SECTION: 2.9

PIPING INSTALLATION

1.0 **Scope**

1.1 The scope of work covers supply, installation, testing & commissioning of all piping.

2.0 **Application**

2.1 This specification shall be applicable to pipes covering the following fluids:

i) cooling water not exceeding 50 deg C
ii) chilled water not less than 6 deg C

3.0 **Pipes & Fittings**

3.1 Pipes shall conform to the following schedule:

NB	Pipe (mm) Min.OD	Thickness	Material
25	33.3	4.05	ERW Heavy class carbon steel tube to IS-1239-79 Part I
40	47.9	4.05	
50	59.7	4.50	
65	75.3	4.50	
80	88.0	4.85	
100	113.1	5.40	
150	163.9	5.40	
200	219.1	6.00	
250	273.0	6.00	ERW pipes to IS 3589-1981
300	323.9	6.00	
350	355.6	7.00	
450	406.4	7.00	

All pipes shall be factory fabricated.

3.2 All pipes shall be new and from standard manufacturers. All pipes shall be black steel and be prepared for butt or socket welding as specified herein.

3.3 All bends upto 65 mm NB shall be hydraulically formed with a minimum R/D of three unless space restrictions inhibit, in which case long radius elbows may be used with the approval of the Engineer-in-charge. For sizes upto 40 mm NB, socket weld fittings shall be used. For larger sizes upto 150-mm dia butt welding wrought steel fittings to BS 1965 and matching with the straight pipe wall thickness shall be used. All bends shall be ready made only.

3.4 Flanges shall be slip-on carbon steel with plain faces conforming to IS 6392-1971. Flange shall be rated for 1.0 N/mm^2 or twice the system pressure whichever is higher and drilled to suit the equipment or valve flange if already drilled. All bolts & nuts shall be carbon steel and gasket 3-mm fiber reinforced PTFE.

4.0 **Valves**

4.1 All valves and the flanges shall be suitable for 1.0 N/mm^2 cold non-shock working pressures or twice system pressure whichever is high.

4.2 Valves upto 50 mm NB shall be full bore ball valves with forged body and polished hard chrome plated ball with PTFE seal.

4.3 Higher size valves shall be butterfly type. Butterfly valves shall have a fine grain cast iron body with mirror smooth finished cast steel disc and spindle of stainless steel AISI 410. The valve shall be of wafer-type and should be fitted with two slip on type pipe flanges. The valve shall have an easily replaceable molded EPDM sleeve which shall bring about 100 % tight shut off at the design working pressure. Shaft bottom shall have an axial bearing Where valves are to be insulated they should have on extended neck.

4.4 Non-return valves upto 50 mm NB shall be swing-type of gun metal construction with flanged ends. Larger sizes shall be of cast iron construction with gun mental internals and flanged ends.

4.5 Water strainers shall be either 'Y' or pot type with cast iron bodies for specified test pressure. Strainers shall be complete with brass basket with 3 mm perforations, a dirt blowout plug and a permanent magnet. Strainers shall be designed for easy removal of strainer basket without dismantling the pipe and shall have flanged end connections.

4.6 Manual/Auto air vents shall be provided at all high points in the piping systems for air purging. Vent sizes shall be as follows and suitable for specified test pressure.

Up to 152 mm : 12 mm size ball type gun metal valves with hose connections.

Over 152 mm : 20 mm size globe type gun metal valves With hose connections.

Air vents associated with equipment or cooling coils shall be 12mm automatic venting type with a shut off ball cock and a plastic pipe discharging into the condensate drain. Such air vents should form part of the coil or equipment.

4.7 Drains shall be provided at all low points and all drain valves shall be ball valve with hose connectivity. Drain sizes shall be 25 dia or as shown on drawings.

4.8 Pressure gauges shall be "Bourdon' type with minimum 100 mm dial and required range. All gauges shall be provided with gun metal plug type gauge cocks and copper or S.S capillary connection to prevent system fluctuations affecting the gauge. Gauges shall be provided wherever shown.

4.9 Thermometers shall be industrial direct reading stem type of the required range. Thermometers shall be provided in separable wells. All instruments shall be installed by providing gate valves.

5.0 **Pipe Installation**

5.1 Pipe installation shall be carried out in a workman-like manner in accordance with approved drawings. Pipes shall be aligned parallel to walls and ceiling and not across a room. Change of direction shall be through hydraulically formed or wrought iron welding fittings as specified. Alignment shall follow the approved drawings and wherever necessary pipe shall be rerouted under the instructions of the Engineer-in-charge in order to meet the site conditions and or interference from services. Wherever there is a connection between two different metals, it shall be done through bimetallic strip only.

5.2 Pipes passing through walls & floors shall be provided with sleeves as follows:

Space	Sleeve dia (mm)	Sleeve Projection (mm)	Sleeve Material	Sleeve packing and Closure
Floors	D + 50	50 AFF	1.25 mm GSS OR Light duty galvanised tube	32 Kg/cum Resin bonded fibre glass with 8 mm thick polysulphide or Silicon sealant
Walls				
i) Internal	D + 50	Flush with Finish	- do -	32 Kg/cum Resin bonded fibre glass closed on both sides with 1.0 mm GSS split flange
ii) External	D + 50	- do -	- do -	Caulked with lead wool and oakum & closed on both sides with 1.25mm GSS split flanges with brass screws

D = Outside diameter of pipe with insulation
GSS = Galvanised sheet steel
AFF = Above finished floor

5.3 Pipe supports shall be standard factory made galvanised systems or fabricated from steel structural galvanised after fabrication. Supports shall be spaced as follows:

Size	Horizontal	Vertical
Upto 15 mm	1.25 m	1.8 m
20 to 25 mm	2.00 m	2.5 m
32 to 125 mm	2.50 m	3.0 m
150 & over	3.00 m	3.0 m

5.4 Additional supports shall be provided at the bends, at heavy fittings like valves, near equipment and as directed by the Engineer-in-charge. Pipe hangers shall be from galvanised structural steel, steel inserts in concrete or anchor fasteners, wall brackets or floor supports as decided by the Engineer-in-charge depending upon the location of the support. Hangers shall not be secured to light weight roof, wall, false ceiling or any other member which is not structurally meant for such loading. Hangers from structural steel shall be from suitably designed clamps or attachments and in no case should drilling or punching of such steel members be allowed. All pipe supports shall be capable of being adjusted in height to the tune of 50mm. All supports suspenders and hangers shall be galvanized before assembly.

5.5 Pipe clamps shall be specially fabricated fittings for pipes. All clamps shall be of galvanized mild steel. Clamps shall take into account pipe movement owing to temperature variations & anchors, and in no case shall the clamping arrangement induce stresses beyond the safe load limits of the pipe under fully filled conditions. Where pipes are insulated, the clamping shall interpose a hard insulation material or shall be designed so that the insulation is not compressed for more than 60% of its compression strength. No support shall transfer the temperature to the support.

5.6 Vertical pipe risers shall be supported at each floor and in addition, the riser shall have a duck-foot support at the lowest point.

5.7 All pipe joints shall be welded except where flange joints are specified. Pipes upto 40 mm NB shall use socket-weld fittings with fillet welding and larger sizes use butt-welding type single V 35 deg weld preparation. Flange joints shall be provided at the following positions:

i) Pair of flanges for isolation of equipment
ii) Mating flanges for equipment flange connections
iii) Mating flanges for valves, strainers as the case may be
iv) Pair of flanges at every 30 m continuous run of piping

5.9 Entire piping shall be self-draining, using only eccentric reducers at all change of sections. 25mm NB drain points with a dirt leg and a shut off valve (ball Valve) shall be provided at all low points of the piping and the piping system shall be pitched 1% towards such low points. All air handling unit drains shall be pitched 2% with a 75-mm water seal trap. Fan coil unit drains also shall be pitched likewise but the water seal could be 40 mm. All traps shall be built-up or prefabricated. In the case of the multiple risers of supply and return water lines, isolating valves with a strainer and drain valve shall be provided wherever required. All isolating valves shall be gate/ball/ butterfly valves suitable for tight shut-off. Valves shall not have their spindles downwards.

5.10 Automatic air vent shall be provided at high points. All vents shall have a shut off ball valve with hose connectivity.

5.11 Where pipes are directly buried in ground, the pipes shall be coated 2.0mm "Sealfas' or equivalent coating (cement lining).

5.12 Where pipes are buried at a length less than 1.5m FFL, pipes shall be enclosed with RCC in such a way that pipe will not get damaged in heavy loaded condition also. No piping shall be left in open position but should be closed temporarily always.

5.13 All piping shall be laid and tack welded in position with flanges, valves etc. After inspection and approval by the Engineer as to the alignment and height, the piping shall be full welded. Slip-on flanges shall be demounted for welding. Piping may be presented to the Engineer for such approval in sections. Random samples of valves shall be tested for leaks and seating. Necessary hand pump and blank flange facilities with pressure gauge, valves etc. should be provided at site.

6.0 **Refrigerant Piping**

6.1 Refrigerant piping shall be heavy duty seamless mild steel tubes with weld-able socket type fittings. All tubes shall conform to IS 1239-1979.

6.2 All fittings shall be forged steel socket type fittings suitable for welding.

6.3 Pipe sizes shall be as shown on the drawings or should follow the following criteria :

Suction lines	:	Pressure drop not exceeding equivalent to 1.1 deg.C
Liquid lines	:	- Do – 0.5 deg. C
Discharge lines	:	- Do – 0.5 deg. C

6.4 All suction and liquid lines shall be lapped and together insulated as specified under "THERMAL INSULATION".

7.0 Testing

7.1 Hydraulic testing of piping shall be carried out before equipment connections are made. **No insulation shall be carried out unless and until the piping, in section, is tested and tests approved**. Piping may be tested in sections, with the approval of the Engineer and in such cases all open ends shall be blanked off with necessary flanges.

7.2 All piping shall be tested for pressure equivalent to the following:

2 x dynamic head of the pump plus the gravity head due to expansion tank or cooling tower.

In such a pressure test, the system shall hold for a minimum period of 3 hours. All pipe testing shall be witnessed and certified by the Engineer-in- charge and leaks or defects found in the joints shall be rectified.

7.3 The contractor shall make all arrangements for testing & removal after testing of all water connections, if any, without causing any damage to the property of the employer or any other contractor. The damages if any during testing to owner's or others property shall be made good by the contractor and the contractor will be responsible for all the consequential damages also.

7.4 After the entire piping has been tested and equipment connected, the system of water piping shall be filled and drained till all the dirt, midscale and any other foreign matter including chemical cleaning and addition of rust inhibitors(process methodology shall be approved before commencing the work, is flushed out to the satisfaction of the Engineer-in- charge. **At any rate, the system shall be flushed atleast 3 times before commissioning.** All strainers shall be cleaned of all accumulated dirt before the system is charged.

8.0 **Mode of measurement**

8.1 All pipes shall be in unit length rounded off to the nearest centimeter and measured along the center line of the pipe and all fittings, flanges etc. excluding the flange to flange distance of valves, strainers or any other equipment. The rate shall include all clamps, bolts etc. cutting holes in ceiling, floor or wall and making good the same including scaffolding, staging supports, flexible etc. and painting of piping as per the painting specifications.

8.2 All valves, strainers etc. shall be measured per unit in each size and paid for.

8.3 All pressure gauges complete with socket, gauge cock and pressure gauge and CP brass capillary shall be measured per unit.

8.4 Thermometers together with thermowell, conducting fluid etc. shall be measured as one unit.

8.5 Air vents and drains shall each be measured per unit and paid for. Auto air vents with cooling coils / equipment shall form part of the coil or equipment.