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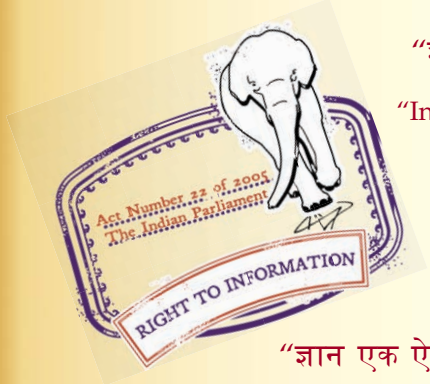
IS 13930 (1994): Shipbuilding - Ships' main engine fresh water cooling system - Code of practice [TED 17: Shipbuilding]



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"Knowledge is such a treasure which cannot be stolen"

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IS 13930 : 1994

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(Reaffirmed 2004)

पोतनिर्माण — जहाज के मुख्य इंजन के ताजे पानी के शीतल तन्त्र — रीति संहिता

Indian Standard

SHIPBUILDING — SHIPS' MAIN ENGINE FRESH WATER COOLING SYSTEM — CODE OF PRACTICE

UDC 629·12 : 621·436-713·1

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 6

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after thedraft finalized by the Shipbuilding Sectional Committee had been approved by the Transport Engineering Division Council.

This standard has been prepared to specify recommendations and requirements for main diesel engine cooling fresh water piping system in ships with the object to ensure uniformity and proper working of the system.

In preparing this standard due consideration has been given to factors involved and current practices regarding the use of ferrous materials.

Failure of the component parts of fresh water piping systems may occur as a result of impingement attack, arising from excessive turbulence. Such a condition may be brought about by poor design, workmanship or the use of too high a water speed. Excessive water speed may arise as a result of poor design. Failure may also occur by pitting resulting from deposit attack and cracking due to stress corrosion or by general wastage.

Attention shall be given to the design, fabrication and installation of system to ensure streamlined flow. In particular, abrupt changes in the direction of flow, mismatched pipe bores, tube bore protrusions and other restrictions to flow shall be avoided. Adequate provision is to be made in the fresh water systems for drainage and venting of the system pipework and equipment. Consideration is to be given to the fitting of automatic air eliminators in preference to vent cocks.

At each stage of construction it is the responsibility of the user of this Indian Standard to ensure compliance with the requirements of the statutory authorities and/or classification society as applicable.

The Committee responsible for the preparation of this standard is given at Annex A.

Indian Standard

SHIPBUILDING — SHIPS' MAIN ENGINE FRESH WATER COOLING SYSTEM — CODE OF PRACTICE

1 SCOPE

1.1 This standard specifies requirements for the materials, design, installation, inspection and testing of ship's main engine fresh water cooling piping system including all fittings which form part of such systems.

1.2 For the purpose of this standard a fresh water cooling piping system includes all pipes and fittings from engine outlet to engine inlet, excluding the heat exchangers but including all other fittings, various safety and relief valves and pressure and temperature gauges.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standards :

IS No.	*Title*
812 : 1957	Glossary of terms relating to welding and cutting of metals
2712 : 1979	Compressed asbestos fibre jointings (*second revision*)
3233 : 1965	Glossary of terms for safety and relief valves and their parts

3 TERMINOLOGY

For the purpose of this standard, the following definitions in addition to those given in IS 812 : 1957 and IS 3233 : 1965 shall apply:

3.1 Design Pressure

The maximum pressure to which the system can be subjected when in service and is the value used in design calculations. This pressure may result from a combination of circumstances unlikely to occur under normal working conditions. But it shall not be more than the highest set pressure of the safety valve or relief valve, if provided.

3.2 Test Pressure

The pressure to which the system and its components are subjected under test conditions.

Test pressure of the system should be minimum 1·5 times of the working pressure of system. However, recommendation, if any, of engine manufacturer(s) to be considered.

3.3 Piping System

All pipes, valves and fittings from engine outlet to engine inlet, but excluding all pumps and heat exchangers.

3.4 Flow Conditions

The expected conditions of water flow in individual parts or sections of the piping system. To meet varying design requirements three conditions are recognised.

a) *Continuous Flow* — Where the water in a system or part of a system if flowing continuously under the ship's normal operation conditions.

b) *No Flow* — Air vents and where a branch connection to a main pipe has its other end closed. The water in that branch is regarded as having no flow condition.

c) *Intermittent Flow* — All systems and parts of the system not covered by (a) and (b).

3.5 Purchaser

The ship owner or ship operator according to the circumstances of the particular ship.

3.6 Manufacturer

The ship builder or authorised sub contractor.

4 RATING OF SYSTEM

4.1 The design pressure rating of the system shall not be greater than 1MN/M² (10 bar).

4.2 The fresh water cooling system shall be divided into three separate systems for following reasons:

a) The cooling circuits are either totally closed or closed with free out flow;

b) The temperature levels are different in eaeh system; and

c) The pressure levels are also different in each system.

4 3 Usually the slow speed marine engines are fresh water cooled by three different systems:

i) Jacket cooling fresh water system;

ii) Piston cooling fresh water system; and

iii) Fuel valve cooling fresh water system.

4.3.1 *Jacket Cooling Fresh Water System*

The closed circuit jacket cooling system totally closed, includes the cylinder liners, covers and turbo blowers. The temperature and pressure levels shall be maintained by providing temperature control valve and in some cases, throttling piece(s) in the system. The system shall be continuously vented. In some engines turbo blowers are cooled by the piston cooling system.

In case of some of the higher capacity engines, waste heat of engine jacket cooling water is utilised as heat source for fresh water generator which generates fresh water from sea water by evaporation at negative pressure. The capacity is limited to the heat available in the jacket cooling water which, in turn depends on the engine load. For heat recovery at partial load conditions, extent of heat recovery may be obtained from the engine builders. Normally, not more than 30% of the heat from cooling water shall be utilised for fresh water generator.

4.3.2 *Piston Cooling Fresh Water System*

The piston cooling system shall be a closed circuit with free outflow from the engine to fresh water drain tank. For keeping the required system temperature control valve shall be provided.

In some type of engines the pistons are cooled by lubricating oil.

4.3.3 *Fuel Valve Cooling Fresh Water System (Nozzle Cooling System)*

The fuel valve cooling system shall be a closed circuit with free outflow from the engine outlet to fuel valve expansion tank. The static pressure requirement shall be met by keeping the expansion tank at a higher level.

In certain engines, fuel valves are cooled by engine fuel oil in a close circuit with fuel oil coolers in the system wherein the heated fuel is cooled by circulating sea water. There are some marine engines where fuel valves are not cooled either by circulating fresh water or fuel oil.

5 MATERIALS

5.1 Pipes

5.1.1 In general, galvanised steel pipes are used except where the water is treated with nitrite base corrosion inhibitors since this creates sludge due to chemical action. The use of copper or copper based alloy pipes and fittings is to be avoided. Steel pipework and fittings for steel framed engines and aluminium alloy pipe work and fittings for aluminium framed engines are preferred. The water is to be treated with an approved corrosion inhibitor. The main engine manufacturer is to provide storage and mixing tanks for this inhibitor as specified.

5.1.2 Plastic and composites have no scope in fresh water system. Where galvanised pipes are used they shall be treated properly to avoid galvanising material to get mixed with cooling water and entering the engine parts.

5.2 Pumps

5.2.1 *Type of Pump*

5.2.1.1 Normally, centrifugal type pumps shall be employed in fresh water cooling system. Usually, two pumps shall be installed in each system, one as working and the other as stand by.

Sometimes a separate preheater pump of a small capacity along with heater is connected in parallel to main circuit.

Since the cooling system is critical, it is preferable to have auto cut-in to start the standby pump in the event of the failure of the running pump.

5.2.1.2 Since piston cooling pumps take suction from piston cooling drain tank, it may be of a submerged type, mounted directly on the tank or a self priming type placed on top of the tank.

5.2.2 *Capacity of Pumps*

The pump capacity in each system shall be decided according to the guidelines given by the engine supplier and with due consideration to the hydraulic performance of the centrifugal pumps and estimated losses in layout of piping systems.

5.2.3 *Mounting of Pumps*

5.2.3.1 Pumps shall be mounted in such a way that they are readily accessible for maintenance.

5.2.3.2 In case of horizontally mounted pumps, the pump and motor shall be aligned before mounting rigidly and as a further precaution flexible coupling shall be used. A common base frame for the pump and motor is preferable to avoid misalignment. In case of vertically mounted pumps, rigid mounting shall be provided at the base of the pump only.

5.2.3.3 In order to prevent air intake into the jacket cooling system through the glands the height between the expansion tank and jacket cooling fresh water pump inlet shall be kept as large as possible.

5.2.3.4 The fuel valve cooling pumps shall be positioned near to the fuel valves and well below the fuel valve expansion tank.

5.2.3.5 All pumps shall be fitted with compound/ pressure gauges complete with isolating valve of

needle type to check the performance of the pump.

5.3 Tanks

5.3.1 *Jacket Cooling Fresh Water Expansion Tank*

This tank shall be provided to maintain a static pressure on the system and to replace the water losses. The minimum height of the tank above the crank shaft and the capacity of the tank shall be decided according to the recommendation of the engine builder. The outlet pipe from the tank shall be large enough to maintain the static pressure. Air pipe, overflow pipe, chemical filling, fresh water filling, level gauge, low level alarm, heating coil, if required to be provided on the tank. The system vents shall be connected into the tank below the minimum possible water level. The tanks shall be provided with drain pipe and cock having locking arrangement.

If not practicable to locate expansion tank at the required height due to space restriction, a double acting pressurising valve is to be fitted to the top of the tank in lieu of the vent pipe in order to maintain the required pressure after system is pressurised.

The ship builder is to produce an inhibitor mixing tank to afford means of chemical dosage to protect the system from corrosion and freezing.

5.3.2 *Piston Cooling Water Drain Tank*

The fresh water piston cooling drain tank shall be designed with integrated piston cooling leakage water tank as per the recommendations of the engine builder. The tank form shall be such that with a minimum water level the pump suction pipes submerge sufficiently for safe running. The oil contaminated leakage water shall be drained into a leakage tank which is integral with but isolated from the piston drain tank by a wall or a frame plate.

A skimmer unit or any other system of filteration of leakage water shall be provided.

The tank shall be equipped with air pipe, overflow pipe, chemical and fresh water filling, sounding, level alarms, heating coils and drain connection.

5.3.3 *Fuel Valve Expansion Tank*

This tank shall be provided to maintain a static pressure and to replaces the water losses. The minimum height of the tank above the crank shaft and the capacity of the tank shall be decided according to the recommendation of the engine builder.

The tank shall be equipped with filling, venting, drain, overflow and chemical filling lines. Heating coil shall be provided to preheat the water.

5.3.4 *Others*

In addition to expansion and drain tank a separate tank of relatively big capacity to act as storage/mixing tank where corrosion inhibitor can be mixed with fresh water should be included as a part of the main engine fresh water cooling system.

Material for the tanks and connected fittings are to be as stipulated in the ship's specification/ acceptable to the engine supplier.

Separate note on surface treatment shall be put for the internal surfaces of expansion tanks and drain tanks.

5.3.5 Low level indication/alarms as per ship's specification are to be provided.

5.4 Heater

5.4.1 Heater of suitable capacity shall be provided in the jacket cooling system to preheat the main engine before starting and to maintain the temperature whenever temporarily stopped. The heater capacity depends on several factors such as quantity of fresh water in the system, dimensions of pipes, coolers, etc, as well as on the ambient temperature and required heating up time.

5.4.2 The heater shall be connected in parallel to the supply line because of the large water quantity delivered by the pump. The bypass water flow shall be set either by a valve or with an orifice plate.

5.5 Separator

5.5.1 *Air Separator*

A centrifugal air separator (de-aerating tank) shall be fitted in the jacket cooling system near to the engine outlet to discharge any air or gas mixed with cooling water. For smaller engines (capacity to be decided with engine suppliers) air ventilation pipe to be provided in consultation with engine manufacturer.

5.5.2 *Piston Cooling Water Separator*

The piston cooling water may get contaminated with oil and shall, therefore, not to be led directly back to the suction of the pumps. An efficient oil separator shall be provided as per the recommendations of the engine builder.

5.6 Coolers

5.6.1 Coolers shall be provided to remove the heat transferred from the engine to the cooling

water. The capacity shall be determined in consultation with the engine builder.

5.6.2 *Jacket Fresh Water Cooler*

The cooler shall be located close to suction side of the pump so that it shall work under a lower pressure and the pressure at engine inlet shall be achieved with a smaller pump.

5.6.3 *Piston Cooling Fresh Water Cooler*

The cooler shall be installed between the piston cooling water pump and the engine inlet. The working pressure corresponds to the delivery head of the pump.

5.7 Control Valves

Maintaining a particular temperature in the fresh water systems is very important for the proper functioning of the engine.

An automatic temperature control valve shall be provided at the inlet or outlet of cooling water to the engine so that the temperature of water shall be controlled irrespective of the engine load. The valve shall not be located at the highest point in the line, in order to avoid air collecting in it which can lead to operation problems.

5.8 Throttling Piece

This shall be used for setting the prescribed system pressure at engine inlet. In order to ensure proper working of throttling piece a flow stabilizer where required shall be fitted.

6 DESIGN OF PIPE LINE SYSTEM

6.1 General

6.1.1 In designing a fresh water system it shall be noted that certain configurations and some types of fittings which give an appreciable pressure loss shall be avoided, if possible.

6.1.2 Pipes used in the system shall comply with required pressure ranges and shall conform to relevant Indian Standards. The type and material of the flexible pipes, bellows and expansion pieces are to be of approved type.

6.1.3 In order to keep pressure losses low, the pipe run shall be as short and direct as possible, tight right angle bends and T-pieces shall be kept to a minimum.

6.1.4 The diameter of each pipe run shall be determined from considerations of the water flow quantities and a permissible 'maximum velocity—pipe diameter' specification. The length of the pipe shall be such that removal/maintenance is easy.

6.1.5 The flexible pipes are to be used only up to the bore size of 50 mm. For bigger sizes expansion pieces/bellows may be used. Securing arrangements of flexible pipes, expansion pipes and bellows are to be of approved standards.

6.2 Recommended Velocities

6.2.1 The water velocities for pipe shall not exceed specified values. The values given in Table 1 are for guidance only.

6.3 Development of the Design

6.3.1 *Review Basic Design Data*

6.3.2 List pump sizes recommended by suppliers for a typical duty. List standard modules for pump heat exchanger and components of the main system.

6.3.3 Study purchaser's specification and note special requirements for pipe materials, valves, joints, fabrication and erection.

6.3.4 Study statutory and classification society requirements for the systems.

Table 1 Recommended Water Velocities

(*Clause* 6.2.1)

Nominal Diameter, mm		32	40	50	65	80	100	125	150	175	200	225	250	300
Suction Pipe	Velocity m/s	1·2 to 1·5	1·4 to 1·7	1·6 to 1·9	1·8 to 2·1	1·9 to 2·2	2.0 to 2·3	2·1 to 2·4	2·2 to 2·5	2·3 to 2·5	2·4 to 2·6	2·4 to 2·6	2·5 to 2·7	2·5 to 2·7
	Rate of flow m³/h	3·5 to 4·3	6·3 to 7·7	11·0 to 13·5	22·0 to 25·0	34·0 to 40·0	57·0 to 65·0	93·0 to 106·0	140·0 to 159·0	199·0 to 216·0	271·0 to 294·0	343·0 to 372·0	441·0 to 476·0	636·0 to 687·0
Delivery Pipe	Velocity m/s	1·2 to 1·5	1·4 to 1·7	1·6 to 1·9	1·8 to 2·1	1·9 to 2·2	2·0 to 2·3	2·1 to 2·4	2·2 to 2·5	2·3 to 2·5	2·4 to 2·6	2·4 to 2·6	2·5 to 2·7	2·5 to 2·7
	Rate of flow m³/h	3·5 to 4·3	6·3 to 7·7	11·0 to 13·5	22·0 to 25·0	34·0 to 40·0	57·0 to 65·0	93·0 to 106·0	140·0 to 159·0	199·0 to 216·0	271·0 to 294·0	343·0 to 372·0	441·0 to 476·0	636·0 to 687·0

6.3.4.1 All pipes are to be hydraulically tesed to requisite pressure by the supplier and test reports are to be obtained.

6.3.5 Establish if any special requirements are disclosed by the above procedures and if they conflict with standards normally followed by sub contractors or builders. Initiate procedures to resolve points of difference and obtain outstanding information.

6.3.6 *Preparation of Flow Diagrams*

6.3.6.1 Sketch single line flow diagrams indicating pumps, machinery units and ancillary units specified (*see* Fig. 1). The pumps heat exchangers, etc, are to be capable of functioning when the ship is trimmed and/or listed to specified limits.

6.3.6.2 Add legend and a list of symbols and abbreviations which shall be used to identify pipe line fittings. Symbols used shall conform to relavent Indian Standards.

6.3.6.3 Add specified fittings to diagram, paying due regard to features mentioned elsewhere in this standard which shall keep flow resistance to the minimum for the pipe bore size adopted and allow preferential flow, for example, through by-passes where required.

6.3.6.4 Calculate flow quantities required in systems and matching pump capacities.

6.3.6.5 Establish maximum velocities acceptable in system and calculate matching pipe size and indicate it in the diagram.

6.3.6.6 Make first order estimate of probable straight pipe lengths and static heads, list fittings and calculate probable flow resistance. This calculation shall be kept under review as the design is progressed. If the system resistance is higher than acceptable, the pipe bores shall be reconsidered and the calculation adjusted until the results are satisfactory.

6.3.6.7 Results obtained shall be checked with an economic analysis of the cost of pumping the quantity required with various flow resistance pumps and pipe size to ensure they are compatible.

6.3.7 *Preparation of Isometric Sketches*

6.3.7.1 Flow paths can be readily visualised and piping layout generally decided by means of such sketches which can be supplementary and/or alternative to flow diagrams and piping arrangement drawings.

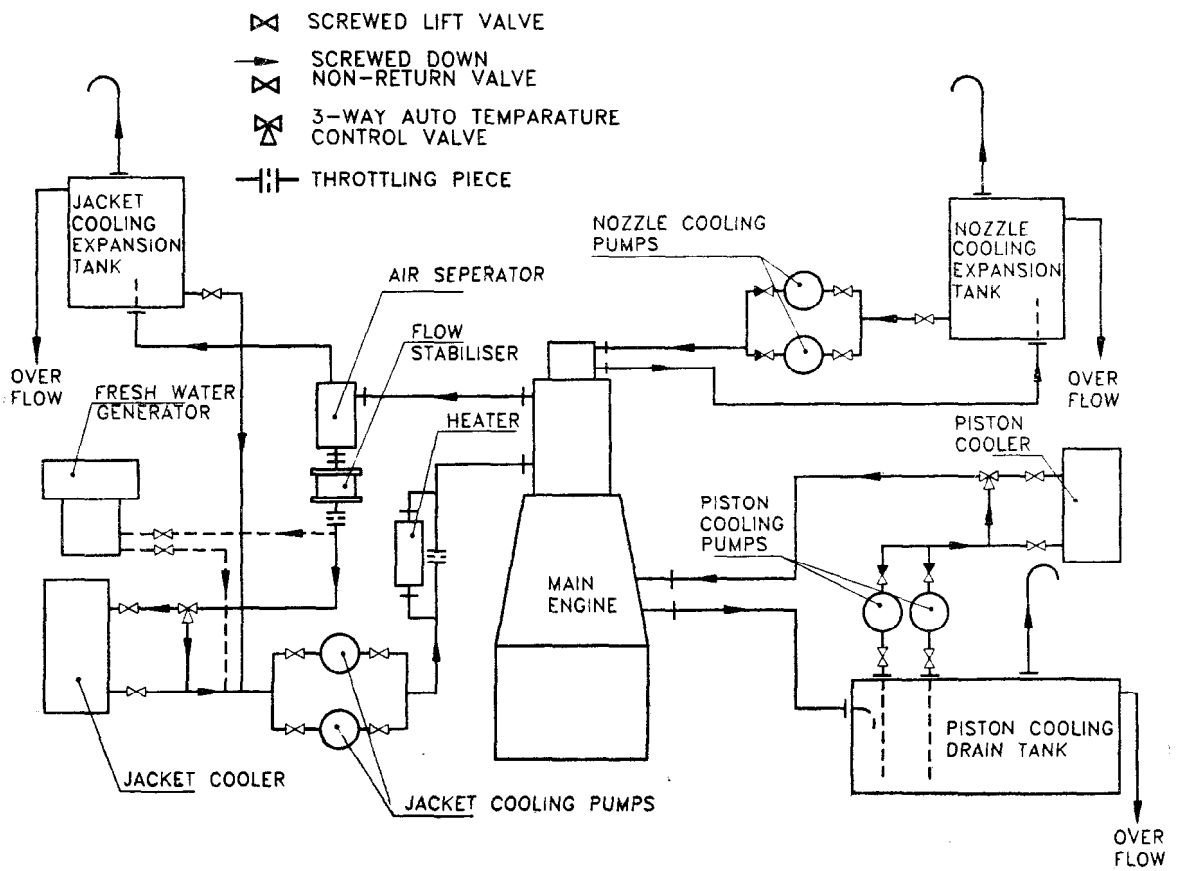

FIG. 1 SCHEMATIC ARRANGEMENT OF FRESH WATER COOLING SYSTEM

6.3.7.2 Such isometric sketches shall show the general arrangement of equipment and piping, with limited details, to determine optimum lay-out and nozzle orientation on equipment. Instrumentation requirements for pipe connections may also be determined.

6.3.8 *Ordering of Requirement*

List of special fittings required, for example special valves, control valves, spectacle piece, shall be prepared from the available sketches. Preliminary requisitions for such fittings and for pumps, piping, etc, shall be issued. Such requisitions shall be kept under review as the systems are developed.

6.3.9 *Piping Layout*

If model techniques are not employed nor alternative, permanent records of the layout found acceptable, it will be necessary to prepare pipe arrangement drawings. Such drawings shall:

a) Determine scale and show orientation.

b) Show the essential minimum detail of associated equipment and ship structure to determine system component locations and clearances. Such outlines shall contrast with piping.

c) Provide clearances for all equipment for access and maintenance.

d) Provide accessibility to all system components which may require manipulation, inspection and maintenance.

e) Provide easily portable sections, short bends or make up pieces to facilitate removal of equipments and fittings.

f) Show piping by single line except where double line is essential to demonstrate clearance.

g) Arrange pipe runs on fore and aft line or athwartships except where large size or other criteria justify the minimum length between two points being used. As far as possible the pipes shall be laid along the bulkhead, deckhead, shipside and under the floor plates so that space in the compartment can be untilised to the best possible extent.

h) Give preference to large bore pipe runs to give direct runs where possible and minimum fabrication costs. Such pipes to be routed to take advantage of ship structure for supports and pipe supports to be shown on drawings.

j) Keep the number of joints to a minimum practicable number.

k) Lay pipes in such a way that they shall not touch the tank top. It is advisable to give sufficient clearance between the pipes and the tank top to avoid pipes submerging in bilge water and also for inspection of the tank top and also opening flanges.

m) Show the essential minimum details of seatings of equipment, ladder ways, etc, to enable to design the fully co-ordinated pipe layout.

n) Specify that lifting eyes to be provided for enabling motors of pumps, etc, which are weighing more than 30 kg to be removed.

p) Show the bends to pipe where running in straight length to compensate for expansion and contraction of the pipes.

q) Show suitable openings to be provided on floor plates wherever valves are fitted below floor.

r) Provide accessibility for the location where a closing length is to be made from dimensions lifted at site.

s) Avoid pockets and vertical loops where possible but provide additional drains and vents where such configurations are unavoidable.

t) Provide and indicate location of instrumentation system connections.

u) Show enlarged detail section to indicate orientation and flow direction through special control valves or other fittings which are of unusual construction.

v) Show component unit numbers of all pipes and fittings.

w) Indicate non-standard joints, materials, fittings, testing procedures, purchaser's special requirements, etc, with drawings.

x) Include essential dimensions for locating pipe centre lines in the ship where these may be required to produce pipe fabrication sketches or pipe support dimensions.

y) Clearly indicate terminal points of lines where continuations will be arranged by other piping designers and detail connecting flanges.

z) Piping in general shall be kept away from electric switch boards and other electric equipments. Flanges shall be arranged as far away from electric cables as practicable. If unavoidable, suitable protection shall be provided.

6.3.10 *Checking of System*

On completion of the drawings the system resistance losses shall be re-calculate, the pipe and fitting schedules reviewed and requisitions for equipment confirmed.

6.4 Pressure Loss Items

The pressure loss through proprietory items may be obtained from the manufacturer's specification. The extra losses to be determined are those occurring in the pipes, valves, bends and other fittings.

7 PIPE WORK FLEXIBILITY SUPPORT AND INSTALLATION

7.1 Flexibility of Piping Systems

7.1.1 Piping systems shall be designed with adequate flexibility so that expansion of the piping machinery, vibration and working of the ship shall not result in overstressing of tne system or leakage at joints.

7.1.2 Flexibility shall normally be provided by the use of plain piping bent to normal specified radius and off sets in the piping.

7.1.3 Where space limitations prevail or where piping is to be attached to resiliently mounted machinery use may be made of flexible pipes or bellows expansion pieces. They shall be installed in unstressed condition.

7.1.4 Pressure of fluid in a piping system can result in distortion particularly in way of bends and flexible units if adequate anchorage is not provided. Attention is drawn to the necessity of making such provision as stated in **7.3.3.**

7.2 Flexible Piping Units or Assemblies

7.2.1 The design and construction of these components shall be suitable for the pressure, vacuum and temperature under all conditions likely to occur in service, including ambient temperature and shall also be capable of absorbing the movements imposed by attached machinery and pipe work.

7.2.2 The material of these components, including any fittings if separately attached shall be suitable for containing fresh water and be compatible with the material of the piping system to which they are attached.

7.2.3 Resistance to damage by fire or other means shall be considered and where deemed necessary a protective arrangement shall be given around the flexible components.

7.2.4 Flexible pipes shall be limited to only one compartment of the ship and that too for small lengths only.

7.3 Pipe Supports

7.3.1 Pipe lines shall be routed to enable the surrounding structure to provide logical points of support, anchorage, guidance or restraint. Supporting of the largest of critical piping systems shall take prime consideration over others and the location of supports and anchors shall be shown on arrangement drawings.

7.3.2 The design of supports is to be capable of adequately supporting the piping system without undue distortion. In addition to pipeline gravitational loads, the supports shall provide for concentrated loads imposed by valves and risers, for axial loadings due to expansion and the pressure of fluid, and for inertia effects due to ship movements. Hangers for supports shall be provided close to concentrated weights, at horizontal changes in line direction, and or adjacent to pipe risers.

7.3.3 Pipe work adjoining flexible units shall be supported as closely as possible to the flexible unit. The support shall be designed to prevent the pressure loads transmitted by the flexible unit distorting the attached pipe work and equipment.

7.3.4 The intervals of supports for pipes shall be decided according to the bore and configuration of pipe work.

7.3.5 All pipe work shall be examined during the sea trial to determine whether additional hangers are necessary due to unforeseen vibrations.

8 PIPING INSTALLATION

8.1 Pipe Jointing

Jointing material shall conform to Grade C of IS 2712 : 1979. Other materials may be adopted by agreement between the purchaser and the manufacturer.

Jointing material shall be pre-cut and so dimensioned that it will not project into the bore of the pipe. It is recommended that the gaskets be full face and located on the bolts except where raised face flanges are in use.

8.1.2 Pipe Erection

8.1.2.1 Flange face shall be closely mated and bolt holes in alignment before making up the joints. The pipes shall not be strained into position in order to make them fit. Pipes which do not fit satisfactorily shall be returned to the workshop for correction and re-stress relieving where necessary.

8.1.2.2 Mating pipes, valves and fittings shall be installed with their bores concentirc and in

line, and care taken to ensure that any jointing fitted does not protrude into the bore.

8.1.2.3 Care shall be taken with alignment of piping when making screwed, brazed or welded joints.

8.1.2.4 The installation of bellow pieces or flexible units shall be carefully carried out to ensure that they are not pre-stressed.

8.1.2.5 The closing length of piping shall be manufactured to a sufficient degree of accuracy so that it can be fitted in place without undue manual effort.

8.1.2.6 The pipes or any of the fittings in the system when mounted shall not touch another pipe or fitting or any structural member of the ship. If this is entirely unavoidable, then clamps shall be provided at such points of contact to ensure rigidity of the assembly and to avoid abrasive wear of the material due to vibration and rubbing.

9 INSPECTION AND TESTING

9.1 Component Inspections and Tests Before Installation

9.1.1 Pipes shall be internally cleaned and made free from scales. If conditions like corrosive atmosphere exist, pipes shall be suitably protected on the exterior. Where fabricated pipe work is to be used, pipes shall be shot blasted in random lengths before fabrication.

9.1.2 *Shop Inspection*

9.1.2.1 All components shall be checked to ensure that they are correct and in accordance with drawings, especially details of terminals and materials.

9.1.2.2 All components shall be visually examined for faults and irregularities.

9.1.2.3 Welded and brazed joints shall be examined to ensure that fillets are regular and continuous in form. Wherever practicable it shall be established that there is no lack of root penetration or evidence of non-fusion or burn through excessive penetration of the pipe in way of the joint.

9.1.3 *Shop Test*

Each completed pipe and fitting shall be hydraulically tested to 1·5 times the maximum pressure to which the system can be subjected under service conditions.

9.1.3.1 Hydraulic tests and capacity tests for pumps:

a) All pumps intended for essential services are to be tested hydraulically and for capacity at manufacturer's works;

h) Pump housings and cylinders are to be tested to at least 1·5 times the working pressure; and

c) Pump capacities are to be checked with the pump running at rated speed with rated pressure head. Capacity test may be dispensed with when previous satisfactory tests have been carried out on similar pumps.

9.1.3.2 The completed pipes and fittings shall be tested with fresh water with filling, air evacuation and test gauge connections provided. The test pressure shall be maintained for not less than ten minutes after the filling valves are closed to demonstrate the integrity of all connections. After testing all such components shall be drained. All terminals shall be blanked before the component is despatched to ship.

9.2 System Inspections and Tests After Installation

9.2.1 *System Inspections After Installation*

Before any testing is carried out the system shall be inspected to check that:

a) Pipes are pained as per the colour code where required. The colour of the paint on the pipes shall be as specified in relevant Indian standards unless specified otherwise in the ship's specification.

b) The installation is in accordance with the pipe arrangement drawings.

c) The location and fitting of supports and hangers are adequate.

d) The joints are accessible for maintenance.

e) The fittings are installed correctly for the required direction of flow, especially valves and filters.

f) The valves are accessible for operation and maintenance.

g) Loads are not imposed on pump castings and other fixed components due to distortion of pipes or lack of support of adjoining fittings.

h) All valves and necessary remote control shall operate through their full limits open-shut-open. In case of safety and relief/automatic temperature control valves, etc, are to be set to the requisite temperatures/pressures.

j) All bellow pieces and flexible pipes are installed correctly within the operating limits specified.

k) Pumps are fitted with required suction and discharge pressure gauges.

m) Valves and fittings are correctly labelled.

10 INSTRUMENTATION AND CONTROL

10.1 Different instruments such as thermometers, pressure gauges, level indicators, therrmostats, pressure switches, flow switches, etc, shall be used for indicating the system conditions and also for controlling the conditions within the required limits.

10.2 Methods of Warning of System Failure

Lights and audible alarms shall be installed on the system to indicate the failure of the fresh water cooling system.

10.2.1 *Initiation of Warning*

Flow switches, level switches, pressure switches, temperature switches, etc, shall be used to initiate the warning of the system failure.

10.2.2 The use of audiable alarms is recommended to indicate the following:

a) Jacket cooling water — low pressure

b) Piston cooling water — low pressure

c) Fuel valve cooling water — low pressure

d) Jacket cooling water expansion tank — low level

e) Piston cooling water drain tank — low level

f) Fuel valve cooling water expansion bank — low level

g) Piston cooling water drain tank — high level

h) Jacket cooling water — high temperature

j) Piston cooling water — high temperature

k) Fuel valve cooling water — high temperature

11 COMMISSIONING

11.1 To ensure the proper commissioning of system following operations shall be carried out:

a) cleaning of pipes;

b) checking the main items of equipment and control devices;

c) filling of system;

d) setting of operating conditions;

e) running test to prove that system; and

f) checking for leaks.

12 SEA TRIAL

12.1 System Tests

a) Each pump shall be primed before starting.

b) The system shall be circulated with water at the maximum pressure attainable by the pumps under normal service conditions.

c) All air vents shall be operated to ensure that air is released from high points.

d) The system shall be examined for leaks from joints and glands.

e) Note shall be made of undue noise and vibration and additional supports fitted where necessary.

f) The temperature and pressure controls in fresh water cooling system are important for the proper functioning of the engines. Control valves to be arranged as per the engine manufacturer's recommendation. Engine valves are to be set to the requisite pressure/temperature.

g) Complete system shall perform satisfactorily in all specified conditions of list and trim of the vessel.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Shipbuilding Sectional Committee, TE 17

Chairman	*Representing*
CAPT K. K. LOHANA	Institution of Naval Architects, Bombay
Members	
SHRI S. N. BASSI	Garden Reach Shipbuilders & Engineers Ltd, Calcutta
SHRI S. K. BOSE (*Alternate*)	
SHRI S. K. BHATIA	DGTD, New Delhi
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DEPUTY CHIEF SURVEYOR	DG Shipping, Bombay
SHRI A. K. CHOPRA	Indian Register of Shipping, Bombay
SHRI D. G. SARANGDHAR (*Alternate*)	
SHRI JAYWANT Y. CHOWGULE	Small Shipowners Association, Goa
SHRI A. R. I. HAVALDAR (*Alternate*)	
HEAD OF DESIGN DEPARTMENT	Mazagon Dock Ltd, Bombay
HEAD OF STANDARD CELL (*Alternate*)	
GENERAL MANAGER	The Shipping Corporation of India, Bombay
SHRI G. SHARMA (*Alternate*)	
SHRI P. R. GOVIL	Ministry of Surface Transport (SBR), New Delhi
SHRI M. K. AGARWAL (*Alternate*)	
R. ADM. Y. N. INAMDAR	The Institute of Marine Engineers (India), Bombay
SHRI JOSEPH ISAAC	Cochin Shipyard Ltd, Cochin
SHRI U. S. BHOWMICK (*Alternate*)	
SHRI MADAN LAL KOCHAR	American Bureau of Shipping, Bombay
SHRI P. K. BANERJEE (*Alternate*)	
CMDE R. NATH VSM	Directorate General of Naval Designs, New Delhi
CMDE R. K. BHATIA VSM (*Alternate*)	
CAPT H. K. D. PATEL	The Indian National Shipowners Association, Bombay
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LT CDR S. S. JASWAL	Directorate of Standardization, Ministry of Defence, New Delhi
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SHRI R. SEN	Chowgule Steamships Ltd, Bombay
SHRI A. SENGUPTA	Lloyd's Register of Shipping, Bombay
SHRI R. BHAVE (*Alternate*)	
SHRI G. SINHA	Flakt India Ltd, Calcutta
SHRI S. K. HALDER (*Alternate*)	
CAPT K. S. SOOD	Oil & Natural Gas Commission, Dehradun
SHRI S. SRINIVASAN	Hindustan Shipyard Ltd, Visakhapatnam
SHRI K. P. RAO (*Alternate*)	
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Member Secretary

SHRI N. S. JUDGE
Director (Transport Engineering), BIS

Marine Piping Subcommittee, TE 17 : 1

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