PART 8

BOILERS AND MACHINERY

8.1 Machinery (Regulations 62, 63 and 64)

8.1.1 General

8.1.1.1 The propelling machinery of every passenger ship should have sufficient power for going astern to ensure proper control of the ship in all circumstances. The arrangements should be such that the propulsion machinery can be reversed rapidly enough to enable the ship to be properly handled.

8.1.1.2 There are no statutory requirements for passenger vessels to have multiple propellers, however Regulation 64(3) requires that trials be undertaken to determine the ability of the ship to manoeuvre with one propeller inoperative. Such trial reports for vessels built after 1st September 1984 should be placed on board. Vessels not being able to manoeuvre satisfactorily with one propeller inoperative should not be permitted to go to sea.

8.1.2 Steam turbines

8.1.2.1 Means should be provided which will automatically shut off the steam to the ahead turbines in the event of any of the following fault conditions:-

(i) failure of the lubricating oil pressure;

(ii) overspeed;

(iii) excessive axial rotor displacement; and

(iv) low vacuum in the condenser.

8.1.2.2 This automatic arrangement should preferably not shut off steam to the astern turbine which may be required to stop the machinery quickly.

8.1.2.3 Where two or more propulsion turbines are coupled to the same main gear wheel and only one overspeed governor is provided it is to be fitted to the low pressure ahead turbine. Hand trip gear should also be provided for shutting off steam.

8.1.2.4 Overspeed governors should be fitted to steam turbines driving main or auxiliary generators or other auxiliaries.

8.1.2.5 Auxiliary turbine arrangements are to be such that steam supply is automatically shut off in the event of failure of the lubricating oil pressure.

8.1.2.6 Steam turbine ships will generally be expected to have an astern power capability of 80% of the ahead torque at 50% of the ahead revolutions; the ship should be capable of maintaining, whilst proceeding astern, 70% of the ahead revolutions for a period of at least 30 minutes without overheating of the ahead turbines and condenser. The aforementioned ahead torque and revolutions are those obtained when the ship is proceeding at its normal service speed. Most types of propulsion machinery will normally exceed the astern power capability mentioned above, but where the astern power proposed is less than 80% of the full ahead power full details should be submitted to the Certifying Authority for special consideration.

8.1.2.7 The nozzle boxes of impulse steam turbines should be tested by hydraulic pressure to one and one-half times the maximum pressure to which they may be subjected in service. This maximum pressure will generally be the pressure at which the superheater safety valve is set to operate.

8.1.2.8 The steam casing of all turbines should be tested by hydraulic pressure to one and one-half times the maximum working pressure in such casings or to 2 bar, whichever is the greater.

8.1.2.9 The steam spaces of condensers should be tested by hydraulic pressure to 1 bar.

8.1.2.10 Water boxes of condensers and similar fittings, the failure of which might lead to rapid and serious flooding of the machinery space, should be tested by hydraulic pressure to the maximum pressure that can be developed by any pump capable of delivering to the water boxes when the overboard discharge valve is closed, plus 0.7 bar or to 2 bar, whichever is the greater. Where the operating conditions are not known the test pressure should be not less than 3.5 bar.

8.1.2.11 In single screw ships fitted with steam turbines having more than one cylinder, the arrangements are to be such that steam can be led directly to the low pressure turbine, and either the high pressure or intermediate pressure turbine can exhaust direct to the condenser. The emergency pipes, fittings and controls provided for this purpose are to be such that the pressure and temperature of the steam will not exceed the pressures and temperatures which the turbines and condenser can safely withstand.

8.1.3 Compression ignition engines

8.1.3.1 Fuel oil used in such engines should have a closed flashpoint not less than 60°C.

8.1.3.2 In the case of direct reversing engines the reversing gear should be such that when operated quickly from ahead to astern or vice versa there should be no possibility of the propelling machinery continuing to run in the direction contrary to that corresponding to the position of the reversing gear.

8.1.3.3 Where the Secretary of State considers it safe to do so, only one means of preventing overspeeding need be fitted. However, main engines developing 225kw shaft power or more which are capable of being detached, or which drive a controllable pitch propeller, should be fitted with an additional overspeed protection device.

8.1.3.4 The two means of speed limitation should be independent and the additional overspeed protection device should limit the engine speed to not more than 20% above the normal running speed. The additional device should normally be arranged to shut off the fuel supply to the engine.

8.1.3.5 Each engine cylinder over 230 mm in diameter should be fitted with an efficient relief valve, the discharge from which should be directed so as not to be harmful to those in attendance. The relief valve should, in general, be set to not more than 40% in excess of the maximum design cylinder pressure.

8.1.3.6 Scavenge spaces in open connection with cylinders should be provided with explosion relief valves.

8.1.4 Diesel engines driving electric generators and auxiliaries

8.1.4.1 The normal governor is accepted as one means of preventing overspeed. The other means should be independent of the governor and should not operate by moving the engine fuel pump rack. The other means should limit the speed of the engine to not more than 20% above normal and should stop the engine.

8.1.4.2 Generally, generating sets should be installed with their axes` of rotation in a fore and aft direction. The lubrication should be efficient at all running speeds with the ship listed to any angle up to 15° and with a fore and aft trim of 10° and when rolling up to 22½° from the vertical, without the spilling of oil. With the exception that the lubrication of emergency generators should be efficient and continuous with the ship listed to any angle up to 22½° and with a fore and aft trim of 10°.

8.1.4.3 In all cases, starting and running trials of main and emergency generators, after installation on board, should be witnessed.

8.1.4.4 Use of low melting point materials in diesel engines

(i) Aluminium fuel filters, fuel pumps etc may be permitted provided that not more than 45 litres of flammable fluid would be released in the event of destruction of the fitting by fire, or otherwise.

(ii) If more than 45 litres of fuel oil would be released, a valve operable from outside the engine room, or closed automatically by the rise in temperature at the fitting, should be fitted to limit the escape of flammable fluid.

(iii) In the case of engines where:-

(a) the engine is fitted with more than one fuel pump;

(b) a fuel shut-off valve adjacent to the engine and operable from outside the engine room is not fitted;

(c) a temperature operated fuel shut-off is fitted; or

(d) one or more of the fuel pumps could be damaged by direct flame impingement without the temperature-operated valve closing;

fuel pumps should be protected by suitable screens against direct flame impingement and the temperature-operated shut-off valve should be fitted as near as possible to the first low melting point material fitting through which the fuel oil flows.

(iv) If a fitting will withstand a fire test of 800°C for 20 minutes with no flow of fluid through the fitting, the fitting may, in general, be permitted without consideration of the quantities of fluid involved. This is based on the premise that the outlet valves from fuel oil daily service tanks will be fitted with remote closing arrangements in accordance with the Merchant Shipping (Fire Protection) Regulations 1998. If the fitting referred to is in a lubricating oil system, e.g. a lubricating oil filter, and failure of the fitting when the engine is stopped would release more than 45 litres of oil, a valve automatically operated by rise of temperature at the fitting, or a remotely controlled valve, should be fitted to limit the release of oil.

8.1.4.5 Brazed Joints

Brazed joints may be accepted provided the melting point of the brazing metal is not lower than 800°C.

8.1.4.6 Jointing Material

Where failure of the joint under fire conditions would release more than 45 litres of flammable fluid, the thickness of the jointing material should not, in general, be greater than 0.8 mm but, if the jointing material is not readily rendered ineffective by heat, thickness up to 1.6 mm may be accepted.

8.1.4.7 Crankcase safety arrangements

(i) The construction of crankcases and associated fittings of engines with forced lubricating oil systems, should be such as to prevent, as far as is practicable, danger to personnel in the event of a crankcase explosion.

(ii) The crankcases and inspection doors should be of robust construction and the attachment of the doors to the crankcase or entablature should be substantial.

(iii) Except in the case of small engines, one or more valves designed to relieve any abnormal pressure should be fitted to the crankcase of each engine. The number of relief valves fitted should be as follows:-

(a) engines having cylinders less than 200 mm bore and a gross crankcase volume of less than 0.6 m^3 need not be fitted with crankcase explosion relief valves;

(b) engines having cylinders 200 mm bore or greater but not greater than 250 mm should be fitted with two relief valves, one at each end of the engine. If the crankshaft has more than eight throws, an additional relief valve should be fitted at or near the centre of the engine;

(c) if the bore of the cylinders is greater than 250 mm but not greater than 300 mm, a relief valve should be fitted at each alternate crank with a minimum of two relief valves. The number of relief valves should not be less than half the number of cranks; or

(d) if the bore of the cylinders is greater than 300 mm, then a relief valve should be fitted at each crank,

a relief valve should also be fitted to any separate engine gearcase, chaincase etc when the gross volume of the space is 0.6 m^3, or more.

(iv) The total clear area through the relief valves should not, in general, be less than 115 cm^2 per cubic metre of gross crankcase volume. The clear area through the relief valves for other spaces should be determined on the same basis.

(v) Explosion relief valves should be of the non-return type and should open at a pressure not greater than 0.2 bar.

(vi) Relief valves and their outlets, should be so arranged, or provided with efficient flame arresters, that the discharge of the products of a crankcase explosion will reduce, as far as is practicable, the danger to watchkeeping personnel.

(vii) Lubricating oil drain pipes from the engine sump to the drain tank should extend to well below the working level of the oil in the tank.

(viii) In multiple engine installations, drain pipes are to be arranged so that the flame of an explosion cannot pass from one engine to another.

(ix) Where crankcase vent pipes are fitted, they should be as small as is practicable to minimise the inrush of air after an explosion. Vent pipes should be led to a safe position outside the engine room and the outlet ends should be fitted with wire gauze or other suitable flame arresters. In multiple engine installations, the vent pipe from each engine is to be kept separate from the vent pipe(s) from other engine(s).

(x) Consideration should be given to the provision of means for the detection of overheating of running parts in the crankcase.

8.1.5 Funnel dampers in exhaust gas uptakes

Funnel dampers should not, as a rule, be fitted; but if fitted, they should be provided with a suitable device whereby they may be securely locked in the fully open position, and there should be clear indication to show whether the dampers are open or shut. Casings and uptake joints should be gas tight.

8.1.6 Controllable pitch propellers

8.1.6.1 An emergency means of controlling the pitch from a position adjacent to where the control rods or operating oil enters the line shafting should be fitted. Means of communication between the bridge and the emergency control position should be provided if the propulsion engines are not reversible.

8.1.6.2 Controllable pitch propellers should be fitted with an emergency means of putting the blades into ahead pitch in the event of failure of the normal pitch changing system. The emergency means may be either automatic in operation or a manual jacking arrangement and should be capable of holding the blades in sufficient ahead pitch to give the ship a navigable speed.

8.1.6.3 In the case of a multi-screw ship, emergency means of putting the blades into ahead pitch need not be fitted provided:-

(i) the normal pitch changing system for each propeller is completely independent from that of any other propeller; and

(ii) it is demonstrated on sea trials that the ship can be steered satisfactorily with one propeller out of action, whichever propeller it is that has failed.

8.1.6.4 Where two or more engines are geared to one line of shafting, the pitch of the propeller in the emergency jacked position should be such that the

engines can be clutched in without overloading the engines or any other part of the system.

8.1.6.5 An audible alarm should be fitted at the control station(s) to give warning of lower than normal pressure in any hydraulic or part hydraulic pitch changing system. The alarm should operate before the pressure drops to a point where the propeller no longer operates satisfactorily.

8.1.6.6 Where a controllable pitch propeller is driven by a turbocharged engine, the rate of increase of engine speed and propeller pitch should be controlled automatically so that the amount of fuel delivered to the engine cylinders by the high pressure fuel pump(s) is not more than will burn properly in the weight of air being delivered to the cylinders.

8.1.6.7 An emergency stop for the main engines should be fitted on the bridge. The emergency stop should be independent of the normal pitch control and pitch changing arrangement.

8.2 Boilers (Regulation 65)

8.2.1 General

Both shell and water tube boilers should comply with the appropriate requirements for fusion welded pressure vessels set by a recognised Classification Society, with particular attention being paid to the permissible design stresses.

8.2.2 Superheaters

8.2.2.1 Superheaters are to be so designed as to ensure steam circulation over every part of the surfaces exposed to heat or flame under working conditions. Completed superheaters are to be tested to the same hydraulic test pressure as the boilers of which they form part, or to which they are connected.

8.2.2.2 Superheaters that can be shut off from the main boilers are to be fitted with safety valves in accordance with paragraphs 8.2.9 and 8.2.13 of these Instructions. Drains should in all cases be fitted to superheaters in which a collection of water in the bottom is possible. Suitable provision should be made to avoid overheating of the tubes when raising steam.

8.2.3 Economisers

8.2.3.1 Where the economisers cannot be shut off from the boiler the design pressure is to be that of the boiler. An economiser which can be isolated is to be fitted with an efficient type of safety valve in order to prevent an increase in pressure beyond the design pressure of the economiser under any conditions likely to arise in service. When the arrangement of the boiler feed water system is such as to permit the economiser to be by-passed, provision should also be made to enable the products of combustion to by-pass the economiser.

8.2.3.2 Where bolted joints are used to connect the pressure parts, the nuts should not be exposed to the products of combustion.

8.2.3.3 Economisers which cannot be shut off from the boiler are to be tested, on completion, by hydraulic pressure to the same test pressure to which the boiler is subjected.

8.2.3.4 Economisers which can be shut off from the boiler are to be tested on completion by hydraulic pressure to 1.5 times the economiser's safety valve pressure.

8.2.4 Working pressure

The term working pressure, or maximum working pressure, for boilers including integral superheaters referred to throughout, should, unless otherwise defined, be taken to mean the maximum pressure which the boiler is designed to withstand. In the case of safety valves attached to the steam drums of water tube boilers, or to the shells of cylindrical boilers, this working pressure will usually be the pressure at which those safety valves are set, but if the safety valves are set at some lower pressure the working pressure is to be taken as the maximum pressure which the boiler is designed to withstand. In the case of a superheater which is integral with the boiler, and where the superheater safety valve is usually set to an appreciably lower pressure than the designed working pressure of the steam drum, the working pressure of the boiler as a whole is to be taken as the maximum pressure which the boiler is designed to withstand. The superheater outlet steam pressure will ordinarily be limited by the setting of the superheater safety valve, which should be such that the design working pressure will not be exceeded in any part of the boiler. In no case should the superheater safety valve setting be in excess of the pressure for which the steam pipes and machinery have been designed.

8.2.5 Access for examination and cleaning

All boilers, where possible, are to have access for the examination and cleaning of the internal surfaces of plates and tubes. Where boilers are too small to permit entry, they are to be provided with handholes and sightholes, sufficient in size and number to enable all internal surfaces to be satisfactorily cleaned and inspected.

8.2.6 Boiler securing arrangements

All boilers are to be properly secured to the ship's structure and account should be taken of the various forces to which they may be subjected in service, including collisions. Provision is to be made in the securing arrangements for the expansion of the boiler when heated.

8.2.7 Hydraulic tests

8.2.7.1 Before witnessing hydraulic tests of boilers, surveyors must satisfy themselves that the boilers are suitable for the intended working pressure.

8.2.7.2 On completion, all new boilers (including superheaters) are to be hydraulically tested to 1.5 times the maximum working pressure.

8.2.7.3 Boilers which have been in service and boilers which are too small to permit internal examination, or are otherwise required to be subjected to a hydraulic test, are to be tested to 1.5 times the maximum working pressure.

8.2.7.4 The hydraulic test pressure should be maintained for a period of at least thirty minutes.

8.2.7.5 Surveyors witnessing hydraulic tests should satisfy themselves that the tests are properly carried out, and should inspect the boiler thoroughly while it is under test. If a test is unsatisfactory, the boiler should be retested after defects have been made good.

8.2.7.6 When witnessing hydraulic tests, surveyors should use calibrated test pressure gauges.

8.2.7.7 Particulars of hydraulic tests, including the date, and stamping details should be recorded.

8.2.7.8 On completion of the survey of a new boiler it is to be stamped:-

TEST AUTHORITY

TESTED TO bars
WP bars

SURVEYOR'S INITIALS
DATE

In addition it is desirable that, where applicable, the pressure to which the superheater safety valves are set should be added below the WP thus:-

SUPHT SAFETY VALVES bars

8.2.7.9 Horizontal shell boilers are to be stamped on the front end plate near the furnace door, on the right hand side facing the boiler, or on the adjacent part of the shell. Vertical boilers are to be stamped on the shell immediately over the fire-hole, and water tube boilers on the steam drum over the manhole. Waste heat boilers which have no fire-hole are to be stamped over the manhole. The stamping should be clear of the radius of the fire-hole or the manhole.

8.2.8 Boiler mountings steam and feed pipe fittings

8.2.8.1 The necks of stop valve chests and other boiler mountings should be as short as is practicable.

8.2.8.2 Where boiler mountings are secured by studs, those studs should have a full thread holding in the plate for a length of at least one diameter. If the stud holes penetrate the whole thickness of the plate, the studs should be screwed through the plate and be fitted with nuts inside the boiler. Where bolts are used for securing mountings they should be screwed through the plate from the inside of the boiler. Where boiler mountings of small bore are permitted to be attached to the shell by screwing, the screwed portion should be a good fit in the threaded part of the shell and a substantial back nut should be fitted inside the boiler.

8.2.8.3 The spindles of all valves over 38 mm in diameter should have outside screws and the covers should be secured by bolts or studs. Every valve with a screwed cover should be provided with means to prevent the cover being slackened back or loosened when the valve is being operated. All valves are to be arranged to shut with a clockwise motion of the handwheels.

8.2.8.4 It is important that all valves and cocks are provided with means to show whether they are open or shut.

8.2.8.5 All boiler mountings should be hydraulically tested in accordance with recognised national standards but in no case should the test pressure be less than one and one half times the maximum working pressure of the boiler, except that boiler mountings in the boiler feed system should be tested by hydraulic pressure to one and one half times the maximum working pressure to which the feed lines may be subjected in service. Steam pipe and feed pipe fittings should be tested by hydraulic pressure to one and one half times the maximum working pressure to which they may be subjected in service.

8.2.9 Safety valves: general

When the surveyor has determined the working pressure of the boilers and machinery, he is to see the safety valves loaded accordingly and in such a manner as to preclude the possibility of the load being increased. Therefore, the springs, valves, spindles and adjusting screws should be so cased-in that they cannot be tampered with. Substantial locks should be used for locking up the safety valves. Any other part of a safety valve capable of adjustment to increase the load on the valve should be fitted with a substantial locking device. Should it at any time come to a surveyor's knowledge that the loading of the valves has been altered, or that the valves have been in any way interfered with, so as to increase the pressure without sanction, they are at once to report the facts to the Certifying Authority or Recognised Organisation acting on its behalf.

8.2.10 Minimum number and area of safety valves and area of passages

8.2.10.1 Each boiler should be fitted with at least two safety valves, but where the total heating surface is less than 9.3 m² the provision of only one safety valve could be considered. Where a boiler is provided with an integral superheater which is not capable of being isolated from the boiler, at least one safety valve should be fitted on the superheater outlet. This safety valve may be included in the complement for the boiler.

8.2.10.2 The minimum aggregate area of the locked-up safety valves should not be less than is obtained from the following equations, but in no case should valves less than 38 mm in diameter be accepted without special consideration.

For saturated steam,

$$A = \frac{HE}{CP}$$

where: A for ordinary, high lift and improved high lift safety valves, is the aggregate area in cm² of the orifices through the seats of the valves, and for full lift and full bore safety valves, the aggregate area in cm² of the valve passages which limit the flow through the valves when the valves are fully open.

E is the evaporation in kg per square metre of heating surface H per hour with a minimum value of 29 kg/m² for oil fired boilers. For boilers heated by exhaust gas only, the makers figures for the maximum evaporation per square metre of heating surface may be taken. For composite boilers E may be modified accordingly.

H is the total heating surface is square metres to which factor E applies.

P is the working pressure of the safety valves in N/mm² absolute, i.e. P + 1 (P + 15).

C = 50 for ordinary spring loaded valves, having a lift not less than D/24,

75 for high lift spring loaded valves, having a lift not less than D/16,

100 for improved high lift spring loaded valves, having a lift not less than D/12,

200 for full lift valves, in which the area of discharge which limits the flow through the valve is not less than 80% of the minimum orifice area of any section at or below the body seat, and,

320 for full bore relay operated valves.

For superheated steam,

$$A_S = A(1 + \frac{T_S}{556})$$

where: A_S is the aggregate area of safety valves in cm² for superheated steam,

A is the aggregate area of safety valves in cm² as found from the equation in paragraph 8.2.10.2 of these Instructions

T_S is the superheat of steam in degrees C, i.e. superheat temperature minus saturated temperature.

8.2.10.3 All the safety valves of each boiler may be fitted in one chest, which should be separate from any other valve chest. The valve chest should be connected directly to the boiler by a strong and stiff neck, the passage through which should have a cross-sectional area at least equal to one half the aggregate area of the safety valves in the chest, except that, in the case of full lift and full bore safety valves, the cross-sectional area should be at least equal to the aggregate area of the safety valves in the chest.

8.2.10.4 With ordinary, high lift and improved high lift safety valves, the openings for the passage of steam from the valves on a boiler, including the waste steam pipe, should have a cross-sectional area at least 1.1 times the required aggregate area of the safety valves. With full lift safety valves where constant C does not exceed 200, the waste steam pipe and the openings for the passage of steam from the valves should have a cross-sectional area at least twice the required aggregate area of the safety valves and three times that area where the valves are of the full bore type with a constant C not exceeding 320. The cross-sectional area of the discharge openings and discharge pipe from the safety valve on an economiser should be at least twice that of the valve. The area of any main waste steam pipe should not be less than the sum of the areas required for the branch pipes attached to it. Valve chests and waste steam pipes should be drained by a pipe fitted at the lowest part of the exhaust opening of each chest and led clear of the boiler, superheater or economiser. No cock, valve or other restriction should be fitted on this pipe.

8.2.10.5 Where silencers are fitted in the waste steam pipes, particulars, including the minimum clear area through the silencer, which should not be less than that required for the waste steam pipe and the makers estimate of the maximum pressure that could occur in the waste steam pipe between the safety valve and the silencer, should be considered

8.2.10.6 Waste steam pipes should be designed to withstand the maximum pressure to which they may be subjected. They should be adequately

supported and the arrangement should be such that no undue load falls on the safety valve branch.

8.2.11 Details of safety valves

8.2.11.1 The clearance of the spindle, springs etc, above the valve should be such as to permit a lift of at least one-fourth the diameter of the valve.

8.2.11.2 Valves and valve seats should be made of non-corrodible metal, and the valve seats should be effectively secured to the chests.

8.2.11.3 Valve wings should have a clearance in the seats of at least 0.8 mm on the diameter. Valve stems should have sufficient clearance in the seats and valve wings or stems should not project through the seats.

8.2.11.4 The construction of a safety valve should be such that the valve will be retained on the spindle and cannot lift out of its seat in the event of a spring breaking.

8.2.11.5 Valve spindles, compression screws and the bushes in which they work, should be made of non-corrodible metal. The spindles should have sufficient clearance in the bushes and the bushes should be well secured. The washer fitted over the top of the spring should be suitably recessed and the end of the compression screw should be a good fit in the recess to ensure that the washer cannot come into contact with the valve spindle.

8.2.11.6 The compression screw should abut against a metal stop or washer when the valve is loaded.

8.2.11.7 Safety valves should be fitted with screw lifting gear so arranged that they can be operated easily by hand from an accessible place free from the danger of steam. The lifting gear should, where practicable, be arranged to lift all the safety valves on any one boiler together. The arrangement should, in general, permit the valves to be turned round on their seats by hand.

8.2.12 Springs of safety valves

8.2.12.1 The particulars of springs for safety valves are to comply with BS 6759: Part 1: 1984, or another acceptable standard.

8.2.12.2 The clearance between separate coils of springs in ordinary, high lift, and improved high lift safety valves should not be less than 0.8 mm when the valve is lifted a distance D/4. The clearance between separate coils of springs in full lift and full bore safety valves should be not less than 1.6 mm when the valve is lifted sufficiently to permit its maximum rated discharge.

8.2.12.3 Springs should be protected from the steam issuing from the valves.

8.2.13 Safety valves to be tested under steam

8.2.13.1 Safety valves should not be accepted by the surveyor unless they are satisfied that the valves are in accordance with the accepted design. The Surveyor should see that the safety valves are set to their working pressure under steam. They should also see that when under steam the valves are free to lift the full amount appropriate to the type of the valve.

8.2.13.2 Except as stated in paragraph 8.2.13.3 of these Instructions, tests for accumulation of pressure are to be witnessed under full firing conditions with the feed water shut off and the stop valves closed. During the test there should be no communication between two or more boilers under test at the same time. The test is to be continued for as long as the water supply in the boiler permits, but the duration of the test need not exceed 15 minutes for shell boilers or 7 minutes for water tube boilers. The accumulation of pressure should not exceed 10% of the working pressure.

8.2.13.3 When owners or builders of water tube boilers consider that an accumulation test might cause damage to the superheaters, applications to forgo accumulation tests should be specially considered.

8.2.13.4 In the case of waste heat boilers heated by exhaust gases, the accumulation test should be carried out with the feed water shut off, all stop valves closed and with the engines supplying the exhaust gas under maximum load conditions and, in the case of composite boilers, the test should be under full firing conditions representing the most severe case likely to arise in service.

8.2.13.5 When witnessing safety valve tests, surveyors should use calibrated test pressure gauges. No steam gauge should be used without having a siphon filled with water between it and the boiler.

8.2.14 Stop valves

8.2.14.1 Wherever a pipe is connected to a boiler, a valve or cock, should, in general, be fitted between the boiler and the pipe.

8.2.14.2 Where there are two or more water tube boilers and they are connected together, the main and auxiliary stop valves should be of the self-closing or non-return type.

8.2.14.3 To avoid piercing the boiler shell more than is necessary there should be as few auxiliary stop valves as possible. The arrangements, however, should be such that when more than one boiler is fitted it will be possible to supply the steam whistle and steam driven electric generators from at least two boilers.

8.2.15 Water level indicators

8.2.15.1 Every steam boiler should have at least two independent means of indicating the water level, one of which should be a glass water gauge, and the other an additional glass water gauge or other accepted water level indicator.

8.2.15.2 Every boiler is to be fitted with two water level indicators, so arranged that an indication of water level is obtained during all conditions of list and trim to be expected in service.

8.2.15.3 In the case of shell boilers, the level of the highest part of the combustion chamber or heating surface should be permanently marked in a position easily seen at all times and adjacent to the water level indicators.

8.2.15.4 In the case of water tube boilers where water and steam drums exceeding 4 m in length are fitted athwartship a water level indicator should be fitted near each end of the drum.

8.2.15.5 The position of the water level indicators of water tube boilers, in which the tubes are entirely immersed when cold, is to be such that the water is just showing in the indicator when the water level in the steam drum is just above the top of the uppermost tubes when the boiler is cold. In boilers, where the tubes are not entirely immersed when the boiler is cold, the water level indicators are to be placed, to the surveyor's satisfaction, in positions which have been found by experience to indicate satisfactorily that the water content is sufficient for safety under all service conditions.

8.2.15.6 Surveyors are to satisfy themselves, by actual examination, that the water level indicators of the boilers of the ships they survey are clear.

8.2.16 Boiler water level safety devices

Each oil fired boiler should be provided with an efficient device to give an audible alarm and automatically shut off the supply of fuel to the burners when the water in the boiler falls to a predetermined low level. The device should be so adjusted that water is visible in the glass when the alarm is sounded. The low water level alarm and oil fuel shut off device should be entirely independent of any other boiler mounting.

8.2.17 Blow down valves

8.2.17.1 Each boiler should have a blow down valve of substantial construction fitted directly to the lower part. Blow down valves, and scum valves when fitted, of two or more boilers may be connected to one common discharge, but when so arranged there should be screw down non-return valves fitted for each boiler, to prevent the contents of one boiler passing to another.

8.2.17.2 The blow down cock or valve on the ship's side should be fitted in an accessible position and provided with means to show whether the cock or valve is open or shut. When a cock is fitted, the handle should not be capable of being removed unless the cock is shut. If a valve is fitted, the wheel must be fixed to the spindle.

8.2.18 Salinometer cocks or valves

A salinometer cock or valve should be fitted directly to each boiler in a convenient position; it must not be fitted to a water gauge stand pipe or pillar. In the case of high pressure boilers, a cooler should be fitted to ensure that a representative sample of water is obtained.

8.2.19 Pressure gauges

Each boiler should have a separate steam pressure gauge placed where it can be easily seen. In the case of water tube boilers, a pressure gauge should be connected to the saturated steam drum.

8.2.20 Boiler feed water arrangements (Regulation 66)

8.2.20.1 Every boiler should have at least two efficient and separate feed water systems, each with its own check valve. Check valve chests, should, in general, be attached directly to the boiler with a stop valve fitted in each chest, or between each chest and the boiler. This is to allow for either of the feed systems to be examined while the other feed system is in operation.

8.2.20.2 In water tube boilers, at least one of the feed systems should be fitted with an accepted apparatus whereby the feed supply is controlled automatically. The feed check valves should, where necessary, be fitted with efficient gearing, whereby they can be controlled from the boiler room floor or another convenient position.

8.2.20.3 Feed water pumps should be reserved for feeding the boilers and the arrangements for supplying feed water should, if necessary, provide for the interception of oil in the feed water.

8.2.20.4 Feed water heaters, filters and fittings between the pumps and the boilers should be constructed for a working pressure of 25% in excess of the

boiler pressure, or for the maximum pressure to which the feed line may be subjected in service; whichever is the greater. An efficient relief valve or valves, suitably adjusted and of a type which cannot be readily overloaded, should be fitted (where necessary) to prevent overpressure in any part of the feed system under conditions likely to occur in service.

8.2.20.5 In ships fitted with closed feed systems, means should be provided for automatically shutting off steam from the main engines before overpressure occurs in the condenser.

8.3 Evaporators, Heaters, Filters, etc

8.3.1 Material and Design

8.3.1.1 Evaporators, in which the main body is a single casting, may have a working pressure not exceeding 0.1 N/mm². In general, cast iron should not be used for the shells of evaporators where the working pressure exceeds 0.2 N/mm².

8.3.1.2 Cast iron, bronze or gun-metal may be accepted where the working temperature does not exceed 220°C.

8.3.1.3 Where parts of evaporators, steam generators, heaters, filters, etc are of fusion welded construction, they should comply with the relevant requirements for fusion welded pressure vessels.

8.3.2 Fresh water generators

8.3.2.1 All distilled water produced by fresh water generators, which is intended for drinking or culinary purposes, is to be effectively treated after distillation by an automatic chlorination plant or equivalent process.

8.3.2.2 Where the heating medium in the heat exchanger of the evaporating and distilling plant is engine cooling water treated with a corrosion inhibitor, then such an inhibitor must be approved in respect of its acceptability from the toxicity aspect where the water produced is to be used for drinking or culinary purposes.

8.3.2.3 The water which is used to produce distillate is to be taken from a pump used exclusively for sea water service. Such a connection may be made from the discharge side of the pump if the bore of the discharge pipe is 76 mm or greater. Where the distilled water is intended for drinking or culinary purposes, no connection is to be taken from the discharge side of any heat exchanger, or similar vessel, which may provide a source of contamination.

8.3.2.4 The plant is to be provided with a means of testing the salinity of the distillate.

8.3.2.5 Surfaces or parts made of copper in contact with steam or distilled water should be tinned. Only commercially pure tin should be used, i.e. lead should be excluded as far as practicable.

8.3.2.6 Adequate provision is to be made to guard against overpressure in any part of the system.

8.3.2.7 For reverse osmosis plants the production of drinking water is to be witnessed by an appointed surveyor, at the manufacturer's works and samples forwarded to an independent analyst for complete chemical and bacteriological examination; the pH value should also be determined. In regard to these tests, the plant should be operated using good clean sea water to ensure that the plant will remove salt and then operated using polluted type dock water to demonstrate its capabilities to remove bacteria etc. Samples should be taken both "before" and "after" passing through the plant for each type of feed water. Copies of the test results should be forwarded to the crew accommodation section of Headquarters.

8.3.2.8 Reverse osmosis plants are not to be used in waters in which weed or other organisms are present and in waters affected by esturial discharge. In any case, a 20 mile limit from any coast must be observed. A notice to this effect should be contained in the operations manual and must also be fixed in a conspicuous position on each plant.

8.3.3 Hydraulic tests

8.3.3.1 All new evaporators, steam generators, heaters, filters, etc, should be tested by hydraulic pressure as follows:

Description	Hydraulic test
Cast evaporators, heaters, etc. not subject to feed water or oil fuel pressure	2 P
Fusion welded evaporators, steam generators, fresh water generators, heaters, etc. not subject to feed water or oil fuel pressure	1.5 P, but not less than 1.4 bars
Cast or fusion welded heaters etc subject to feed water pressure	Twice the maximum working pressure to which the feed water system may be subjected
Cast or fusion welded heaters etc subject to oil fuel pressure	2 P or 27.6 bars whichever is the greater*
Coils or tubes of evaporators etc not subject to feed water or oil fuel pressure	2 P
Coils or tubes of heaters etc subject to feed water pressure	Twice the maximum working pressure to which the feed water system may be subjected
Coils or tubes of heaters etc subject to oil fuel pressure	2 P or 27.6 bars, whichever is the greater*
Where P is the working pressure * See paragraphs 8.7.8.1 of these Instructions	

8.3.3.2 On completion of the hydraulic tests, the apparatus should be stamped in a conspicuous place, preferably on the dressed edge of a flange, with the test pressure applied to the shell, the test pressure applied to the coils (or tubes) if any, the date and the Certifying Authority surveyor's initials.

8.3.4 Vacuum test of evaporators

An evaporator should also be tested under vacuum if the Certifying Authority and/or surveyor considers its design warrants such a test.

8.4 Pressure Pipes

8.4.1 Hydraulic tests on new pipes

8.4.1.1 On completion, copper and copper alloy pipes intended for steam and feed water systems, and air pressure systems, should be tested by hydraulic pressure to twice the maximum working pressure.

8.4.1.2 Steel pipes intended for steam systems, should be hydraulically tested in accordance with recognised national standards. In no case should the test pressure be less than one and one half times the maximum working pressure.

8.4.1.3 Steel pipes intended for feed water systems should be tested by hydraulic pressure to not less than one and one half times the maximum working pressure to which they may be subjected in service.

8.4.2 Reduced pressure pipe lines

Where a pressure pipe or fitting receives steam or air from any source at a higher pressure than that for which the pipe or fitting is designed, an efficient reducing valve should be fitted. An efficient relief valve of sufficient size, together with a pressure gauge, should be fitted on the low pressure side of the reducing valve.

8.4.3 Installation of steam pipes (Regulation 67)

8.4.3.1 Suitable provision should be made to avoid excessive stress in any steam pipe due to expansion and contraction resulting from variations in temperature or due to vibration.

8.4.3.2 Efficient means should be provided for draining and supporting all steam pipes. The drainage arrangements should be such that the pipes are kept clear of water, and the possibility of water hammer action avoided under all conditions likely to arise in service. It is desirable that the drains should be automatic in their action.

8.4.3.3 Where practicable, the branch lines of main and auxiliary steam ranges should be provided with isolating valves where the branch lines join the main and auxiliary ranges.

8.4.4 Steam pipes in passenger and crew accommodation

8.4.4.1 Steam and exhaust pipes should not pass through passenger or crew accommodation, but exceptionally, where it can be shown that alternative arrangements are unreasonable or impracticable, such pipes may be permitted to pass through passageways forming part of the accommodation provided the pipes are properly lagged or encased. Additionally, in the case of steam supply pipes, they should comply with the following conditions:-

(i) the pipes should be of seamless steel or equivalent construction;

(ii) the pipes and their flanges should be of scantlings suitable for the maximum steam pressure to which they may be subjected;

(iii) all connections in the pipes should be by faced flanges properly jointed;

(iv) adequate drainage arrangements should be provided; and

(v) the pipes and flanges within accommodation spaces are subject to a hydraulic test, after installation, to not less than twice the maximum working pressure.

8.5 Compressed Air Starting Arrangements (Regulation 68)

8.5.1 A starting air compressor which can be put into operation without external aid when no power units are running and when no compressed air is available in the ship, is required.

8.5.2 The arrangements of air receivers should be such that one of the receivers can be kept fully charged ready for use in case the air pressure in the other receiver (or receivers), falls below the pressure necessary to start the main engine. The number of starts from one air receiver, and the lowest pressure at which the engine can be satisfactorily started, should be ascertained.

8.5.3 Air pressure pipes should be made of steel. Pipes of less than 20 mm bore may be made of copper.

8.5.4 All air pressure pipes and every fitting connected to such pipes, should be capable of withstanding the maximum working stresses to which they may be subjected with a factor of safety which is adequate, having regard to the material of which it is constructed, and the working conditions under which it is intended to be used.

8.5.5 Air pressure pipes and fittings should, in general, be tested by hydraulic pressure to twice the maximum working pressure. However, when bursting discs are fitted, the test pressure should not be less than the normal bursting pressure of the disc plus 14 bar.

8.5.6 Representative samples of bursting discs, fitted to protect the pipes and fittings from the effects of an internal explosion, should be tested to destruction to confirm their nominal bursting pressure.

8.5.7 Air pressure pipes should be properly supported. Provision should be made to keep the interior of the pipes free from oil and to either prevent the passage

of flame from the cylinders of the engine to the pipes or to protect the pipes from the effects of an internal explosion.

8.5.8 All discharge pipes from starting air compressors should lead directly to the starting air receivers and all starting air pipes from the air receivers to the main or auxiliary engines should be kept entirely separate from the compressor discharge pipe system.

8.5.9 Means should be provided in any ship to prevent overpressure in any part of any compressed air system and, where water jackets or casings of air compressors and coolers might otherwise be subjected to dangerous overpressure due to leakage into them from air pressure parts, suitable pressure relief arrangements should be provided.

8.5.10 If any air pressure pipe may receive air from any source at a higher pressure than it can withstand with an adequate factor of safety, an efficient reducing valve, relief valve and pressure gauge should be fitted to such a pipe.

8.5.11 An isolating non-return valve or the equivalent should be fitted at the inlet end of the starting air manifold. Engines should be fitted with a flame arrester or pressure relief device at the starting air valve on each cylinder if the bore of the air pipes between the manifold and the starting valves on the cylinders exceeds 20 mm. Engines not fitted with a flame arrester or pressure relief device at each cylinder should be fitted with a pressure relief device on the starting air manifold at about its mid-length. In small engines where the bore of the starting air main supply pipe does not exceed 20 mm the requirement for flame arresters or pressure relief devices may be waived.

8.5.12 Valves used in air pressure systems should be so designed and constructed as to prevent the cover of the valve chest being slackened back or loosened when the valve is operated.

8.5.13 Air compressors, air receivers and air bottles

8.5.13.1 Air compressors

(i) An efficient relief valve should be fitted in the high pressure discharge from each air compressor. The relief valve should be of such a size, and so set, that the maximum accumulation pressure will not exceed the working pressure by more than 10% should the compressor discharge valve be closed when the compressor is running normally.

(ii) An efficient relief valve or safety diaphragm should be fitted on the casing of the high pressure air cooler to provide ample relief in the event of a high pressure air tube bursting.

(iii) Means for draining water and oil should be fitted at each interstage and final discharge pipes of air compressors.

(iv) Air compressor cylinders, cooling coils and tubular intercoolers should be tested by hydraulic pressure to one and one-half times the maximum working pressure.

(v) The cooling water passages of air compressors should be tested by hydraulic pressure to 4 bar or one and one-half times the maximum working pressure, whichever is the greater.

8.5.13.2 Air receivers

(i) The design, construction and testing of fusion welded steel air receivers should be in accordance with good practice and to an acceptable standard.

(ii) Air receivers should be provided with efficient drains and be protected by relief valves of satisfactory design which are suitably loaded and positioned to prevent any possibility of overpressure. Any air receiver which can be isolated from the relief valves should be fitted with a fusible plug or plugs to discharge the contents in case of fire.

(iii) On completion, each air receiver is to be stamped over an access hole as follows:-

TEST AUTHORITY

TESTED	bar
Wp	bar

DATE
SURVEYOR'S INITIALS

8.5.13.3 Air bottles

(i) The design, construction and testing of steel air bottles should be in accordance with recognised Standards. Certificates of Manufacture furnished by the manufacturer may be accepted by the Certifying Authority or Recognised Organisation acting on its behalf.

(ii) Where applicable, the requirements of paragraph 8.5.13.2 of these Instructions should be complied with.

8.6 Cooling Systems (Regulation 69)

8.6.1 Ships propelled by compression ignition engines, or having compression ignition auxiliary engines for the maintenance of services essential for the safety of the ship or persons on board, should comply with the following:-

8.6.1.1 At least two cooling water pumps should be provided, each of which should be capable of providing an adequate supply of sea water to the machinery, auxiliary engines and any oil coolers and fresh water coolers connected thereto.

8.6.1.2 Where a fresh water cooling system is fitted, the pumping arrangements should be such that an adequate supply of fresh water will be provided, and that an adequate alternative supply of cooling water will be available via a stand-by fresh water pump.

8.7 Oil Fuel Installations (Regulation 70)

8.7.1 General

The requirements laid down concerning oil fuel installations in both oil fired steam ships and vessels fitted with internal combustion engines, together with these Instructions, are aimed primarily at preventing the outbreak and spread of fire; they will have little or no effect if certain simple precautions are not taken. Fires generally originate from occurrences which might be regarded as insignificant, e.g. oil dripping from furnace fronts onto tank tops, or from ignition of an almost imperceptible spray of oil leaking from a gland or joint. A significant contribution to safety can be made by the avoidance of design features that may lead to the escape of oil by failure of a component being subjected to stresses other than those due to internal pressure, e.g. unsupported pipes or overtightened securing nuts on fuel oil filters.

8.7.2 Oil fuel storage

8.7.2.1 The expression ‘oil fuel tank’ includes oil fuel storage, oil fuel settling, oil fuel service and an oil fuel overflow tank.

8.7.2.2 Oil fuel may be carried in double bottom tanks, peak tanks, deep tanks and other tanks of approved construction. Oil fuel tanks should not be sited directly over boilers or other heated surfaces, nor should they be abreast the boilers unless this is unavoidable and adequate precautions are taken. Cofferdams should be provided between fresh water and oil fuel tanks.

8.7.2.3 Heating coils should be provided in tanks where the viscosity of the fuel at low temperatures may create pumping difficulties. Where practicable, the temperature of the oil in such tanks should be capable of being monitored.

8.7.2.4 All oil fuel tanks in the machinery spaces should be fitted with save-alls, gutters or cofferdams as appropriate to contain and prevent the spread of oil and to contain or guide such oil to a safe place.

8.7.2.5 Oil fuel tanks forming the boundaries to cargo spaces need only be provided with save-alls or gutters in way of manholes, valves or fittings on any other area where leakage may occur.

8.7.2.6 An air pipe should be led from every fuel tank to the open air and the outlet thereof should be in a position such that the ingress of sea water is unlikely and such that there will be no danger of fire or explosion resulting from the emergence of oil vapour or fuel whilst the tank is being filled. Every such outlet should be fitted with a detachable wire gauze diaphragm. If such a pipe serves as an overflow, provision should be made which will prevent the overflow from running into or near a boiler room, galley or other place where ignition may occur.

8.7.2.7 On any oil tank filled under pressure, either from the ship's pumps or when bunkering, the aggregate area of the air pipe or pipes or air and overflow pipes connected to the tank should not be less than one and one quarter times the aggregate area of the filling pipes.

8.7.2.8 Where separate overflow and air pipes are provided the air pipes need not exceed the minimum size of 50 mm but the overflow pipes should not be less than one and one quarter times the aggregate area of the filling pipes. Generally, any air pipe should not be less than 50 mm bore.

8.7.3 Settling, storage and service tanks

8.7.3.1 Oil fuel tanks may be constructed integrally with the ship's structure when the hull is made of steel.

8.7.3.2 All tanks not forming part of the ship's structure should be securely fastened to the hull.

8.7.3.3 Consideration should be given in the design stages to the combined effects of the inertia of the tank contents and the motion of the vessel in a seaway.

8.7.3.4 Every oil fuel tank, before being put into service for the first time, should be subjected to a hydraulic test pressure equal to that of a head of water 300 mm greater than the greatest head to which the tank may be subject when in service.

8.7.3.5 A suitable thermometer pocket should be fitted in any settling, storage or service tanks fitted with heating arrangements.

8.7.3.6 Open drains for removing water from oil in storage, settling or service tanks are not permitted unless the drain valve is of the weighted lever or other self-closing type.

8.7.4 Oil filling arrangements

8.7.4.1 Oil fuel stations should be isolated from other spaces in the vessel and should be efficiently ventilated; any oil present should be drained to a safe and suitable receptacle within the vessel.

8.7.4.2 Provision should be made to prevent overpressure in any oil filling line such as may occur during filling operations if one tank filling valve is closed before another is open. Any relief valve on the filling line should be downstream of the main filling line shut-off valve and discharge into an overflow tank of suitable capacity fitted with an audible (high level) alarm. Alternatively, the discharge from the relief valve may be led back to the fuelling barge or station.

8.7.5 Sounding arrangements

8.7.5.1 Efficient means are to be provided for determining the level in every oil fuel tank either by sounding pipe or by using accepted indicating apparatus. Sounding pipes should not terminate in passenger or crew spaces.

8.7.5.2 Sounding pipes or connections to indicators should be suitably protected against damage if passing through cargo holds. Short sounding pipes in or below machinery spaces should be avoided as far as is possible. Where fitted they should be provided with self-closing fittings. If the self-closing fittings are in the form of cocks they should have parallel plugs with handles permanently attached and so loaded that on being released they close automatically.

8.7.5.3 Sounding pipes terminating in boiler or engine rooms should be so arranged that oil cannot be discharged onto any heated surface such as exhaust pipes, boilers or electric motors, if the self-closing fittings on the sounding pipes are opened when tank filling, or are opened by the motion of the vessel in a seaway.

8.7.5.4 Oil level indicators should be of a type which will not impair the oil tight integrity of the tank and be of such construction that they will not be readily damaged either mechanically or as a result of fire thereby permitting the contents of the tank to escape.

8.7.6 Pumping arrangements

8.7.6.1 The arrangements should be such that provision is made to isolate oil fuel from water ballast. Pumping arrangements should permit oil fuel to be transferred from any storage or settling tank to another part of the vessel.

8.7.6.2 Provision should be made to prevent, as far as is reasonable and practicable, the accidental discharge or overflow of oil overboard.

8.7.7 Steam heating arrangements

Steam condensate returns from oil fuel tanks should discharge to an observation tank. The steam heating pipe which may be in contact with the oil should be made of steel and together with its joints should, before being put into service for the first time, subjected to a test by hydraulic pressure to twice its maximum working pressure and should, at any time thereafter, be capable of withstanding such a test.

8.7.8 Oil fuel pumps heaters, filters and separators

8.7.8.1 Every ship should be provided with not less than two oil fuel units each comprising a pressure pump, filter and a heater. The pump, filter and heater should be of efficient design and substantial construction. Provision should be made which will prevent overpressure in any part of the oil fuel units; every oil fuel pressure pipe and joint therein should, before being put into service for the first time, subjected to a test by hydraulic pressure to 28 bar or twice the maximum working pressure; whichever is the greater. Every fitting connected to oil pressure pipes and all parts of oil fuel units which are subjected to oil pressure should, before being put into service for the first time, subjected to a test by hydraulic pressure to twice the maximum working pressure; every oil pressure pipe, joint fitting and pressure part of an oil fuel unit should, at any time thereafter, be capable of withstanding the relevant hydraulic test stated above; any relief valves fitted to prevent over-pressure in the oil fuel heater should be in closed circuit.

8.7.8.2 Every pump provided for use in connection with the oil fuel system should be separate from the ship's feed pumps, bilge pumps and ballast pumps and the connections of any such pumps.

8.7.8.3 Such oil fuel pumps should be provided with an efficient relief valve which should be in close circuit (i.e. discharging to the suction side of the pump).

8.7.8.4 Valves should be provided in the pipe lines to enable the pumps to be isolated for overhaul.

8.7.8.5 Means should be provided for stopping every oil fuel pressure and oil fuel transfer pump from a position outside the compartment in which the pump is situated. The arrangement should not allow starting of the pump from the remote position. The remote position should be such that it is not likely to be rendered inaccessible by a fire in the machinery space.

8.7.8.6 Electric immersion heaters should be provided with high temperature cut-outs and should be so situated in the tanks that they are fully immersed at all times.

8.7.8.7 Save-alls or gutters should be provided under oil fuel units to catch any oil which may leak or be spilled. Save-alls or gutters should also be provided in way of furnace mouths to catch leakages from burners.

8.7.8.8 Provision should be made to prevent oil that may escape from oil fuel units or burners coming in contact with boilers or heated surfaces.

8.7.8.9 Every fuel oil separator should be of efficient design and substantial construction; provision should be made which will prevent overpressure in any part and which will prevent the discharge of oil vapour into confined spaces.

8.7.9 Oil fuel pipes and valves

8.7.9.1 Every oil pipe not being an oil pressure pipe should be made of seamless steel or other suitable material and should be led at such a height above the ship's inner bottom, if any, as will facilitate the inspection and repair of the pipe.

8.7.9.2 Every such pipe and joint therein and every fitting connected to same should, before being put into service for the first time, subjected to a test by hydraulic pressure to 3.5 bar or to twice the working pressure; whichever is greater and should, at any time thereafter, be capable of withstanding such a test.

8.7.9.3 Non-metallic flexible pipes conveying oil to boiler fronts and other high fire risk areas should be designed, manufactured and tested in accordance with paragraph 8.12 of these Instructions.

8.7.9.4 Every valve used in connection with an oil fuel installation should be so designed and constructed as to prevent the cover of the valve chest being slackened back or loosened when the valve is being operated.

8.7.9.5 Every master valve at the furnace fronts which control the supply of oil to sets of burners should be of a quick closing type and fitted in a conspicuous position and be readily accessible. Provision should be made to prevent oil from being turned on to any burner unless said burner has been correctly coupled up to the oil supply line.

8.7.10 Cooking ranges and other heating appliances

8.7.10.1 In any ship, if a cooking range or other heating appliance is supplied with fuel from an oil tank, the tank should not be situated in a galley and the supply of oil to the burners should be capable of being controlled from a position outside the galley. No range or burner should be fitted which is designed to be operated by means of oil having a flashpoint of less than 60°C (Closed Cup Test).

8.7.10.2 The tank should be provided with an air pipe leading to the open air. The pipe should be in such a position that there will be no danger of fire or explosion resulting from the emergence of oil vapour from the pipe when the tank is being filled. The pipe should be fitted with a detachable wire gauze diaphragm.

8.7.10.3 Safe and efficient means should be provided for filling every such tank and for preventing overpressure therein.

8.8 Lubricating Oil Systems (Regulation 71)

8.8.1 In multiple engined ships where each main propulsion unit has its own lubricating oil system which includes a pump, a stand-by pump need not be provided if in the event of the failure of one of the propulsion units the ship can still be operated safely at navigable speed.

8.8.2 In ships propelled by geared turbine installations, or having turbo-electric propelling machinery, the lubricating oil arrangements should be such that an adequate emergency supply of lubricating oil is available sufficient for at least three minutes, or for such time as may be required for unloaded turbine propelling machinery to come to rest from maximum running speed. This emergency lubricating oil supply should come into use automatically on the failure of the supply from the lubricating oil pump or pumps. A system employing a gravity tank would be considered satisfactory for this purpose. The automatic arrangements for shutting off steam to the ahead turbine in a geared turbine installation, in the event of failure of the lubricating oil supply, is dealt with in paragraph 8.1.2 of these Instructions.

8.8.3 The lubricating oil systems of main propelling machinery should be provided with an audible alarm to give a warning should the pressure of the oil supply fall to the minimum safe level.

8.8.4 Strainers should be provided for straining the lubricating oil and should be capable of being cleaned without interrupting the supply of such oil.

8.8.5 Means should be provided for ascertaining whether the lubricating system is working properly and for preventing overpressure in any part of the system. If the means of preventing overpressure is a relief valve it should be in closed circuit.

8.8.6 Where necessary, means should be provided so that the pressure, temperature and flow prevailing in the various parts of the lubricating system can be readily observed. In this respect, particular attention is drawn to the indication of pressure on the discharge side of the lubricating oil pumps and the inlet and outlet sides of the lubricating oil filters. The change-over arrangements for the filters should be such that it is not possible to take the cover off the filter that is in use.

8.8.7 Lubricating oil pipes, valves and fittings, should be made of materials suitably resistant to the effects of fire (see also paragraph 8.1.4.4 of these Instructions).

8.8.8 Flexible pipes used in lubricating oil systems should meet the requirements for flexible pipes conveying fuel oil.

8.8.9 Oil level indicators, fitted to lubricating oil storage or service tanks, should meet the requirements for level indicators for fuel oil tanks.

8.9 Steering Gear (Regulation 73)

8.9.1 An auxiliary steering gear is not required if the main steering gear power units are in duplicate and are capable individually of meeting the requirements set down in Schedule 9 to Merchant Shipping Notice MSN 1698 (M).

8.9.2 The equipment and services referred to in paragraph 11 of Schedule 9 to Merchant Shipping Notice MSN 1698 (M) should, in addition to that required in this paragraph, be located within the B/5 line.

8.10 Ventilation

8.10.1 Ample ventilation should be provided in main and auxiliary machinery spaces, at filling stations where oil fuel is used and also in all compartments adjacent to any oil storage tanks, or in which an oil storage tank is situated. This ventilation should supply fresh air to all parts of the spaces and should be capable of removing foul air in a reasonably short time.

8.10.2 The clearance space between the boilers and tops of double bottoms and between the boilers and the sides of the storage tanks or bunkers in which oil fuel is carried, must be adequate for the free circulation of air necessary to keep the temperature of the stored oil well below its flashpoint.

8.11 Protection Against Noise (Regulation 75)

Compliance with the Code of Practice for Noise Levels in Ships should also ensure compliance with IMO Resolution A.468(XII) and also the requirements of various other Merchant Shipping legislation.

8.12 Flexible Pipes Carrying Flammable Liquids (FPCFL)

8.12.1 General

8.12.1.1 Non-metallic FPCFL should be constructed according to BS 3832: 1991 (ISO 1436-1991) or BS 4586: 1992 (ISO 3862-1991) with an inner tube of seamless construction with reinforcement outside and the complete pipe should be wholly oil resistant. Such pipes should pass a hydraulic pressure test of twice the working pressure, or 3.5 bar, whichever is greater and should have

an adequate recommended service life under expected working conditions of temperature, pressure, bending, flexing, vibration and pulsing and should be certified by the manufacturer to this effect. Such non-metallic FPCFL which are used in Category A machinery spaces, or in any other space where there is a significant risk of fire, should be capable of withstanding the pressure test mentioned above followed by the fire test outlined in paragraph 8.12.2 of these Instructions.

8.12.1.2 Metallic FPCFL should be of steel, bronze, or other suitable material acceptable to the MCA and should be capable of withstanding a test pressure of 5 times the working pressure. However, when the working pressure exceeds 10 bar, the test pressure should be 3.5 times the working pressure or 50 bar, whichever is greater. Such pipes should also have an adequate recommended service life under expected working conditions of temperature, pressure, bending, flexing, vibration and pulsing and should be certified by the manufacturer to this effect.

8.12.1.3 All FPCFL should be restricted in length to that which is the minimum necessary to provide the required degree of flexibility and any FPCFL which may be subjected to a high degree of fatigue in service should meet the impulse test requirements in the British Standards mentioned above, or any other tests considered equivalent by the Certifying Authority.

8.12.1.4 End fittings of FPCFL should be of steel, or equivalent construction. They should be designed so that when properly tightened during installation they will not cause the FPCFL to twist. To facilitate checking whether a FPCFL has been twisted during installation, a straight longitudinal line running the full length of FPCFL should be marked clearly and indelibly on the outside of each length of FPCFL. During installation the surveyor should ensure that FPCFL are properly fitted in the piping system to withstand the degree and nature of use in service. The rigid pipes, or other connections at each end of FPCFL, should be so arranged that the amplitude of vibration of FPCFL is kept to a minimum i.e. the axis of FPCFL shall be as close as possible to the axis of vibration.

8.12.2 Fire test

8.12.2.1 A sample length of non-metallic FPCFL with end attachments, which has already passed the pressure test and if necessary the impulse test, should be subjected to a fire test for 30 minutes at a temperature of at least 800°C while water at the maximum service pressure is circulated inside the pipe. The temperature of the water at the outlets should not be less than 80°C. No leak should be recorded during or after the test.

8.12.2.2 This test is only applicable to non-metallic FPCFL and to non-metallic joints or other non-metallic equipment which is claimed as suitable for use in fire hazard areas.

8.12.3 Range of sizes

When a range of FPCFL of a particular type of construction is submitted for consideration, it will suffice if every third size in the range, beginning with the smallest, is subjected to the impulse and/or fire test as appropriate.

8.12.4 Shelf life and service life

So far as is practicable the contents of BS 5244: 1996 should be taken into consideration and the surveyor should check that the manufacturer's recommended shelf life and service life for the intended temperature and pressure range (as well as degree of bending, flexing, vibration and pulsing, as applicable) are not exceeded. For any shipboard use the expected minimum service life should be adequate in proportion to length of voyage etc so that renewals can be effected at a convenient time with regard to survey, refit etc.

8.12.5 Certification and installation

8.12.5.1 If a manufacturer of FPCFL (or other non-metallic joints or equipment used in fire hazard areas) requires to be issued with formal Certificates of Inspection and Tests which are acceptable to the Certifying Authority then the manufacturer should be directed to contact one of the Nominated Bodies in accordance with the procedures laid down in Merchant Shipping Notice No. M.1645. Tests witnessed by other authorities meeting the provisions of Merchant Shipping Notice No. M.1440 (or its replacement) will not be issued with a formal Certificate of approval, however, the FPCFL (or equipment) will be acceptable on UK registered vessels.

8.12.5.2 Notwithstanding the meeting of the requirements of certification or acceptability to the Certifying Authority, each piece of FPCFL (or other similar equipment for fire hazard areas), will be required to be pressure tested to twice the working pressure before actual installation on board.