5 CHILLED WATER PIPEWORK

5.1 GENERAL

5.1.1 Scope

1 This Part details the requirements for chilled water pipework as specified in the Project Documentation.

2 Related Sections and Parts are as follows:

Section 1 General

5.1.2 Reference

1 The following standards are referred to in this Part:

ASTM A53 Schedule 40 Steel Pipe Specification

BS 10.....Flanges for bolting pipes, valves and fittings

BS 21.....Pipe threads for tubes and fittings where pressure-type joints are made on threads (metric dimensions) (EN 10226)

BS 916.....Black bolts, screws and nuts (BS 3555)

BS 1387.....Screwed and socketed steel tubes and tubulars for plain end steel tubes suitable for welding of for screwing to BS 21 pipe threads (EN 10255)

BS 1845.....Filler metals for brazing (EN 1845)

BS 1965.....Butt-welding pipe fittings for pressure purposes

BS 2871.....Copper and copper alloys. Tubes (EN 12451)

BS 3505.....Unplastisized polyvinyl chloride (PVC-U) pressure pipes for cold potable water(ISO 1452 Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U))(ISO 1452)

BS 3601.....Steel pipes and tubes for sizes of 150 mm diameter and above. (ISO 3601)

BS 4504.....Circular flanges for pipes, valves and fittings (PN designated) (EN 1092)

BS 6755.....Testing of valves (ISO 10497)

5.2 PIPEWORK

5.2.1 General

1 All pipework shall be free from surface or general corrosion and without any signs of scaling, pitting or excess weathering. Any pipework so affected shall be replaced at no cost to the contract.

2 Each length of pipework shall have at least one coloured identification band or identifying mark, when delivered. All pipework shall be supplied in the manufacturer straight random lengths, but not less than 6m long except where shorter specific or flanged lengths between fittings are actually required.

3 In congested areas where small bore chilled water piping is required, type K copper piping to BS 2871 with cast bronze non de-zincifiable fittings may be used subject to the Engineer's approval, and to a test of the welding operatives who will be doing the brazing. Brazed joints are required throughout; no compression fittings will be permitted.

4 All pipework, pipework fittings, jointing materials and gaskets shall be stacked in storage sheds in accordance with the manufacturer's recommendations and as required elsewhere in the Project Documentation. The ends of all pipework shall be protected during transit and storage.

5 Metal pipework may be stacked in the open, provided that such stacks are, in the Engineer's opinion, adequately protected from weathering. The pipework shall be located in steel pipe racks and clear of the floor, the floor being formed from either timber sleepers or paving slabs. A watertight lightweight roof shall be provided to extend 450 mm beyond the edges of the stack and tarpaulin or heavy gauge Polythene sheeting shall be provided to cover all sides.

6 The pipes and fittings beyond stock rust shall not be used.

5.2.2 Pipework Supports

1 All pipework shall be adequately supported. All support installations shall be in accordance with relevant standards, except where modified or extended by the Project Documentation.

2 Support shall allow free movement for expansion or contraction of pipework and shall be located to ensure that pipework branches or fittings are not fouled by the support during expansion or contraction of the pipework service.

3 Double banking of pipework from a single support position will be permitted, provided the normal operating temperature of the fluids in the two pipes do not differ by more than 30 ºC, but only where space restrictions prohibit individual support. Triple banking will not be permitted.

4 Where double banking is necessary, the larger of the two pipes shall be uppermost, and where pipes are the same size but manufactured from different materials, then the pipe having the material with the lowest coefficient of expansion shall be uppermost. Support intervals for double-banked pipework of different sizes shall relate to the smaller size.

5 Vertical rising pipes shall be supported at the base and the support shall withstand the total weight of the pipe and fluid contained.

6 Supports shall not be permitted which clamp the pipe so that it in contact with building fabric or structure.

7 All supports shall be specifically designed for the outside diameter of the pipe concerned (including specified packing). Oversized brackets will be rejected.

8 Where non-ferrous pipework is to be supported using ferrous pipe clamps or rings, an approved plastic coating applied to the clamp or ring shall be used to prevent contact between the ferrous and non-ferrous surfaces. Where cast iron rollers are to be used in contact with copper pipework, these shall be copper-plated.

9 Plastic pipework shall be supported using the pipework manufacturer's standard support clip.

10 Mild steel pipework shall be supported individually by hangers consisting of malleable split rings with malleable iron sockets or steel clevis type hangers or roller hangers where indicated.

11 All chilled water pipe supports shall be mild steel and painted with a protective coating to suit the environmental conditions.

12 Copper pipework where fixed against brick or dense concrete block walls shall be supported using polished cast brass built-in brackets. Build in brackets shall be long shank type, when pipework is to insulated or where the finish to the wall surface is greater than 15 mm, elsewhere build-in brackets shall be the short shank type.

13 Copper pipework in exposed positions where fixed against lightweight hollow block or other patent wall or partitions, shall be supported using polished cast brass screw on brackets.

14 All chilled water pipework services shall be supported around the insulation and not directly around the pipework. Care shall be taken to ensure the integrity of vapour sealing is not damaged in any way.

15 It shall be noted that in certain cases it will be necessary to adopt a combination of the support methods indicated, and when supports are required to be detailed to suit special site conditions or requirements, then these details shall be submitted to the Engineer for approval. Anti-vibration supports shall be fitted at all locations where pipework vibration is likely to be a problem.

16 Pipe support spacing shall be as detailed in Table 6.1.

Table 6.1
Pipe Support Spacing

Pipe Size (mm)	Horizontal Spacing (m)			Vertical Spacing (m)		
	Steel Pipe Sch. 40	Copper	ABS/PVC-U	Steel Sch. 40	Copper	ABS/PVC-U
15	2.0	1.5	0.7	2.4	2.0	1.3
20	2.0	1.5	0.7	3.0	2.4	1.5
25-32	2.4	1.8	0.9	3.0	2.4	1.8
40	2.7	2.4	1.0	3.6	3.0	1.8
50	3.0	2.4	1.0	3.6	3.0	2.0
65	3.3	2.7	1.0	4.5	3.6	2.0
80	3.7	3.0	1.3	4.5	3.6	2.5
100/125	4.0	3.7	1.5	5.0	4.0	3.0
150	5.2	4.0	2.0	6.0	5.0	3.5
200	5.5	5.0	-	-	-	-
250	6.0	5.5	-	-	-	-
300	7.0	6.0	-	-	-	-
350	7.5	-	-	-	-	-
400	8.0	-	-	-	-	-
450	8.5	-	-	-	-	-
500	9.0	-	-	-	-	-

(a) spacing does not apply where span calculations are made or where concentrated loads are placed between supports, such as flanges, valves, specialities, etc.

(b) spacing lengths for pipework larger than listed in the table shall be the same as the largest size included.

5.2.3 Condensation Drain Pipework

1 All exposed condensate piping at low level in plant rooms shall be galvanized medium weight seamless mild steel to BS 1387, with screwed joints. Fittings will be screw type, forged.

2 All concealed condensate drain piping shall be PVC-U Class E to BS 3505 with solvent welded joints.

3 All other exposed condensate piping shall be copper.

5.3 PIPE INSTALLATION

5.3.1 General

1 All pipework shall be arranged to set around piers and other obstructions and minor modifications shall be made as required by the Contractor to circumvent site difficulties.

2 Pipe shall be arranged to follow the contour of walls or beams or other building structure lines and all vertical pipework shall be plumb, without offsets and set as close as possible to any local projections consistent with maintaining adequate clearances for installation of wall plates or insulation.

3 Pipework shall be installed so as to give the following minimum clearances between adjacent services as follows:-

(a) walls 25 mm
(b) ceilings 50 mm
(c) finished floors either above top of skirting 50 or (if greater) 150 mm
(d) adjacent pipes, both insulated 25 mm
(e) adjacent pipes in trench, both insulated 100 mm
(f) adjacent pipe, both uninsulated 150 mm
(g) adjacent pipes, one insulated 75 mm
(h) insulated pipes to adjacent conduit or trunking 100 mm
(i) adjacent electrical cables not in conduit or trunking 150 mm

Not withstanding the above minimum clearances, sufficient space shall be allowed to facilitate easy application of insulating materials. Pipes shall not be enclosed in a common insulating covering.

4 Pipework shall be graded to ensure adequate draining and venting. Draining and venting facilities shall be fitted at all low and high points respectively and wherever else necessary to ensure that all sections and subsidiary sections can be drained and that no air locks can form.

5 The Engineer may at his discretion ask for the removal of installed pipework for examination. No extra payment will be made when such removal is called for. If the pipework is found to have been installed in an unsatisfactory manner, then the complete installation shall be thoroughly inspected and all unsatisfactory sections shall be removed and re-fixed in a proper manner.

6 During construction work on all pipework services, care shall be taken to prevent any foreign matter entering the pipework. All open ends shall be capped with the appropriate pipework fittings. Wooden plugs and the like shall not be used. Valves fitted in the ends of pipework shall not be accepted as a means of preventing the ingress of foreign materials.

7 Failure to comply with these requirements shall mean that the Engineer shall have the right to instruct that pipework so left uncovered to be dismantled for such lengths as the Engineer requests, and the pipework blown through and/or cleaned at no cost to the contract.

8 All pipework fittings shall be installed in such a manner to ensure that air cannot be trapped and that pipework can be drained.

9 Unequal tees shall be used in preference to equal tees with separate reducing fittings. Bushes shall not be used. Unequal tees shall be eccentric pattern on horizontal pipework, and concentric on vertical pipework.

10 Segmented, cut-and-shut, or any other site manufactured bends or fittings shall not be installed in any section of the Works.

11 The use of fire or cold pulled bends will not be permitted.

12 Where weldable steel pipework fittings to BS 1965 are to be used then branch bends, although not covered by this standard, will be accepted, but only at the specific location designated by the Engineer and subject to total approval by the Engineer.

13 Where fittings are connected to light or medium weight pipework they shall be 'medium' quality, and where connected to heavyweight pipework they shall be 'heavy' quality.

14 All fittings, valves, cocks etc., shall be manufactured from materials guaranteed proof against de-zincification unless specifically stated otherwise elsewhere.

15 Only one manufacturer of pipework fitting shall be used for each differing range of fitting specified.

16 Reducers on all vertical pipework shall be concentric. In all other positions eccentric reducers shall be fitted in a manner to maintain a level bottom and ensure that fluids are not collected at that point in the system. Where it is not possible to fit eccentric reducers the Engineers approval shall be obtained before fitting concentric reducers. Reductions in all cases shall be made by use of factory made fittings.

17 Sufficient unions or flanges shall be provided to install and dismantle screwed or solvent jointed sections of pipework. Union on all steel pipework shall be of malleable iron construction with spherically ground bronze-to -bronze seats and shall have screwed ends to BS 21. Union on PVC-U systems shall be factory manufactured unions appropriate for the pipe.

18 All branches shall be made by easy sweep tees, twin elbows or sweep crosses. Bends shall be used wherever possible. All sweep fittings and all sweep bends shall be of the long radius pattern except where the use of these fittings would stand pipework too far from wall surfaces and make for unsightly appearance, in which case short sweep tees and elbows may be used provided that the Engineer's written approval is obtained beforehand.

19 Where copper pipework is specified, or allowed, as having bronze welded joints, the Engineer will allow the use of silver brazed joints (low temperature brazing) using brazing alloys conforming to BS 1845 Type CP1 or BS 1845 Type CP2. All details of inspection and testing procedures for bronze welding shall apply to silver brazing jointing methods, and all joints shall be made in accordance with the brazing alloy manufacturer's recommendations for the application concerned.

5.3.2 Installation of Steel Pipework

1 Black steel size up to 50 mm will be threaded and size 65 mm and above will be welded.

2 Threaded joints shall be:

(a) screw threads shall be clean and true

(b) in addition, all internal threads must be checked for quality and any with any indication of damage must be rejected and removed from site. All pipe shall be reamed or scraped to remove internal burrs after threading.

3 Welding piping. Where so shown on drawings, specified or directed, welded joints, outlets and flanges shall be used. Welded joints may also be provided elsewhere, where approved by the Engineer, except on piping small than 80 mm, or at points where it may be explicitly specified or directed to leave flanged joints in order to facilitate future changes.

4 All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees as appropriate. Cut samples shall be submitted for approval if directed. All such fittings etc., shall be of type which maintains full wall thickness at all points, ample radius and fillets, and proper bevels or shoulders at ends.

5 Splayed type fittings may be used where standard fittings of required sizes are not available and elsewhere as approved. All job welding shall be done by the electric arc welding process in accordance with the following:

(a) all joints 45 º bevel type. Pipe shall be mill-bevelled or machine-bevelled

(b) all scale and oxide removed with hammer, chisel or file a bevel left smooth and clean

(c) pipe lengths lined up straight with abutting pipe ends concentric.

6 Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to locations of welding work is being done. The leads from welding machine to locations of welding works shall be held together with tape or other approved means so as to prevent induced current ins structural steel, in piping or other metals within the building. The ground lead shall be connected to length of pipe with suitable clamp in such manner that welding current will not flow through joints in pipe, structural steel of building or steel pipe supports.

7 Weld metal is to be thoroughly fused with base metal at all sections. Welds shall be sound metal, free from laps, slag inclusion or other defects.

8 All welders shall be certified by the Engineer for the service for which they are employed and on which they work.

9 Wherever welded piping connections to equipment, valves, or other units need maintenance, servicing, or required possible removal, the connection joint shall be flanged. Pressure rating of the pipe flanges shall match the pressure rating of the flanges on the equipment to which the piping connects.

5.3.3 Installation Copper Pipework

1 Hard drawn copper shall not be bent by any means. Care is to be taken during brazing that excess heat is not used. All copper pipe may only be cut by pipe cutting wheels. No flame cutting or hacksaw work will be permitted. No water quenching will be permitted.

2 All copper pipework and fittings shall be of copper to BS 2871 Part 1 Table X and fittings shall comply with BS 864 or their equivalent.

3 Pipe clamps shall be selected to ensure no reaction between dissimilar metals.

4 Pipes shall be supported as specified in Table 6.1

5 Dielectric joints shall be installed between copper and steel pipes. Direct joints will not be permitted.

6 All joints shall be properly cleaned before jointing.

7 All soldered joints shall be made with 95 % tin and 5 % antimony soldier, having a melting point of not less than 238 ^{o}C. All soldered joints for tubing larger than 50 mm in size shall be made with the simultaneous application of two or three blow torches.

5.3.4 Installation PVC-U Pipework

1 PVC-U piping system is to be installed in accordance with the manufacturer's recommendations, using appropriate pressure pipe and fittings.

2 Extreme care must be taken in the preparation of joints. All joints must be cut square. The burrs must be removed and a 2 mm chamfer filed onto the outside at 45 º.

3 The pipe is to be abraded using emery cloth to approximately the depth of the socket. In addition, the inside of the socket is to be roughened in a similar manner.

4 The roughened surfaces are to be cleaned using the proprietary cleaner from the system manufacturer.

5 The proprietary cement from the manufacturer of the system must be thoroughly stirred before each use. The cement is to be applied longitudinally to both the pipe and the fitting. Generally two coats will be necessary, but care is to be taken to ensure that no excess solvent is left on the inside of smaller fittings.

6 Immediately after application of the cement the pipe must be pushed fully home against the stop in the fitting. The pressure must be maintained for about 30 seconds.

7 Wipe off any excess cement. Clean brushes in cleaner solvent and close lids on all solutions.

8 The system is to harden at least 24 hours before pressurising.

5.3.5 Expansion Provisions and Anchor Points

1 All sections of pipework installation shall be installed in such a manner as to allow expansion and contraction for the pipework, without causing undue stress in any part of the installation.

2 The stress in the pipework shall be kept below the yield point. Care shall be taken to prevent branch connections becoming anchor points.

3 Wherever possible expansion and contraction shall be absorbed by natural offset and changes in direction of pipe runs. Anchors, pipe guides and expansion loops shall be provided where shown or required, to the Engineer's approval. Do not use screwed fittings on expansion loops.

4 Wherever it is not possible to accommodate expansion and contraction of the installations as described above, expansion devices shall be supplied, erected and connected into the pipework installation, and the position of these devices shall be to the approval of the Engineer. 'Articulated' expansion devices shall be fitted on steel pipework systems.

5 The exact location and working details including anchor loads of all expansion devices, guides, anchors, and all associated equipment shall be submitted to the Engineer for approval prior to commencement of the installation, carrying the manufacturer's confirmation that these are in accordance with the requirements.

6 Connection to items of plant and equipment shall be made so that no stress in placed on the equipment or its' connections. All expansion devices shall be carefully erected in full accordance wit the manufacturer's recommendation and instructions, and be approved by the particular application concerned.

7 No system of expansion control shall be accepted where the closure of movement exceeds the amount recommended by the manufacturer when operating from the cold to the upper limit working temperature. The minimum temperature difference for calculation purpose shall be 40 ºC for interior pipes, and 50 ºC for exposed or external runs.

8 All expansion devices shall be cold drawn by a distance equal to half the total expansion and all contraction devices shall be cold compressed by a distance equal to half the total contraction. Cold draw shall not be applied until the anchor installations have been completed and approved by the Engineer.

9 All anchor points shall be treated as main anchor points; the practice of utilising a less substantial anchor for intermediate positions shall not be permitted.

10 Where the installation is required to be tested in sections, extra anchor points shall be installed where necessary, for the protection of the expansion devices.

11 Pipework between anchors shall wherever possible be straight, but where this is not possible, the bracing of all guides shall be adequate to overcome this resultant turning moment produced by the offset forces, but the Engineer shall be informed before the work commences.

12 Each axial expansion device shall be guided as close as possible on both sides of the joint, but in no case more than 1.5 diameters away. A further set of guides shall be installed at a distance of not more than 15 diameters away from the axial expansion device unless the manufacturer imposes more stringent requirements.

13 The positioning of anchors and guides immediately adjacent to angular expansion devices shall be in accordance with the manufacturer's recommendation for the application concerned and shall be submitted to the Engineer for approval before installation commences. The remainder of the pipework shall be set in guides at a maximum of twice the maximum interval for support spacings specified elsewhere for the pipe size to which the expansion device is fitted.

5.3.6 Flanges

1 Flanges shall be provided on the pipework systems wherever necessary to connect to components, plant or equipment having flanged connection. In addition, flanges shall be provided where services are specified elsewhere as having flanged joints.

2 Flanges (including the associated nuts, bolts, and washers) shall be to the minimum requirements of BS 4504 to suit the conditions within the pipework or to suit equipment, valves and other pipework components having flanged connection. Where these connections have flanges shall be provided to suit the connection concerned. Where flanges to BS 4504 are not manufactured then flanges to BS 10 will be accepted.

3 Flanges shall be bolted up using hexagonal nuts and bolts manufactured from high tensile carbon steel in accordance with BS 916 using two flat steel washers, one each side of the jointed flanges.

4 Bolt threads shall not project more than 3.2 mm or less than 1.6 mm beyond the nuts when jointed up.

5 Blank flanges where required shall be manufactured from the same material and same thickness as the flanges to which they are mating.

6 Flanges shall be smooth machined across the full width of the flange and on the edge but may be rough turned on the back. Flanges shall be drilled off-centre.

7 Flanges shall be mounted square with the axis of the pipe after all surface scale, oxides, grease, oil and dirt have been removed.

8 Care shall be taken to avoid distortion of the flange during welding.

9 Steel flanges shall be provided on mild steel pipework.

10 Cast iron flanges shall be provided on cast iron pipework.

11 Steel and gunmetal flanges shall be of the welding neck pattern, welded to the pipework in accordance with the general requirements for welding detailed elsewhere in the Project Documentation.

12 Flanges shall be finished or coated exactly as specified for the pipework on which they are to be fitted.

13 Composite type flanges having gunmetal inner and steel outer flanges shall be provided on copper pipework.

14 Flanges for PVC-U pipe shall be to BS 10, Table E with 14 bar ratings. Backing rings will be provided for sizes of 150 mm and larger, nominal pipe size.

15 Stub flange assemblies will only be permitted if specifically requested for specific reason and if thought appropriate by the Engineer.

16 All items of plan including air heater batteries and fan coil units etc., shall be capable of being disconnected from connected pipework services by means of unions, union valves, flanges or flanged valves. Pipework shall be so arranged to allow the item to be removed.

5.4 VALVES

5.4.1 General

1 Valves shall be provided and installed where required for the purpose of circulation control and isolation. Valves shall be of full bore size to suit the mains into which they are installed.

2 All castings shall be clean close-grained metal, free from rough projections. Screwed valves shall have heavy hexagon reinforcement threads, ample length threads and heavy shoulder to prevent over entry of pipes. Flanged valves shall have the flanges flat faced and of thickness conforming to the appropriate standard and shall be drilled off-centre.

3 Valves shall have pressure rating as necessary for the service indicated on the drawing. Samples must be provided for inspection of the manufacturing methods.

4 Gate valves for sizes up to 50 mm, shall be bronze non rising stem, screwed bonnet, one piece wedge. The casting shall have large hexagon section at all threads to permit gripping to prevent in distortion during installation. Pressure rating shall be PN 16 bar.

5 Gate valves sizes 65 mm diameter and above shall be cast iron rising stem, inside screw, bronze trim and flanged to BS 4504. Pressure rating shall be PN 16 bar.

6 Globe valves sizes 50 mm diameter and below shall be bronze rising stem, screwed bonnet and renewable dynamic disk. The casing shall have a large hexagonal section at all threads to prevent distortion during installation. Pressure rating shall be PN 16 bar.

7 Globe valves sizes 65 mm and above shall be bronze trimmed cast iron body valves, with outside screw and yoke, bolted bonnet, guide feature for disc seating. Pressure rating shall be PN 16 bar.

8 Check valves size 50 mm and below shall be bronze body with bronze trim, rotating disc with flexible hinge assembly, threaded access to top. Pressure rating shall be PN 16 bar.

9 Check valves size 65 mm and over shall be iron body with bronze trim, 16 bar, rated rotating disc with flexible hinge assembly, bolted access to top with outside lever and weight to permit vertical installation if required.

10 Balancing valves up to size 50 mm shall be of bronze body. Valves to have differential pressure read out ports across valve seat area. Read out ports to be fitted with internal EPDM insert and check valve. Valve bodies are to have 6 mm tapped drain/purge port. Valves are to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak tight at full rated working pressure. All valves to be provided with moulded insulation to permit access for balancing and read out.

11 Balancing valves size 65 mm diameter and above shall be of heavy duty cast iron flanged construction with flanged connections to BS 4504 PN 16 working pressure. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak tight at full rated working pressure. All valves to be provided with moulded insulation to permit access for balance and read out.

12 Triple duty valves may be installed on chilled water pump discharge to perform the functions of a non slam check valve, throttling valve, shutoff valve, and calibrated balancing valve. The valve shall be of heavy duty cast iron construction with 9 bar ASNI flanged connections suitable for 12 bar working pressure for operating temperatures up to 120°C. The valve shall be fitted with a bronze seat replaceable bronze disc with EPDM seat insert, stainless steel stem, and chatter preventing stainless steel spring. The valve design shall permit re-packing under full system pressure. Each valve shall be equipped with brass read out valves (with integral check valve) to facilitate taking differential pressure readings across the orifice for accurate system balance.

13 An angle pattern flow straightening suction diffuser may be installed at the chilled water pump suction connection. Each fitting shall be equipped with a combination diffuser strainer orifice cylinder, flow straightening vanes, start-up strainer, permanent magnet and adjustable support foot. The combination diffuser-strainer-orifice cylinder shall be designed to withstand pressure differential equal to the system pump shutoff head and shall have a free area equal to five times the cross section area of the pump suction opening. The length of the flow straightening vanes shall be no less than 2 times the diameter of the system pump suction connection. The flow straightening fitting shall be of cast iron construction with flanged system and flanged pump connections. The fitting shall have a carbon steel combination diffuser-strainer-orifice cylinder with 4 mm diameter perforations to protect the system pump. The full length carbon steel flow straightening vanes shall provide non-turbulent flow to the suction side for the system pump. The magnet shall be positioned in the flow stream to protect the pump seal(s). The start-up strainer shall be of 16 mesh bronze, and the adjustable support foot shall eliminate pipe strain at the flow fitting/pump connection. All internal components shall be replaceable.

14 All valves shall be rated for a working pressure of 16 bar, unless otherwise indicated.

15 All valves shall be pressure tested at the manufacturer's works to BS 6755.

16 All threaded valves shall be threaded to BS 21.

17 All flanged valves shall be flanged to BS 4504.

5.5 PUMPS

5.5.1 General

1 Pumps shall be provided from the factory complete with their electric motors mounted on a common cast iron or fabricated steel base and properly aligned.

2 Pumps and motor base shall be supported on an isolated reinforced concrete foundation as detailed on the drawings.

3 Pump and motor base shall be aligned and levelled throughout the length and width of the base and where necessary suitable shims shall be provided under the base to facilitate levelling.

4 Pump and motor base shall be secured to the foundation with proper size anchor bolts and completely grouted in to provide a rigid non-deflecting support.

5 Pump and motor shall be realigned in the field after grouting in of base and connecting piping.

6 Piping shall be supported independently of pump nozzles to prevent piping weight or stresses from bearing on or being transmitted to the pump nozzles.

7 Pumps shall be located in accessible locations for ease of repair and maintenance.

8 Drains for packing glands and base shall be piped to the nearest floor drain or sump.

9 Where required by pump design and recommended by the manufacturer, a clean water supply shall be provided for cooling and lubrication of shaft packing or mechanical seals.

10 Pumps shall be provided with shaft packing or mechanical seals compatible with the pump design and nature of liquid pumped in accordance with manufacturer's recommendations or as specified for each particular pump.

11 Pumps shall be constructed of materials and shall have pressure ratings suitable for the service and operating conditions.

12 Where corrosion can occur, appropriate corrosion resistant materials and assembly methods shall be used including isolation of dissimilar metals against galvanic interaction.

13 Pumps shall be provided from the factory with plugged connections for casing vent, drain and suction and discharge pressure gauges.

14 Pump impellers and rotating assemblies shall be statically and dynamically balanced at the factory.

15 Packing rings shall be installed in alternative layers staggered at right angles to each other. The packing shall be tightened for seal while permitting the prescribed amount of leakage for lubrication.

16 Mechanical seals shall be installed and aligned in accordance with manufacturer's recommendations.

17 Before operating pumps, care shall be taken to ensure that the pump is properly lubricated, the rotating element rotates freely by hand, the casing is vented and full of water, the direction of rotation is correct, the strainer is clean and the suction and discharge valves are open.

18 Pumps shall operate in a stable manner without pulsation, noise, vibration or cavitation throughout their full capacity range.

19 Pumps shall be selected so that their operating point of specified flow and head falls at the point of maximum efficiency as obtained from manufacturers' published data. A pump will not be approved if it is selected to operate near the end of its curve.

20 The horsepower rating of the motor driving the pump shall be of sufficient magnitude to ensure non-overloading of the motor throughout the capacity range of the pump for the impeller diameter selected.

21 Electric motors shall always be specifically supplied for the available electric current voltage and frequency. Motor speed shall not exceed 1450 rpm unless specified otherwise.

5.6 STRAINERS

5.6.1 General

1 Strainer shall be full line size located ahead of all pumps and motorised control valves. Bodies shall be brass, screwed body, "Y" type, 16 bar rated up to 50 mm size with 37 % open mesh monel metal screen, and 1.4 mm diameter holes. For sizes 65 mm and above, iron body, flanged, "Y".

2 All strainers 65 mm and above shall have a 20 mm bleed off/drain tapping and valve fitted.

5.7 AIR VENTS

5.7.1 General

1 Provide air vents at all high points in supply and return piping.

2 Vents will have a positive shut-off, and be connected to the nearest floor drain by means of a copper pipe.

3 Air vents shall not be installed directly on the pipework but shall be fitted to air bottles that are adequately sized for the pipe it is venting.

(a) 15 mm - 50 mm air bottles shall be line size
(b) 65 mm - 100 mm air bottles shall be 50 mm
(c) 125 mm -200 mm air bottles shall be 80 mm
(d) 250 mm and above air bottles shall be 100 mm.

4 The body of automatic air vents shall be bronze with stainless steel float, lever trams and accessories

5 A separate gate valve shall be installed below the automatic air vent to facilitate future maintenance.

5.8 FLOW SWITCHES

5.8.1 General

1 Flow switches shall be provided at the outlet connection to each chiller.

2 Flow switches shall be paddle type with bronze construction for all parts in contact with water except the paddle which shall be in stainless steel.

3 Electrical termination box shall be weather protected to IP 65 and suitable for installation in ambient case temperature up to 85 °C.

5.9 FLOW MEASUREMENT

5.9.1 General

1 Provide all equipment to enable flow measurement. If indirect measurements are used, provide all calibration equipment, charts etc.

2 Provide Binder Sockets suitable for the application of flow sensors at all locations shown or necessary for all balancing purposes. The binder test points shall be installed at the following locations.

(a) across all coils
(b) across each chiller
(c) across each 2 or 3 port control valves
(d) across calibrated valves
(e) across metering stations.

5.10 CLEANING OF WATER SYSTEM TREATMENT

5.10.1 General

1 The chilled water system shall be prepared by flushing with clean water to remove any debris. The system will then be further treated as described below.

2 Prior to testing and commissioning, the Engineer shall be provided with water conditioning programme, to control water quality. Cleaning shall be supervised and programme of conditioning administered by the conditioning company.

3 For pre-commission cleaning, the system shall be dosed with the prescribed amount of the non-acid cleaning agent and a surfactant as advised by the chemical company.

4 Cleaner shall be run into the system and retained for a period of 72 hours or more as advised by the chemical company. At the end of this period the system shall be drained and flushed with clean water.

5 All strainers and trapping points shall be inspected, and any debris removed.

6 System shall be refilled with clean water, re-circulated or run through for a further four hours, and again drained and flushed. The flushing shall continue till the effluent is clear, colourless, odourless, free from suspended solids and such that the iron level is not more than 10 ppm and the conductivity is no more than make up water.

7 Upon completion of flushing all strainers shall be inspected and any debris removed.

8 The system shall be refilled with clean water and a specified amount of inhibitor added.

9 The chemical company representative shall conduct an analysis of the system's water after the cleaning operation, and shall submit a report to the Engineer.

5.11 GAUGES AND ACCESSORIES

5.11.1 General

1 Wet service thermometers shall be straight shank mercury fill insertion type. They shall have a stem length of 80 mm and a scale length of 225 mm, and the capability of adjusting the angle of the scale to the stem. Provide copper or brass separable wells for each thermometer with 13 mm MPT connection. The range shall be – 6 °C to 50 °C unless otherwise advised.

2 Air service thermometers shall be straight shank mercury fill insertion type. They shall have a stem length of 150 mm and a scale length of 225 mm, and the capability of adjusting the angle of the scale to the stem.

3 Pressure gauges shall have 100 mm diameter stainless steel case, black figures, forged brass sockets with phosphor bronze bushed rotary type movement and Bourdon tube. Gauges shall be complete with impulse dampening insert and T-handle gauge cock.

4 Where the line size is 100 mm or less the gauge is to be installed into a T-branch with a reducer. For sizes above 125 mm, a splayed fitting with a threaded joint may be used, subject to the requirements of Clause 1.1.17 of Part 1 of this Section.

5 Range of gauges shall be selected such that the operating point is almost midway of the selected range.

5.12 SUBMITTALS

5.12.1 General

1 Submittals shall comply with the relevant provisions of Section 1, General.

2 Technical submissions are to include the schematic for components actually to be installed showing flow rates, and accompanies by pressure drop calculation for the system.

3 The Contractor shall provide technical brochures and information on all components:-

(a) pipework
(b) pipe fittings
(c) pipe supports
(d) valves
(e) strainer
(f) gauges and accessories
(g) air vents
(h) flow measuring instruments
(i) expansion joints
(j) anchor points
(k) test forms
(l) water treatment.

END OF PART