PART 9

PUMPING AND PIPING SYSTEMS

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Section 9.1 - (i) Sea water piping

9.1.1 All engine cooling sea water piping and fittings are to be to the engine Manufacturer's requirements, and may be of aluminium bronze, cupro-nickel or similar recommended corrosion-resistant material. Mild steel piping, where used, is to be schedule 80 and is to be **fully galvanised after fabrication**. Valves, strainers, and other fittings are to be of compatible material to avoid electrolytic action. Bends should have as long a radius as practicable.

9.1.2 All flexible sea water inlet piping within the engine space is to be of a fire resistant standard as detailed in section 9.1.11.

9.1.3 Pipe connections may be flanged and bolted, welded, or brazed as appropriate, but must not be connected by soft soldered joints or non fire-resistant materials within the engine compartment. Screwed mild steel joints and malleable iron fittings are not to be used. Short flexible connections to pumps and other machinery may be fitted, see Paragraph 9.1.11, to the Surveyor's approval. Piping joints should be arranged in order that sections may be easily removed for service/replacement.

9.1.4 All seacocks, filters, valves, and piping, are to be readily accessible, and braced and supported against vibration. Seacocks and valves are to be clearly marked, indicating the direction of turn to open or close. All sea water inlet and discharge pipes are to be fitted with a shut-off valve at the hull. Overboard discharges of 25mm or greater located below the weathertight or freeboard deck, are in addition to be fitted with a non-return valve. Valve chests are to be clearly labelled with regard to the function and position of each valve. Arrangements to prevent back-flooding are to be incorporated in all systems.

9.1.5 Handwheels or levers operating the main sea inlet valves are to be accessible at all times during vessel operation, and are to extend above the engine room floor plates, and are to incorporate open/closed indication.

9.1.6 Piping or valves attached to the hull are to be fitted as described in Part 3, Section 3.8.

Section 9.1 - (ii) Oil fuel piping

9.1.7 Pipes used to convey fuel oil, lubricating oil, cooling oil or hydraulic oil, should be of solid drawn black seamless steel or other approved material, and is to be installed to best marine practice. Flanged joints in fuel and oil pipe systems are to have jointing gaskets which are impervious to oil.

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9.1.8 Fuel return pipes are to be led back to the fuel tank, and care is to be taken that where tanks can be isolated, the fuel should be returned to the emptying tank except where a service tank is incorporated in the system. See Figure 9.6.1.

9.1.9 Dual filters are to be fitted in the main and auxiliary engine fuel lines on all vessels over 10m, and are recommended to be so arranged that they can be changed over and cleaned without the need to stop the relevant machinery. Filters are to be of the type that cannot be opened when in use.

Section 9.1 - (iii) General

9.1.10 Flexible piping and associated fittings will be considered with regard to the intended service and the properties of the material proposed, and are to be of robust construction complying with established standards. In enclosed engine rooms, plastic piping is not to be used for the fuel supply to the engine or fuel tanks.

9.1.11 Fire-resistant hoses should comply with one of the following British Standards (BS) or their equivalent ISO Standards:-

BS EN 853; 1997 Rubber covered wire braided reinforced hydraulic type
BS EN 856; 1977 Rubber covered spiral wire reinforced hydraulic type
ISO 7840; 2004 Fire-resistant flexible oil fuel hose.

9.1.12 All pipes should be colour coded to indicate service and direction of flow. Colour codes are shown in Section 9.5. Simple pipe work systems on vessels of less than 12m RL need not be colour coded providing the valves are clearly labelled.

9.1.13 All valves are to be labelled indicating service and function.

9.1.14 Keel cooling systems, where fitted, are to be of substantial construction and are to meet the requirements of engine Manufacturer.

9.1.15 The connection between keel coolers and the vessel hull is to be approved by the Surveyor prior to installation.

Section 9.2 - Tanks

9.2.1 Fuel tanks are to be constructed of approved material suitable for the fuel type. Tanks may be integral with the hull structure or independently mounted within the vessel. Tanks are to be fitted with baffles and all necessary valves, cocks, filling pipes, vents and filters. Tanks which are not integral with the hull structure are to be mounted on approved seats and secured to the main structure of the hull. Where tanks are connected by common lines such as suction, filling, or levelling pipes, etc., particular care is to be taken to avoid situations where transferring of liquids will be detrimental to the stability of the vessel.

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9.2.2 The following table may be used for guidance purposes only:-

	Volume in litres					
	50	50-99	100-199	200-499	500-999	1000-
	Size in mm					
Steel	1.5	2	3	4	5	6
Stainless steel 316L	1.25	1.25	2	3	3	4
Aluminium	2	3	4	5	5	6
GRP	4	4	4	5	5	6
Polyethylene	5	7	9	-	-	-

9.2.3 Steel plate and sections used for the construction of fuel tanks are to be thoroughly de-scaled and cleaned.

9.2.4 Adequate save-alls are to be fitted to integral and non-integral tanks to the approval of the Surveyor, in order to prevent oil spillage to the bilges or on to hot surfaces. Save-alls should be fitted under all drain or draw-off cocks.

9.2.5 Fuel filler pipes are to be led up to the main deck terminating below the height of the venting pipe, and fitted with watertight covers marked "**Fuel**". Pipes should be of adequate sectional area. Alternative proposals are to be submitted for approval prior to installation.

9.2.6 Tank air pipes are to be led outside of the engine room or tank space, terminating to outside atmosphere above main deck level at a height according to Part 3, Section 3.2 of the Standards. The open end of fuel, hydraulic and lubricating oil tank vent pipes are to be fitted with a gooseneck with a removable flame screen and an automatic means of closure, or similar approved device at the surveyors discretion.

9.2.7 In general, tank air pipes are to be 1.25 times the cross-sectional area of the tank filling pipes. For fuel tanks less than 1000 Litres capacity, the internal diameter of the air pipe may be reduced in size but should be no less than 19mm. In such cases, a notice is to be fitted next to the fuel filling pipe opening stating "Closed fuel filling systems are not to be used".

9.2.8 Consideration is to be given to the total combined cross sectional area of the supply lines from the tank, which should not be more than the cross sectional area of the air pipe.

9.2.9 Levelling pipes between tanks should have a cross-sectional area proportional to the size of the tank. Isolating valves are to be fitted at each tank so that the levelling pipes can be isolated in case of rupture or leakage, and to reduce free surface effects.

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9.2.10 In non-integral tanks, where practicable, a sediment sump of suitable dimensions should be provided, complete with self-closing draw-off cock. Adequate provision is to be made to prevent sediment etc. being pumped from integral tanks into the fuel system. Integral tanks are to be fitted with a drain-off cock for drawing water.

9.2.11 All tanks are to be provided with access for cleaning, and those with a capacity of 200 litres and over should be fitted with a manhole of sufficient dimension to permit full access. Where a manhole is fitted at the tank side, a save-all is to be fitted below the manhole to collect any leakage.

9.2.12 In vessels with an enclosed engine room, and where oil fuel tanks are sited in the engine space, shut-off valves capable of being remotely closed from outside the engine room are to be fitted to all fuel tank outlets used for supply of fuel oil to machinery. All shut-off valves are to be accessible.

9.2.13 Sight glasses, contents gauges or sounding pipe arrangements are to be fitted to all fuel tanks. Sight glasses are to be adequately guarded and fitted with spring loaded isolating valves or other approved positive shut-off device, so that in the event of a breakage, only the contents of the glass can spill.

9.2.14 Where spare lubricating or hydraulic oil is carried in drums, adequate stowage and securing arrangements are to be provided.

9.2.15 In vessels fitted with an outboard engine, and where a permanently mounted tank is not provided above deck, the portable fuel tank is to have an adequate securing arrangement. The tank is to be fitted on the open deck and arranged such that it can be easily and securely fitted in place, and can be quickly jettisoned in an emergency. Petrol is not to be stowed below decks.

9.2.16 Non-integral fresh water tanks should be constructed of steel or other approved material, and should be complete with all necessary baffles, inspection covers, cocks, vents, filling pipes, contents indicator, etc., and are to be securely mounted to the hull structure.

9.2.17 All tanks are to be tested in accordance with Part 1, Section 1.5 ‘Testing of structures’ unless stamped to an approved standard.

Section 9.3 - Bilge pumping systems

9.3.1 An approved means of draining any compartment is to be provided in accordance with the following:-

(a) Where a vessel is divided into watertight compartments, the bilge suctions and means of drainage are to be so arranged that any water

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entering any main watertight compartments can be pumped out through at least one bilge suction situated in that compartment.

(b) Where peak compartments are incorporated in a vessel's design and are not for ballasting purposes, an accessible drain cock may be fitted in the bulkhead or vertical floor, providing that any drainage from the drain cock will flow naturally to an adjacent bilge suction.

9.3.2 Bilge pumps are to be fitted in accordance with the following requirements:-

Vessel size (LOA)	Total no. of pumps	Number and type of pump		Minimum capacity of power pumps L/Min	Minimum capacity of hand pumps L/Min
		Hand	Power		
Below 7m	1	1	-	-	70
7m – Below 10m	2	1	1	70	70
10m – Below 15m	2	1	1	130	70

9.3.3 The table above primarily relates to bilge pumping systems where the pumps are capable of drawing from any compartment. Where individual pumps are installed, such as submersible pumps, the requirements shall apply to each compartment.

9.3.4 The hand operated pump may be omitted in favour of a second power pump providing the two pumps draw power from independent power sources, in such cases the second power pump should have the minimum capacity equal to the hand pump requirement.

Systems incorporating a bilge main

9.3.5 Where two pumps are required, the system should be so arranged that either pump can draw from any compartment via a suitable changeover system.

9.3.6 The power pump may be either the washdeck or general service pump, providing that the sea water suction is isolated from the bilge system by means of a positive accessible changeover valve or interlocking valve arrangement to ensure only one system may be used at any time, and to prevent sea water draining to the bilge system. The positive changeover valve or cock is to be arranged to avoid the possibility of leak-back or seepage from the sea water system into the bilge pumping system.

9.3.7 To prevent any leakage from compartment to compartment, bilge pumping systems are to have non-return valves fitted in all suction lines.

9.3.8 In vessels of 10m LOA and over, the bilge main to the power pump is not to be less than 40mm inside diameter. Any branch bilge section is not to be less than 30mm inside diameter. In vessels below 10m LOA, the bilge main piping may be reduced to 30mm diameter.

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Individual power pumps

9.3.9 Where a bilge main is not fitted and an individual power pump is installed to provide bilge suction for a single compartment then an additional means of pumping out the compartment is to be provided in the form of a hand operated pump of a capacity not less than the minimum hand pump capacity stated in the table for the relevant size of vessel.

9.3.10 Discharge pipes should be of an inside diameter to suit the pump, in accordance with the manufacturer's instructions, to maintain the stipulated pumping capacity.

9.3.11 The total capacity of power pumps providing suction in any one compartment shall not be less that the minimum power pump capacity stated in the table for the relevant size of vessel.

9.3.12 Where used, submersible pumps must be fixed in place and have suitable strainers fitted that do not restrict the capacity of the pump.

Additional requirements

9.3.13 Shut-off valves and non-return valves are to be fitted on all discharges below the weathertight or freeboard deck, placed directly on the vessels sides in an accessible position, and sited above the maximum load waterline, and are to comply with the requirements of Part 3, Section 3.8.

9.3.14 All bilge suctions should be fitted with readily accessible strainers. The total area of the perforation in the strainer should be not less than twice the cross-sectional area of the bilge pipe (for submersible pumps, see 9.3.12).

9.3.15 Bilge systems and valves are to be clearly labelled with regard to compartment served and position of valve.

9.3.16 Small compartments may be drained by individual portable hand pump. Such compartments should be no greater in volume than one cubic metre and should not contain any sea inlets or any machinery crucial to the operation of the vessel. The minimum capacity of the hand pump shall be no less than 70 L/min for spaces with a volume of one cubic metre and 35 L/min for spaces with a volume of half a cubic metre or less.

9.3.17 Where a watertight compartment that contributes to buoyancy is to be completely sealed and is void of any piping then a means of bilge drainage may be omitted providing the volume of the compartment is no greater than volume Vm in m^3 (determined using the formula below) or filled with an approved closed-cell foam. In any such cases, details should be submitted for approval.

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$$Vm = L \times B \times D \times 0.14$$

Where L = length of hull (m)
B = breath of hull (m)
D = moulded depth of hull (m)

9.3.18 Piping used in bilge systems is to be of an approved metal or non-collapsible tubing, and in machinery spaces piping/tubing is to be of fire resistant material.

9.3.19 Metals for piping and valves or fittings are to be compatible in order to avoid electrolytic action and wasting. Mild steel piping is to be galvanised after fabrication. Malleable iron fittings are not to be used in bilge systems.

9.3.20 In decked vessels, hand operated bilge pumps, where fitted, are to be capable of operation from above the deck with the hatches closed.

9.3.21 In all vessels, a bilge alarm system is to be fitted in the wheelhouse with audible and visible indication at helm/control position. Bilge level sensors are to be fitted in the machinery space and fish room/hold. Sensors should also be fitted in any compartment which has a bilge suction if the level of bilge water cannot be readily checked visually without entering the compartment.

9.3.22 Where bilge spaces are to be filled with cement or solid ballast, drain holes are to be fitted to ensure adequate drainage when the cement or ballast is not fitted flush with the top of the vertical floor plates, permitting drainage to the bilge suction well or space under all normal conditions of trim.

9.3.23 Provision is to be made for drainage or approved overboard discharges from both port and starboard sides of any weathertight deck shelter.

9.3.24 All bilge pipework is to be colour coded for immediate identification. Simple bilge pipework systems on vessels of less than 12m RL need not be colour coded providing the valves are clearly labelled.

Section 9.4 - Hydraulic installations

9.4.1 Hydraulic equipment should be installed in accordance with the best marine engineering practice, these Standards, and to the Manufacturer's requirements. Installers should take all necessary precautions to avoid contamination, and all systems are to be flushed and cleansed prior to commissioning.

9.4.2 All equipment is to be designed to produce the specified performance when operating at the maximum design pressure.

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9.4.3 Hydraulic pumps are to be capable of safe operation with the prime mover running at its maximum speed. All motors, pumps and valves should be capable of accepting the oil flow under the stipulated conditions.

9.4.4 All hydraulic piping, except for pump suction pipes, is to be of cold drawn mild steel or reinforced rubber hose to BS EN 853 1997 or BS EN 856 1997 (or equivalent), or other approved material, and is to conform with current statutory requirements.

9.4.5 All pump suction piping, return, and relief valve drain piping, is to be capable of accepting the full flow under maximum operating conditions.

9.4.6 Every care should be taken in installation to avoid confusing piping of the same external diameter, but differing bore.

9.4.7 All pump and motor drain piping is to be capable of accepting flows of twice the Manufacturer's stated leakage flow rate. If no leakage flow rate is available, a value of 15% of the input flow rate should be assumed. Drain piping is to be rated to withstand pressures of not less that 10 Bar.

9.4.8 All pressure and return piping should be connected by means of approved high pressure couplings rated to withstand operating pressures of not less than 120% of the normal maximum working pressure, and should be tested to twice maximum working pressure prior to commissioning. Re-usable hose fittings of the screw threaded inner type are not to be used.

9.4.9 Oil reservoirs should, unless formed as an integral unit with the pump, be sited to provide an effective static head of oil in accordance with the requirements of the pump Manufacturer. Oil supply piping from the reservoir to the pump is to be arranged to provide a continuous fall to the pump suction. Small radius bends or elbow fittings are not to be fitted unless supplied as the pump Manufacturer's standard fittings.

9.4.10 Reservoir tanks may be free-standing or built-in, and are to be fitted with an oil level indicator which is easily visible. Where tanks are built-in, to avoid condensation contamination of the oil, it is recommended that the shell plating should not form a tank boundary.

9.4.11 Where the reservoir capacity is greater than 75 litres, the filling system is to incorporate a manual or powered pump delivering to the reservoir through a filter of not more that 25 microns.

9.4.12 Circuited filtration is to be provided in accordance with the following requirements:-

(a) High pressure, not more than 10 microns.

(b) Low pressure, not more than 25 microns.

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(c) The inlet filter should be capable of accepting at least twice the maximum rated pump flow.

(d) A magnetic drain plug should be fitted in the reservoir, or some such similar device shall be incorporated in the system.

9.4.13 Filters should be sited so as to permit easy access for cleaning and replacement of their elements. Blockage indicators, if fitted, are to be clearly visible.

9.4.14 All piping is to be installed clear of all sources of extreme heat. Where practicable, the use of flexible pipes is to be avoided in engine rooms, but when fitted, should not be run over engines or adjacent to heat sources, or exceed a maximum length of 1.50m. Installations of flexible pipe systems in small vessels will be specially considered on submission of details.

9.4.15 Where piping is routed through fish room areas above the fish storage levels, the use of pipe couplings is to be avoided and arrangements should be incorporated to protect the catch from accidental oil leakage.

9.4.16 An oil temperature gauge is to be provided on the pressure side of the system or suitable provision made for monitoring the oil temperature.

9.4.17 A pressure gauge is to be fitted in a visible location capable of indicating the maximum system pressure.

9.4.18 The type and viscosity of the hydraulic oil should be clearly displayed at the oil reservoir or other convenient prominent location.

9.4.19 Where oil coolers are sea water cooled, the sea water inlet, discharge valves and piping are to be as required for engine cooling systems.

9.4.20 An emergency stop facility is to be fitted at the helm position for all hydraulically operated deck equipment and in addition a local emergency stop device is to be fitted at the winch or hauler (Paragraph 11.13.3).

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9.5 Tables

9.5.1 Table 1: Colour codes for piping

Pipe contents	Ground colour		Colour band	
	Colour	BS colour no.	Colour	BS colour no.
Water				
Cooling (primary)	Sea green	217	-	-
Drinking	Aircraft blue	108	-	-
Treated	Aircraft grey/blue	283	-	-
Central heating below 60°C	French blue	166	-	-
Central heating 60°C to 100°C	French blue	166	Post Office red	538
Central heating above 100°C	Crimson	540	French blue	166
Cold water domestic service	Brilliant green	221	-	-
Domestic hot water supply	Eau-de-Nil	216	-	-
Sea, river, untreated	Grass green	218	-	-
Air				
Compressed up to 14g/cm^2	White	-	-	-
Compressed over 14g/cm^2	White	-	Post Office red	538
Vacuum	White	-	Black	-
Drainage/bilge	Black	-	-	-
Electrical service	Light orange	557	-	-
Oils				
Diesel fuel	Light brown	410	-	-
Lubricating	Salmon pink	447	-	-
Hydraulic power	Salmon pink	447	Sea green	217
Transformer	Salmon pink	447	Light orange	557
Fire installations	Signal red	537	-	-

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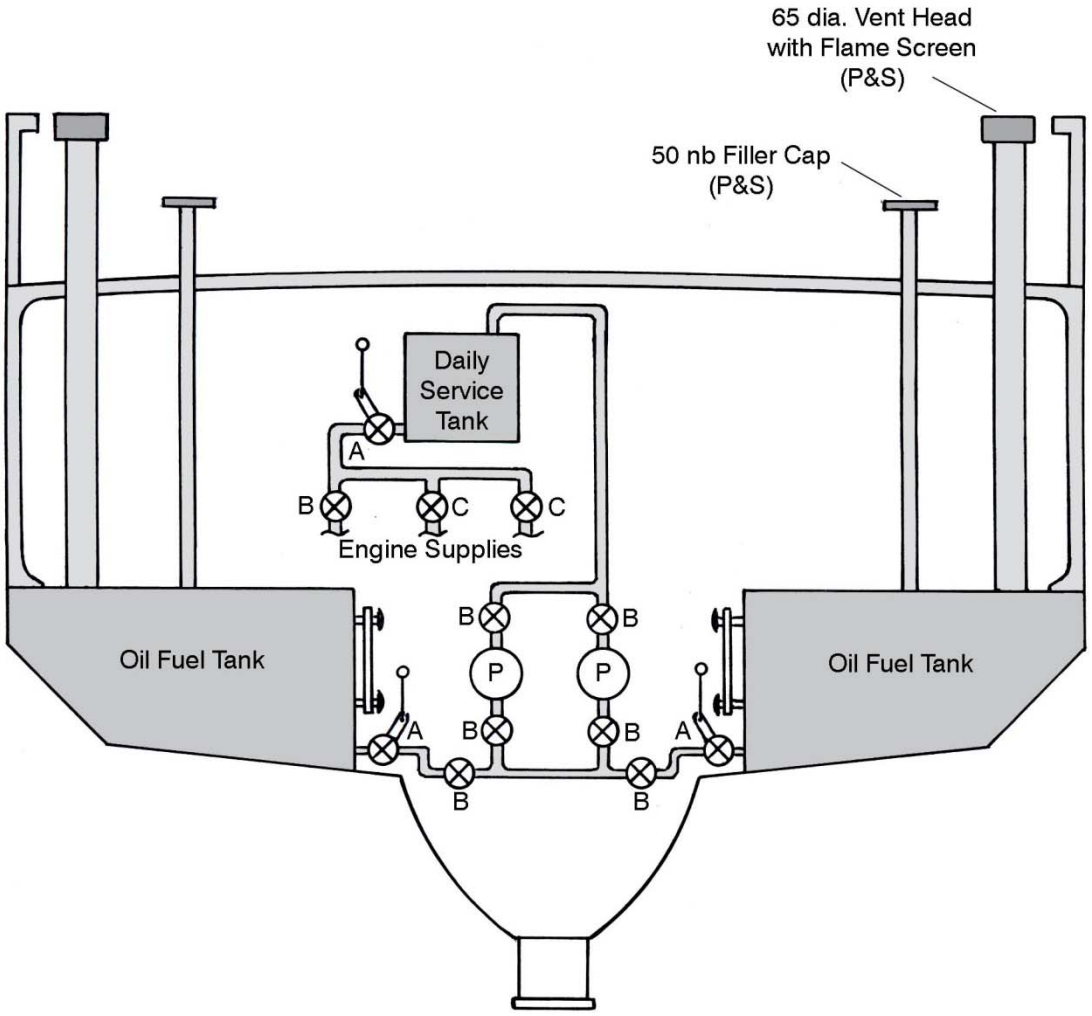
9.6 Figures and illustrations

9.6.1 Typical fuel system



A = 25 nb Tank Ball Valve for Trip Wire

B = 25 nb Ball Valve

C = 15 nb Ball Valve

P = Hand & Electric Fuel Transfer Pumps

Tubing below 25mm nb to be heavy grade bendable copper.

Tubing 25mm nb and over to be schedule 40 black steel pipe.

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