *For the sizing of scuppers and drainage pumps the capacity of both the water spraying system pumps and the water discharge from the required number of fire hose nozzles specified in regulations 10.2.1.5.1 and 19.3.1, as applicable, should be taken into account*.

(Unified Interpretation - MSC/Circular 1120)

7.13.4.7 Installation tests

The following should be tested where practical:

- Discharge lines and nozzles proved clear by operation of system, or by air when this is impossible
- Alarms and pump cut in proven
- Emergency power supply verified
- Control valves operation demonstrated
- Supply pump proved satisfactory at maximum water demand

7.13.4.8 Records

Full system details should be placed on file.

7.13.4.9 Resurvey

- Discharge lines proved clear
- Alarms and pump cut in proven
- Control valves operation demonstrated
- Pressurised gas cylinders maintained as per 7.1.2, above
- Tanks which are pressurised should be treated as for other pressure vessels

7.13.5 Water spray systems for passenger ship balconies

See MGN 367 and MSC/Circular 1268.

7.13.6 Water spray systems for external areas

See MGN 382 and MSC/Circular 1274.

7.13.7 Explosives magazines

Where fixed pressure water spraying systems are provided for the protection of compartments containing explosives, the application rate should be not less than 24 litres per square metre per minute. Open heads are required so that explosives can be wetted before any fire reaches the space.

7.13.8 Manually operated water spraying systems

7.13.8.1 The regulations contain the general requirements for manually operated fixed water spraying systems required in vessels of under 150 tons and less than 21.34 m in length mainly, or wholly, constructed of wood or similar material and decked in way of the machinery space. The requirements are to apply equally to craft of fibre reinforced plastic construction.

7.13.8.2 In any such water spray system, efficient spray nozzles, suitably positioned, should be provided, and in new ships each should be capable of discharging not less than 4.5 litres per minute, the number of heads being such that an application rate of 5 l/m^2/min is obtained. Where such a system is fitted, a 20mm bore ring main fitted with suitable nozzles giving effective spray may be considered acceptable, subject to satisfactory test. Perforated pipes, in lieu of nozzles, are not considered acceptable.

7.13.9 Water spraying systems additional to requirements

Where a fixed water spraying system is accepted as additional to regulation requirements, full details should be submitted for consideration. Such a system may be supplied from either the fire main, or from the fire pump delivery chest, through a valve conspicuously marked as to its function. This arrangement does not contravene the regulations being, in effect, an alternative way of applying the water available to the best advantage. However, it should be possible to shut off the system from a readily accessible position, should it be decided that the water could be used more effectively from fire hoses.

7.14 Fixed Installations for flammable liquid lockers

7.14.1 SOLAS II-2 Reg 10.6.3 lays down acceptable systems.

7.14.2 Water spray systems should meet the requirements of 7.13.8.2.

7.14.3 Gas systems, other than CO_2, may be considered if they meet the application quantities laid down for engine room protection. CO_2, and other inert gas systems, need not meet the 120 second discharge speed.

7.14.4 The 2 separate controls and audible pre-discharge space alarm are not required if the space is less than 10 m^2 floor area, not normally occupied and not used for any purpose but storage of flammable liquids.

7.14.5 Fire fighting systems in cargo sampling lockers (SOLAS Reg.II-2/10.6.3.2)

"The requirements given in SOLAS Reg. II-2/10.6.3.2 and 10.6.3.3 are not considered applicable for cargo service spaces intended for the stowage of cargo samples, when such spaces are positioned within the cargo area onboard tankers."
(IACS Unified Interpretation SC 199)

7.15 Exemption from the requirement to have a fixed fire extinguishing system in cargo spaces

7.15.1 If an exemption is sought from the provision of a fixed fire extinguishing system in the cargo spaces, as provided for in the regulations in the case of ships employed solely in the carriage of the materials listed in MSC/Circular 1146 or those having steel hatch covers, the prospective owner's formal application, together with the surveyor's confirmation regarding the adequacy of the closing arrangements, should be referred to Headquarters.

7.15.2 Fire protection arrangements in cargo spaces (SOLAS Reg. II-2/1.6.4 and Reg. II-2/10.7.1.3)

Ships of less than 2,000 tons gross tonnage carrying petroleum products having a flash point exceeding 60°C (c.c. test) are not required to be fitted with a fixed fire extinguishing system.
(IACS Unified Interpretation SC 48)

Non-combustible cargoes, such as materials listed in paragraph 1 of Annex 2 to the FTP Code, need not be mentioned on exemption certificates issued under regulation II-2/10.7.1.4.

The document of compliance with regulation II-2/19 may not permit more cargoes than indicated in the list of cargoes attached to the exemption certificate issued under regulation II-2/10.7.1.4.
(Unified Interpretations - MSC/Circular 1203

7.15.3 Fire protection arrangements in cargo spaces (SOLAS Reg. II-2/10.7.2)

Reg. II-2/10.7.2 apply to all cargo ships, engaged in the carriage of dangerous goods, of 500 tons gross tonnage and upwards.
(IACS Unified Interpretation SC 49)

7.15.4 A condition of exemption is that dangerous goods of Classes 1, 3, 4 and 5 and flammable gases of Class 2, should not be carried in the exempted hold or tweendeck, or adjacent holds or tweendecks in any ship to which the regulations apply.

7.16 Cargo spaces for which a fixed gas fire-extinguishing system is ineffective
(SOLAS II-2 Reg. 10.7.1.3)

For cargoes for which a fixed gas fire-extinguishing system is ineffective and for which a fire extinguishing system giving equivalent protection should be available, reference is made to MSC/Circ.671, annex, and table 2.
(MSC Circular 1120)

Water supplies defined in regulation 19.3.1.2 are considered as an acceptable protection for cargoes listed in table 2 of MSC/Circ. 671.
(MSC Circular 1120)

7.17 Fixed fire-extinguishing system in cargo spaces (IMO Resolution MSC.268(85), IMSBC Code)

For certain individual schedules of solid bulk cargoes in Appendix 1 of the IMSBC Code as amended, such as FISHMEAL (FISHSCRAP) STABILIZED UN 2216, SEED CAKE, containing vegetable oil UN 1386, SEED CAKE UN 2217, the following ventilation requirement is present:

QUOTE

If the temperature of the cargo exceeds 55°C and continues to increase, ventilation to the cargo space shall be stopped. If self-heating continues, then carbon dioxide or inert gas shall be introduced to the cargo spaces

UNQUOTE

Interpretation

This self-heating phenomenon shall be regarded as an emergency condition such that it is not necessary to provide a separate fixed carbon dioxide fire-extinguishing system or inert gas system dedicated to the control of the self-heating of the cargo within the cargo holds.
The fixed carbon dioxide or inert gas fire-extinguishing system complying with the provisions of the Fire Safety Systems Code required by SOLAS Regulations II-2/10.7.1.3 or II-2/10.7.2 may be used for this purpose. Fixed gas fire-extinguishing systems or inert gas systems installed on board dedicated to the protection of spaces other than cargo spaces cannot be used for this purpose.
(IACS Unified Interpretation SC 250)

Annex 1 Halon Replacement Systems Approvals and Applications Table

See table below.

Halon Replacement Systems Approvals and Applications Table

Product	Company	Approval Body	Certificate No.	Certificate Expiry	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application
					MCA MGN 280 - Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats - Alternative Construction Standards - Machinery Spaces	MCA MSN 1813 (F) - The Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels - Machinery Spaces	MCA MSN 1770 (F) - The Fishing Vessels Code of Safe Working Practice for the Construction and Use of 15 metre length overall (LOA) to less than 24 metre registered length (L) Fishing Vessels - Machinery Spaces	MCA - The Codes of Practice for Police Boats - Machinery Spaces	MCA - Inland Waters Small Passenger Boat Code - Machinery Spaces	MCA MSN 1823 (M) - The Safety Code for Passenger Ships Operating Solely in UK Categorised Waters	MCA - The Large Commercial Yacht Code (LY2 Code) - Machinery Spaces	The Merchant Shipping (Fire Protection: Large Ships) Regulations 1998, SI 1012 - Machinery Spaces and Cargo Pump-rooms	The Merchant Shipping (Fire Protection : Small Ships) Regulations 1998, SI 1011 - Machinery Spaces and Cargo Pump-rooms	The International Convention for the Safety of Life at Sea consolidated text of the 1974 SOLAS Convention, the 1978 SOLAS protocol, as amended - Machinery Spaces and Cargo Pump-rooms	The International Code of Safety for High Speed Craft 2000 Code - Resolution MSC.97(73), as amended - Machinery Spaces	The International Maritime Organisation MSC/Circ.848 on Revised Guidelines for the Approval of Fixed Gas Fire-Extinguishing Systems, as referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-rooms; as amended, Chapter II-2/10.5 and 10.9 (SOLAS Chapter II-2, 2002), and cargo compressor & pump rooms of LNG & LPG carriers
FM 200 (HFC-227ea)	Autronica Fire & Security	DNV	MED-B-4905	18/09/13	√	√	√	√	√	√	√	√	√	√	√	√
MX-200 (HFC-227ea)	Minimax GmbH	GL	5954208 Lux	01/10/13	√	√	√	√	√	√	√	√	√	√	√	√
FM 200 (HFC-227ea)	Gielle s.r.l.	GL	6011209 Lux	28/01/14	√	√	√	√	√	√	√	√	√	√	√	√
FM 200 (HFC-227ea)	Hygood	LR	MED 1150258	12/09/16	√	√	√	√	√	√	√	√	√	√	√	√
FM 200 (HFC-227ea)	Dupont Fluoroproducts	MCA	MS 22/9/316	26/11/13	√	√	√	√	√	√	√	√	√	√	√	√
FM 200 (HFC-227ea)	Fireboy-Xintex	RINA	MED026809CS	15/03/14	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230 (Sapphire)	Tyco Safety	BV	MED 1150157	01/06/16	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230	Gielle s.r.l.	GL	7590409 Lux	13/10/14	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230	Chubb Nord-Alarm GmbH	GL	1211510 HH	23/09/15	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230	Kidde Brand-und Explosionsschutz GmbH	GL	1211710 HH	23/09/15	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230	Ajax-Chubb Brandbeveiliging B.V.	GL	1211910 HH	23/09/15	√	√	√	√	√	√	√	√	√	√	√	√
MX-1230	Minimax GmbH	GL	5954408 Lux	01/10/13	√	√	√	√	√	√	√	√	√	√	√	√
Novec 1230	3M	MCA	MS 22/9/0332	10/02/13	√	√	√	√	√	√	√	√	√	√	√	√

Product	Company	Approval Body	Certificate No.	Certificate Expiry	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application	Application
					MCA MGN 280 - Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats - Alternative Construction Standards - Machinery Spaces	MCA MSN 1813 (F) - The Fishing Vessels Code of Practice for the Safety of Small Fishing Vessels - Machinery Spaces	MCA MSN 1770 (F) - The Fishing Vessels Code of Safe Working Practice for the Construction and Use of 15 metre length overall (LOA) to less than 24 metre registered length (L) Fishing Vessels - Machinery Spaces	MCA - The Codes of Practice for Police Boats - Machinery Spaces	MCA - Inland Waters Small Passenger Boat Code - Machinery Spaces	MCA MSN 1823 (M) - The Safety Code for Passenger Ships Operating Solely in UK Categorised Waters	MCA - The Large Commercial Yacht Code (LY2 Code) - Machinery Spaces	The Merchant Shipping (Fire Protection: Large Ships) Regulations 1998, SI 1012 - Machinery Spaces and Cargo Pump-rooms	The Merchant Shipping (Fire Protection : Small Ships) Regulations 1998, SI 1011 - Machinery Spaces and Cargo Pump-rooms	The International Convention for the Safety of Life at Sea consolidated text of the 1974 SOLAS Convention, the 1978 SOLAS protocol, as amended - Machinery Spaces and Cargo Pump-rooms	The International Code of Safety for High Speed Craft 2000 Code - Resolution MSC.97(73), as amended - Machinery Spaces	The International Maritime Organisation MSC/Circ.848 on Revised Guidelines for the Approval of Fixed Gas Fire-Extinguishing Systems, as referred to in SOLAS 74, for Machinery Spaces and Cargo Pump-rooms; as amended, Chapter II-2/10.5 and 10.9 (SOLAS Chapter II-2, 2002), and cargo compressor & pump rooms of LNG & LPG carriers
Novec 1230	Sea-Fire Europe Ltd	MCA	MS 22/11/534	31/07/17	√	√	√	√	√							
FE-13 (HFC-23)	Orfeo S.A.	GL	2087204 Lux	31/08/14	√	√	√	√	√	√	√	√	√	√	√	√
Halotron IIB (FS 49 C2)	Brassbell AS	GL	37998-12 HH	13/06/17	√	√	√	√	√	√	√	√	√	√	√	√
FirePro Aerosol	FirePro Systems Limited	BSI	BSI/A.1/3.46/560436	19/08/15	√	√	√	√	√	√	√	√	√	√	√	√
FirePro Aerosol	Celanova Ltd	MCA	MS 22/3/910	09/05/16	√	√	√	√	√							
Pyrogen Aerosol	AST Global	MCA	MS 22/3/904	08/07/14	√	√	√	√	√							
Stat-Ex Aerosol	Fireaway LLC	MCA	MS 47/11/1042	09/01/17	√	√	√	√	√							
Inergen	Fire Eater A/S	DNV	MED-B-7267	23/11/16	√	√	√	√	√	√	√	√	√	√	√	√

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