

INDEX TO SPECIFICATONS

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PART 1: GENERAL**1.1 SHOP DRAWINGS AND SUBMITTALS**

- .1 After award of contract provide and submit shop drawings within 10 working days. Clearly identify with references to recognized design standards used, and indicate layouts, quantity, details of equipment, control wiring diagrams, sizes, capacities and roughing in and exact requirements for concrete pits, bases and other supporting members. Until the submission is reviewed the Work involving relevant products must not proceed.
- .2 Each shop drawing must be certified by manufacturer and as such shall indicate that all product engineering has been performed to ensure the product will meet the requirements of the intended installation.
- .3 Specified products, and/or products listed as equal or alternate will not be accepted by the Contract Administrator unless the shop drawings are accompanied by this list.
- .4 Guarantee of delivery, when required, is not conditional on approval of shop drawings unless they are submitted within 10 working days after Contract award.
- .5 All Work and equipment shown on shop drawings is taken as part of Contractor's Work unless specifically excluded.
- .6 Secure and verify all field dimensions and where fabrication must proceed before these are available, ensure that field dimensions are followed to suit.
- .7 Each shop drawing shall include name of the job, Contractor, equipment supplier and clause under which equipment is specified.
- .8 Checking of shop drawings by the Contract Administrator does not constitute acceptance of responsibility. Such checking constitutes assistance only to the Contractor in the proper execution of his Work.
- .9 Prior to submittal of shop drawings the Contractor shall check and verify that all details have been included and then indicate so by signing each drawing to this effect.

NOTE: ANY SHOP DRAWINGS SUBMITTED THAT DO NOT MEET THE ABOVE REQUIREMENTS WILL BE RETURNED WITHOUT APPROVAL FOR COMPLIANCE AND SHALL BE RESUBMITTED.

1.2 PERMITS, INSPECTION AND TESTING

- .1 File all necessary notices and approved layouts, obtain and pay for all applicable Local Authority and Fire Underwriters Inspections, approvals and permits. Make changes required to secure Local Authorities approval, without extra cost. Where conflicting requirements occur, comply with most stringent regulation. Note that requirements shown or specified may exceed minimum standards set by Local Authorities.
- .2 The Regulations of the A.S.M.E. Code and the Provincial Labour Department shall cover the design, manufacture, installation, welding and tests of piping and other equipment as specified hereafter.
- .3 Obtain Registration Certificates for all pressure vessels, with suitable metal-framed glass covers installed where directed. Furnish all certificates required by Local Authorities before acceptance of building by the Contract Administrator.
- .4 The Contract Administrator may request the Contractor to operate a device or material installed for such time as may be required, as a thorough test, before final acceptance. Such tests shall not be construed as evidence of acceptance, and no claim for cost of such operation for test, or damage due to inadequacy or defect will be recognized.
- .5 Note that Site reviews by the Contract Administrator are for the purpose of determining in general if the Work is proceeding in accordance with the Contract Documents, and to endeavour to guard the City against defects and deficiencies

and not to superintend the execution of the Work, which is the Contractor's responsibility.

1.3 DELIVERY AND STORAGE

- .1 Check and do not deliver finished equipment to job until weatherproof dry storage is available.

1.4 SPECIAL PROTECTION

- .1 Protect all finished and unfinished Work from soiling or damage, cover floors with tarpaulins or plywood as necessary, and repair any damage resulting from Contactor's Work.
- .2 Protect finished surfaces to remain exposed, by paper, polyethylene or other satisfactory removable protective covering using paste acceptable to fixture manufacturer to prevent possible damage to finishes, until all reason for construction damage has passed and until acceptance by the Contract Administrator, and make good any such damage.
- .3 Cover open ends of pipes, fixtures, ductwork, etc. to prevent entry of building rubbish.

1.5 SPECIAL CLEANING

- .1 Maintain tidiness and at completion remove protective paper, labels, etc. and tools and waste materials. Leave clean and in perfect operating condition.
- .2 Remove dirt, rubbish, grease, and dust for which this section is responsible from all exposed surfaces and fixtures.
- .3 At the end of construction all systems shall be left ready for operation.
- .4 Contractor shall be responsible for repair work as may be necessary to remove dents and touch-up of factory finishes.

1.6 MAINTENANCE AND OPERATING INSTRUCTIONS

- .1 Obtain from each Contractor by Substantial Completion date for each location seven sets of all brochures or literature supplied by manufacturers of each piece of equipment including that listed below, and provide loose with tab dividers and 3-hole punched, and deliver to Contract Administrator:
 - .1 Complete list of mechanical equipment supplied and installed under each section including description, make, type, size, capacity, serial number and list of repair and replacement parts, with names and addresses of suppliers.
 - .2 Correct installation procedure.
 - .3 Manufacturer's recommended operating and maintenance instructions.
 - .4 Separate lubrication schedule including each piece of equipment and showing frequency of service and grade of oil or grease required. This schedule shall be inserted at the front of the manuals.
- .2 Include in the front of each manual a maintenance schedule, showing equipment name and location, type and frequency of required maintenance with referral to manufacturer's maintenance sheet.

1.7 INSTALLATION AND ERECTION

- .1 Mechanical drawings do not show all the architectural, structural and electrical features. Take information involving dimensions of building from Site measurement.
- .2 Drawings show general location and route to be followed by pipes, ducts, etc. Make necessary changes or additions to runs to accommodate structural conditions as built. Location of pipes and other equipment shall be altered without charge, provided change is made before installation. This does not necessitate a change in quantity of materials.

- .3 Where required pipes and ducts are not shown, or are shown diagrammatically, install to conserve headroom with minimum interference to free use of space through which they pass.
- .4 Assume full responsibility for layout of own Work and for any damage caused to property of others through improper location or poor workmanship.
- .5 Before installation of fixtures, fittings and equipment which may interfere with interior treatment and use of building, confer with the Contract Administrator and obtain detail drawings or instructions for each location.
- .6 Where equipment is to be built in, ensure that the same is available when required, or direct the size of openings to be left.
- .7 Where Work is to be concealed, install close to structure, so that furred spaces are minimum.
- .8 Where space is indicated as reserve for future equipment, leave clear and install piping and other Work so that connections can be made to future equipment.
- .9 Secure approval where necessary to cut holes in either finished or unfinished Work, employ section whose Work is involved, cut openings no larger than necessary and without damage to adjoining Work and carefully repair all damage to match adjacent Work. Note the Contractor is responsible for all required cutting and patching relating to this Contract, except as specifically noted otherwise.

1.8 MATERIALS

- .1 As specified under respective sections.
- .2 Installation of all equipment will be by this contract. Where noted in the specification and schedules, the supply of major equipment will be by another contract.
- .3 Materials and equipment specified and acceptable manufacturers are named in this specification for the purpose of establishing a standard of materials and workmanship to which the Contractor shall adhere and not for the purpose of limiting the selection.
- .4 Any substituted item submitted for consideration must not exceed the available space limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Contractor.
- .5 Materials of same general type shall be of same manufacturer, i.e., centrifugal fans, in-line fans, condensate pumps, heating coils, etc.
- .6 Submit copies of orders for all materials and equipment as evidence of purchase within 5 days of receipt of approved shop drawings.

1.9 AS-BUILT DRAWINGS

- .1 Refer to Division 1 – Contract Close-out for Project Record Documents submission.
- .2 As-built drawings to be marked up with all mechanical and electrical work.
- .3 An extra set of clean prints will be issued to the Contractor. Mark up as job progresses, and provide to the Contract Administrator one full-size set of "As-built" prints as a complete and accurate record "As-Built" of all mechanical Work. Drawings should be signed and dated by the Contractor.

1.10 SUPPORTS, BASES AND PITS

- .1 Supply and erect all special structural Work required for installation of tanks, pumps, motors and other apparatus and supply and install all anchor bolts and fasteners for building in and instruct and direct exact sized and locations for bases required. Provide and install 50 mm (2") thick machinery cork vibration isolation pads wherever required, whether particularly shown or not. Unless otherwise indicated on drawings, mount all major pieces of equipment such as pumps, fans, etc. on 300 mm (12") high concrete pads, generally in accordance with standard details and to suit.

1.11 ACCESS PANELS

- .1 Provide in ample time for installation under relevant sections all necessary access panels in walls and ceilings to allow access to dampers, valves, etc., size 300 mm x 300 mm (12" x 12") min. or as required for proper maintenance with steel panel and frame, similar to Acudor, type to suit application. Instruct relevant section for proper location of access panels. Final locations subject to the Contract Administrator's approval. ULC approved access panels must be provided where access is through or into a fire partition or assembly.

1.12 ALTERATION WORK

- .1 Where Work is to be done in existing buildings, accurately survey, provide for avoidance of damage and interference to existing Work and rectify any such damage due to Contractor's Work. Accept existing Work as it exists at time of Bidding.
- .2 Disconnect existing equipment indicated, intended to be reused, rough-in in new position, and after replacement connect up ready for use.
- .3 Removal and relocation of equipment by the Contractor.
- .4 The Contractor shall return all salvage pool heating equipment and materials to the City.

1.13 ABBREVIATIONS

A.S.H.R.A.E.	-	American Society of Heating, Refrigerating and Air Conditioning Engineers Inc.
A.S.A.	-	American Standards Association
A.S.M.E.	-	American Society of Mechanical Engineers
A.S.T.M.	-	American Society for Testing Materials
A.W.W.A.	-	American Water Works Association
C.E.M.A.	-	Canadian Electrical Manufacturer's Association
C.F.M.	-	Cubic Feet per Minute
C.F.U.A.	-	Canadian Fire Underwriters Association
C.I.	-	Cast Iron
C.O.	-	Clean Out
C.P.	-	Chromium Plated
C.S.A.	-	Canadian Standards Association
D.B.I.U.	-	Dominion Board of Insurance Underwriters
F.P.M.	-	Feet per Minute
G.P.H.	-	Gallons per Hour
G.P.M.	-	Gallons per Minute
H.P.	-	High Pressure or Horsepower
K.W.	-	Kilowatts
N.B.F.U.	-	National Board of Fire Underwriters
N.E.C.	-	National Electrical Code
N.E.M.A.	-	National Electrical Manufacturers Association
N.F.P.A.	-	National Fire Prevention Association
N.P.T.	-	National Pipe Thread
O.S. & Y.	-	Outside Screw and Yoke
O.H.S.A.	-	Occupational Health & Safety Association
P.S.I.	-	Pounds per Square Inch
P.S.I.G.	-	Pounds per Square Inch Gauge
R.P.M.	-	Revolutions per Minute
S.P.	-	Static Pressure
U.L.C.	-	Underwriters' Laboratories of Canada
U.S.	-	United States (usually combined with other abbreviations)
W.S.I.	-	Watts per Square Inch

.2 Other abbreviations will be interpreted as referred to in the American Society of Heating, Refrigerating and Air Conditioning (A.S.H.R.A.E.) Handbook, current edition.

1.1 RELATED WORK

- .1 The General Conditions and General Specifications form an integral part of this specification and must be read in conjunction herewith. Read also and be fully cognizant of all Mechanical and Electrical Sections.

1.2 SCOPE OF WORK

- .1 Schedule of Pipe and Fittings
- .2 Installation of Piping
 - .1 Valves
 - .2 Hangers and Supports
 - .3 Sleeving for Piping
 - .4 Expansion and Contraction
 - .5 Strainers, Thermometers and Pressure Gauges

2.1 SCHEDULE OF PIPE AND FITTINGS

- .1 Pool Water Piping (PVC):
 - .1 Pipe and fittings shall be PVC Schedule 80 piping and fittings certified to CSA B137.3. Schedule 80 fittings shall conform to ASTM D-2467. Pipe, fittings and joining material shall be compatible for use with chlorinated water
 - .2 Method of joining shall be Solvent Weld using manufacture approved cement and primer.
 - .1 **Standard of Acceptance:**
 - .1 IPEX Xirtec140 pipe and fittings.
 - .2 IPEX Xirtec 11 cement and Xirtec 7 primer.
- .2 Interior Water Piping (Cold, Hot and Recirculating)
 - .1 Type "L" hard temper copper tube
 - .1 Up to 50 mm (2") diameter with wrought or cast solder fittings and joints.
 - .2 Over 50 mm (2") diameter with silver braze fittings.
- .3 Hot Water Heating Piping
 - .1 Sizes 13 mm (½") to 50 mm (2") inclusive shall be schedule 40 black, stretch reduced, continuous weld, steel pipe to A.S.T.M. Specification A-53 with 150 lb. malleable screwed fittings and 150 lb. malleable iron ground-joint unions, or Type "L" hard temper copper tube.
 - .2 Sizes 63 mm (2½") to 150 mm (6") inclusive shall be schedule 40 black, electric resistance weld, open hearth, steel pipe to A.S.T.M. Specification A-53 with 150 lb. welding fittings and 150 lb. forged steel welding flanges, or Type "L" hard temper copper tube with Emco smoothbore silver brass fittings.
 - .3 Sizes 200 mm (8") to 300 mm (12") inclusive shall be electric resistance weld, open hearth, hydraulically cold expanded, black steel pipe to A.S.T.M. specification A-53 with 150 lb. welding fittings and 150 lb. forged steel welding flanges, or Type "L" hard temper copper tube with Emco smooth bore silver braze fittings.
- .4 Dielectric Couplings
 - .1 Install dielectric couplings in all locations where dissimilar metals are joined. Couplings are to be compatible with and suit the pressure rating of the system.
 - .2 Isolating unions shall be used on pipes 50 mm (2") and smaller.
 - .3 Isolating flanges shall be used on pipes 63 mm (2-1/2") and larger.

2.2 PIPE AND FITTINGS MATERIAL STANDARDS

- .1 Hot Water Heating Pipe
 - .1 All steel piping up to and including 50 mm (2") in size shall be screwed jointed with screwed fittings. All other steel piping shall be welded.
 - .2 Steel pipe shall conform to A.S.T.M. Specification A-53.
 - .3 Type "L" and "K" hard temper copper tube shall conform to A.S.T.M. specification B-88-41.
- .2 Fittings
 - .1 Nipples shall conform to the type of pipe on which they are installed.
 - .2 150 pound malleable iron ground joint unions shall be Crane Fig. 1280, with brass to iron seats. Three hundred pounds malleable iron ground joint unions shall be Crane Fig. 519E, with brass to iron seats.
 - .3 Carbon steel Thred-O-Let welding fittings shall conform to A.S.T.M. specifications A-181, Grade 1.
 - .4 Butt welding fittings shall conform to A.S.T.M. Specification A-234.
 - .5 All steel welding fittings shall be of Crane manufacture. All fittings for copper piping shall be wrought copper up to 100 mm (4") and cast fittings on larger sizes.
- .3 Flanges and Gaskets
 - .1 Forged carbon steel slip-on welding flanges shall conform to A.S.T.M. Specification A-181, Grade 1.
 - .2 Square headed steel bolts and hexagon nuts for flanges shall conform to A.S.T.M. Specification A-107.
 - .3 Flange facings shall have a serrated finish with raised face.
 - .4 All companion flanges on valves and equipment shall have flat or raised faces, to match the flange on the valve or equipment.
 - .5 All forged steel flanges shall be of Crane manufacture.
 - .6 All flange gaskets shall be Cranite pre-formed asbestos type, of Crane manufacture.
 - .7 Site and shop cut gaskets will not be permitted.

2.3 VALVES

- .1 The Contractor shall supply and install all valves called for elsewhere in the specification or shown on the drawings in accordance with the following general specifications. Any valves not specifically covered herein shall be of comparable quality to those specified.
- .2 All valves shall be as far as possible the products of a single manufacturer. After the Contract is awarded, the Contractor shall submit a brochure of the valves he proposes to install showing make, number and use. Globe valve discs must be of a type recommended for the services.
- .3 Drain valves up to and including 19 mm (3/4") shall be compression stops or hose bibbs, rough brass, with garden hose thread outlet.
- .4 Drain valves shall be ball valves as specified below with discharge piped to a suitable drain.
- .5 Valve Schedule
 - .1 Thermoplastic Valves:
 - .1 PVC Ball Valves .5" thru 4" shall be IPEX VX series c/w EPDM o-rings and Teflon seats.
 - .2 Butterfly Valves 2.5" thru 8" shall be IPEX wafer style FK series c/w glass filled polypropylene body, polypropylene disc, EPDM liner and stainless steel shaft.
 - .2 Domestic Cold, Hot and Recirculating Water Valves:
 - .1 Globe valves up to 50 mm (2") - Crane 1702/17025.
 - .2 Globe valves up to 63 mm (2 1/2") and up: Crane 351.
 - .3 Check valves up to 50 mm (2") - Crane 1707/17075.

- .4 Check valves 63 mm (2½") and up - Crane 372/373.
- .5 Ball valves up to 75 mm (3"): Crane CSC-9202/CSC-9222.
- .3 Hot Water Heating Services Valves:
 - .1 Balancing valves up to 50 mm (2") - Crane CSC-9202/9222.
 - .2 Balancing valves 63 mm (2½") and up - Crane 42-BXB or Keystone Fig. 1000 with lever lock handle and positioning cap.
 - .3 Shut-off valves up to 50 mm (2") - Crane 1700/1700S.
 - .4 Shut-off valves 63 mm (2½") and up - Crane 42-BXB or Keystone Fig. 1000 with lever lock handles.
 - .5 Check valves 63 mm (2½") and up - Crane 373.
 - .6 Drain valves - Crane F9202/F9203-B with cap and chain.

2.4 HANGERS AND SUPPORTS

- .1 Steel piping shall be supported by Grinnell figure 260 adjustable wrought clevis hangers sized to suit the O.D. of the pipe.
- .2 All pipe hangers and trapeze hangers shall be supported by mild steel rod of the correct diameter to suit the hanger, as recommended by the manufacturer.
- .3 The load on any hanger rod shall not exceed the capacity indicated in the following table:

Rod Diameter	Max. Safe Load
10 mm (3/8")	610 lbs.
13 mm (1/2")	1130 lbs.
16 mm (5/8")	1810 lbs.
19 mm (3/4")	2710 lbs.

- .4 All vertical runs of pipe shall be supported at each floor by Grinnell Fig. 261 riser clamps. Clamps on copper pipe shall be copper plated.

2.5 STRAINERS

- .1 Up to 50 mm (2") in size - Sarco screwed bronze body Y pattern, with stainless steel screen having 3 mm (1/8") perforations.
- .2 63 mm (2½") and up - Sarco flanged iron body type STM, with stainless steel screen having 3 mm (1/8") perforations.
- .3 Supply and install strainers ahead of all steam traps, temperature control valves, pressure reducing valves, pump suctions and where indicated on the drawings.
- .4 All high pressure steam shall be Y pattern and shall have a gate valve, nipple and cap to allow in service blow down.

2.6 THERMOMETERS

- .1 Thermometers to be bi-metal dial thermometers, having stainless steel cases and rings with bronze or stainless steel stems, brass separable thermowells. Scale range to be as follows:
 - .1 Heating systems - plus 10°C (50°F) to 150°C (300°F).
- .2 Thermometers located up to 1500 mm (5'-0") above finished floor to have 75 mm (3") diameter dials and located above 1500 mm (5'-0") to have 125 mm (5") diameter dials. Use back or bottom inlet stems, whichever is best suited for ease of reading. Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by the Contract Administrator.
- .3 Separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Stem and wells to be immersed in liquid flow, minimum length of stems to be 150 mm (6").

- .4 Where a separable well is mounted in pipe 38 mm (1½") diameter or less enlarge pipe to 50 mm (2") diameter, for well length plus 75 mm (3").
- .5 **Standard of Acceptance:**
 - .1 Winter's
 - .2 Weiss BM
 - .3 Weksler AO

2.7 PRESSURE GAUGES

- .1 Pressure gauges on suctions and discharges of pumps and where noted shall be Weksler type EA14 1% full scale quality gauges having bronze geared movements, bronze bourbon tube, friction glass cover and precision type pointer. Where noted or shown at 1/2% full scale is required shall be Weksler AA14-2 or Weiss 4UGE-1 as equal.
- .2 Use 113 mm (4½") dials. Where mounted above 3000 mm (10'-0") from floor level, use 150 mm (6") dial. Gauges chosen with indicating needle at 12 o'clock position for normal operating pressure.
- .3 Gauges to have A10 brass tee handle cock. Install MSB4 adjustable snubbers on pump gauges. When a gauge is to be used for steam install type AO31 iron (schedule 40) siphon.
- .4 Gauges, subject to vibration, shall have copper tube extension and shall be located away from source of vibration; preferably on an adjacent wall or other stable mounting surface.

EXECUTION PROCEDURES

3.1 GENERAL INSTALLATION OF PIPING

- .1 Copper piping shall not be buried except where specifically noted on the drawings.
- .2 All pipe shall be cut accurately to measurements taken at the Site and shall be installed without springing or forcing. All changes in direction shall be made with fittings.
- .1 Screwed joints in steel piping shall be made with full cut standard taper pipe threads, with Tyte-Untyte, graphite and oil or other approved non-toxic joint compound applied to male threads only. Jointing compound shall not be applied to the first thread.
- .2 Connections to equipment, valves, fittings, etc., shall be made with unions up to 50 mm (2") and with flanges in sized 63 mm (2½") and over.
- .3 Where required on steel piping 63 mm (2½") size and above, use forged carbon steel slip-on welding flanges. Flange connections shall be made with a full complement of nuts and bolts.
- .4 Slip on flanges shall be welded to the pipe on which they are fitted at the neck of the flange and also back welded at the end of the pipe at the inside of the flange. Grind off all welding burrs on the face of the flanges.
- .5 All flanged joints shall have gaskets of pre-formed asbestos Cranite. Site or shop cut gaskets will not be permitted. Ring gaskets shall be used on all raised face flanges and full faced gaskets on all flat faced flanges. Coat all gaskets with Crane thread lubricant prior to installation.
- .6 Install drain valves at low points in all water systems.
- .7 Reducing tees, etc., which have any joint to be soldered with 95-5 solder.
- .8 At flanged valves, etc., install silver braze joint copper companion flanges with suitable gasket, bolts.
- .9 Where screwed valves must be installed in copper lines, install with copper male thread adapters with threads tinned, or with approved joint compound. Valve

- working parts shall be removed to prevent damage from heat or brazing, in every case.
- .10 Install check valves on the discharge piping from all pumps and shut-off valves on the suction and discharge piping at each pump.
 - .11 Run piping parallel to walls and in such a manner as to be as unobtrusive as possible when viewed from inside or outside of building. Install drain cocks on each pump and at other locations in mechanical rooms where shown on the drawings and pipe to nearest floor drain.
 - .12 The inside of all pipe, fittings, valves and all other equipment shall be smooth, clean and free from blisters, loose mill scale, sand and dirt when erected.
 - .13 All accessible steel piping up to and including 50 mm (2") in size shall be screwed jointed with screwed fittings.
 - .14 All pipe welding shall be done in accordance with A.S.M.E. Code and the provincial Department of Labour Regulations and the welder must be fully qualified and licensed by the Provincial Government. Proof of the welder's qualifications shall be furnished to the The Contract Administrator.
 - .15 Install shut off valves directly upstream of unions or flanges at each item of equipment.
 - .16 Install strainers upstream of all flow control equipment.
 - .17 The preparation of parts for fusion welded joints, shall conform to the code for pressure piping. Particular care shall be taken to ensure that backing rings are not burnt through, when welding at joints.

3.2 DOMESTIC WATER PIPING

- .1 Copper water piping (cold, hot and recirculating) up to and including 25 mm (1") size shall be soldered using 95-5 solder.
- .2 Copper water piping over 25 mm (1") size shall have joints soldered using 95-5 solder. Joints must be made in accordance with manufacturer's instructions. Joints over 50 mm (2") shall be silver brazed.
- .3 Install shut-off valves at water meters, hot water tanks and in water mains where shown or necessary for complete drainage. Hot water tanks shall have drain valves.
- .4 Install shut-off valves at water meters, hot water tanks and heaters, at all connections to major pieces of equipment, at the base of each riser (cold, hot and recirculating), and in all branches to fixtures or groups of fixtures, also where shown on drawings or where necessary for the satisfactory operation of maintenance of the system.
- .5 Install enclosed bellows type water shock arrestors up stream of all solenoid water control valves.
- .6 Rough-in and connect up water supplies to all fixtures and equipment specified under Section 15400 and air conditioning equipment as shown or required.
- .7 Install hot water circulation pumps as specified and shown in drawings. Note that recirculating connections must be taken off below the highest fixture connection. Provide Sarco balancing fittings on recirculating lines at all branch connections to ensure balancing of recirculation system.
- .8 Install di-electric insulating couplings or isolating flanges between all pipes or apparatus constructed of dissimilar metals.
- .9 Grade all water piping up in the direction of flow so that air may be properly eliminated through connecting risers to fixtures.
- .10 On all hot water piping systems the branch take-offs to each riser shall be installed in such a manner that the pipe expands to its normal position when the water is heated. There shall be a definite grade up to the riser, so that the air will not be trapped.

- .11 Install a shut-off valve on the supply and return piping in each system branch. Install a balancing valve in each branch of hot water recirculation systems.
- .12 Install check valves in water piping wherever shown on drawings and wherever backflow might occur.

3.3 HOT WATER HEATING SERVICES

- .1 All reductions in pipe size shall be made by using eccentric reducers or eccentric reducing couplings.
- .2 Bending of pipe will be permitted only if seamless steel pipe is used on the sections to be bent and providing the pipe is bent without distortion, rippling and reduction in the wall thickness of the pipe. The Contract Administrator reserves the right to have any or all sections of bent pipe removed and replaced with fittings if the bending of pipe has not been done to the complete satisfaction of the Contract Administrator.
- .3 Where the change in direction of piping is shown as being used to take up the expansion in the piping, spring piping cold when it is being installed.
- .4 On copper piping up to 25 mm (1") in size, joints shall be soldered with 95-5 solder. On copper piping over 25 mm (1") in size, all joints shall be silver brazed.
- .5 Install di-electric insulating couplings or isolating flanges between all pipes or apparatus constructed of dissimilar metals.
- .6 All piping serving heating coils shall be installed in such a manner that the connecting pipe can be dismantled close to the coil, for easy removal of the coil, without having to dismantle excessive lengths of the pipe, i.e., all header pipes serving coils shall be located to the side of the coil or coils and each connection from the header to a coil shall have a union so located that the connections can be dismantled and the coils removed.
- .7 Install air vents at all high points in water systems where air might be trapped. Refer to the clause "Air Venting".

3.4 VALVES

- .1 All valves must be installed with stems upright or horizontal; not inverted.
- .2 Supply and install check valves on condensate pump discharges and also where indicated on the drawings.
- .3 Note: All valves installed in concealed locations, i.e., ceiling spaces, shall be compactly arranged so that they are easily accessible through common access plates or doors.

3.5 HANGERS AND SUPPORTS

- .1 All piping and equipment shall be securely supported from the building structure. Perforated strap or wire hangers will not be permitted.
- .2 Maximum spacing between pipe supports:
 - .1 Pipe size up to and including 50 mm (2"): Max. span 2100 mm (7').
 - .2 Pipe size 63 mm (2½") and larger: Max. span 3000 mm (10').
- .3 Where hangers must be installed in existing concrete slabs, approved expansion type inserts shall be used, or if heavy weights must be supported, a hole shall be drilled through the slab and a 50 mm x 50 mm (2" x 2") washer and nut installed above rough slab before the floor finish is poured.
- .4 All hanger rods shall have sufficient threaded length to allow for vertical adjustment of hangers after pipe is in place. Use 2 nuts on each rod, one above the clevis or angle iron and one below.
- .5 Where pipes or equipment are supported from floors or walls, structural steel supports shall be fabricated, using welded joints except where provision is made for adjustment. Where details of construction are not indicated, drawings shall be submitted to the Contract Administrator for approval before fabrication.

- .6 Clamps should be located immediately below a coupling if possible. Risers up to 50 mm (2") size shall be braced at intervals not over 2100 mm (7').
- .7 On insulated piping supported by roller supports or trapeze supports (angle iron) provide at each hanger or support a protection saddle of 16 ga. galvanized sheet steel, rolled to match the outside diameter of the insulation. The saddle shall cover approximately the bottom one third of the circumference of the insulation. The length shall be at least as long as that recommended by the insulation manufacturer as published in their data.
- .8 On insulated pipe up to and including 50 mm (2") pipe, clevis hangers shall be sized to suit the O.D. of the pipe. On insulated pipe of 63 mm (2½") and above, the hangers shall be sized to suit the O.D. of the insulation and protection saddles, as described above shall be installed.

3.6 TESTING

- .1 All tests shall be carried out fully in accordance with the following time pressure requirements and also in accordance with any regulations and requirements of authorities having jurisdiction.
- .2 On completion of hydronic heating piping systems (systems carrying water at pressure) test to a pressure of 100 psi or a pressure equal to twice the pumped pressure developed (whichever is the higher) for a period of twelve (12) hours.
- .3 On completion of domestic water system test to a pressure of 100 psi plus the system height in water column pressure for a period of twelve (12) hours.
- .4 All tests shall be made with compressed air. If the contractor wished to use water for any system test, the Contract Administrator must be contacted for approval and requirements on methods and procedures.
- .5 All piping on the various services, which has to be concealed prior to the completion of the service as a whole, shall be tested in sections to the pressures and for the periods specified, prior to the piping being concealed. All tests shall be witnessed by the Contract Administrator's representative. Two (2) Working Days prior, notice shall be given to the Contract Administrator of when such tests shall take place. All test pressures specified shall be the pressure as registered at the highest point of the system. When sections of systems are being tested, the additional pressure developed by the static head of the remainder of the system, above the section being tested, shall be added to the specified test pressure.
- .6 Make good any leaks, replace defective parts, and retest until system is satisfactory and adjust until system functions correctly.
- .7 No insulation shall be applied until testing has been completed.

1.1 RELATED WORK

- .1 The General Conditions and General Specifications form an integral part of this specification and must be read in conjunction herewith. Read also and be fully cognizant of all Mechanical and Electrical Sections.

1.2 EQUIPMENT IDENTIFICATION

- .1 Manufacturer's Nameplate
 - .1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
 - .2 Provide Underwriters Laboratories and/or CSA registration plates, as required by respective agency.
 - .3 Manufacturer's nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
 - .4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.
- .2 System Nameplates
 - .1 Provide laminated plastic plates with black face and white centre of minimum size 90 x 40 x 2.5 mm nominal thickness, engraved with 12 mm high lettering.
 - .2 Fasten nameplates securely in conspicuous place. Where nameplates can not be mounted on cool surface, provide stand-offs.
 - .3 Identify equipment type and number (e.g. Pump No. 2) and service or areas or zone of building served (e.g. South Zone Chilled Water Primary). As per Section 15000 Mechanical Schedules (attached).
 - .4 Submit list of nameplates for review prior to engraving.

1.3 PIPING

- .1 Identify medium in piping with markers showing name and service including temperature, pressure and directional flow arrows in accordance with CGSB 24-GP03A.
- .2 Apply primary colours and secondary colour bands on finished piping surfaces, in exposed areas only to indicate type and degree of hazard.
- .3 Use existing coding system for building additions and alterations.
- .4 Manufactured Pipe Markers and Colour Bands:
 - .1 Plastic coated cloth material with protective over coating and waterproof contact adhesive undercoating, suitable for continuous operating temperature of 150°C and intermittent temperature of 200°C. Apply to prepared surfaces.
 - .2 50 mm wide tape single wrap around pipe or pipe covering with ends overlapping one pipe diameter but not less than 25 mm for colour bands.
 - .3 Block capital letters 50 mm high for pipes of 75 mm nominal and larger of including insulation and not less than 20 mm high for smaller diameters.
 - .4 Direction arrows 150 mm long by 50 mm wide for piping of 75 mm nominal or larger o.d. including insulation and 100 mm long by 20 mm wide for smaller diameters. Use double-headed arrows where direction of flow is reversible.
 - .5 Waterproof and heat resistant plastic marker tags for pipes and tubing 20 mm nominal and smaller.
 - .6 Black pipe marker letters and direction arrows, white on red background for fire protection pipe markers.
 - .7 Location
 - .1 Locate markers and classify colours on piping systems so they can be seen from floor or platform.
 - .2 Piping runs at least once in each room.

- .3 Maximum 15 m between identifications in open areas.
- .4 Both sides where piping passes through walls, partitions and floors.
- .5 At point of entry and leaving, where piping is concealed in pipe chase or other confined space, at each access opening.
- .6 At major manual and automatic valves immediately upstream of valves.
- .7 Identify branch, equipment or building served after valve.

1.4 VALVES AND CONTROLLERS

- .1 Provide brass tags with 12 mm stamped code lettering and numbers filled with black point, secure with non-ferrous chains or "S" hooks for valves and operating controllers.
- .2 Provide the Contract Administrator with identification flow diagrams for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.
- .3 Install in main mechanical room or where otherwise directed one copy of the flow diagram and one Valve Schedule mounted in a glazed frame. Provide one copy in each operating maintenance instruction manual.
- .4 Consecutively number valves in system.

1.1 RELATED WORK

- .1 The General Conditions and General Specifications form an integral part of this specification and must be read in conjunction herewith. Read also and be fully cognizant of all Mechanical and Electrical Sections.

1.2 QUALIFICATIONS

- .1 Insulation shall be applied by a well-established firm experienced in this Work.

1.3 APPLICATION STANDARDS

- .1 Materials shall be of same type of uniform quality throughout Work and installed in strict accordance with manufacturer's recommendations.

2.1 PIPING INSULATION

- .1 Domestic Hot and Cold Water, Hot Water Recirculation Lines
 - .1 Pipes 2" (50 mm) diameter and under shall be insulated with ½" (12 mm) Fibreglass 88 kg per cubic meter (7 lb per cubic foot) density pipe insulation with ASJ jacket (use ASJ vapour barrier for cold water piping).
- .2 Heating Water Lines
 - .1 Insulation - Insulate all heating water with Fibreglass 455°C (850°F) pipe insulation, 80 kg per cubic meter (5 lb. per cubic foot) density. Pipe insulation to be held in place with flare type staples.

Iron Pipe Size

13 mm to 50 mm (½" to 2")
 63 mm to 350 mm (2½" to 14")
 400 mm (16") and over

Insulation Thickness

38 mm (1½")
 50 mm (2")
 63 mm (2½")

Copper Tubing

10 mm to 50 mm (3/8" to 2")
 63 mm to 100 mm (2½" to 4")

Insulation Thickness

38 mm (1½")
 50 mm (2")

2.2 EQUIPMENT INSULATION

- .1 Insulation of Hot Equipment
 - .1 Insulate hot equipment listed below with Fibreglass Intermediate Service Board or equivalent, with joints staggered, tightly butted and secured with galvanized steel bands as recommended by manufacturer. Where required, insulation installer shall provide welded anchor studs.
 - .2 Over insulation tightly stretch in place a secure by wiring to anchors 25 mm (1") hexagonal wire mesh with edges tied together, and finish with 13 mm (½") coat of finishing cement.
 - .3 Finish with 602 canvas adhered with lagging adhesive and finished with one coat same lagging adhesive.

3.1 GENERAL INSTALLATION

- .1 All insulation on piping and equipment, etc., shall be applied over clean, dry and oil free surfaces.
- .2 Insulation shall not be applied until the specified tests have been carried out to the entire satisfaction of the Contract Administrator.
- .3 Run all pipe and duct insulation continuously through walls and floors.
- .4 Insulation shall be applied so that the finished application has the full specified thickness of insulation. Flexible duct insulation applied too tightly shall be removed and reapplied properly.

GENERAL**1.1 GENERAL REQUIREMENTS**

- .1 The General Conditions and General Specifications form an integral part of this specification and must be read in conjunction herewith. Read also and be fully cognizant of all Mechanical and Electrical Sections.

1.2 SCOPE OF WORK

- .1 This section shall provide all equipment and services necessary for, and reasonable incidental to the supply only of the equipment shown on the schedules and hereinafter specified. Where indicated in this section and on the schedules, the supply of major equipment will be by another contract. Generally the scope shall include the following:
 - .1 The disconnect and removal of two existing hot water boilers.
 - .2 The on-site relocation and installation of new electric hot water boilers, heat exchanger, expansion tank and pumps, supplied and delivered to site by others.
 - .3 The supply and installation of all other associated piping, valves, fittings, etc. to complete the installation.
 - .4 Extension of the existing pool heating loop to the new heating system.

1.3 GENERAL REQUIREMENTS AND PROCEDURE

- .1 Refer to Section 15010 and 15050 for general requirements and installation procedure.

MATERIALS**2.1 WATER PRESSURE REDUCING VALVES**

- .1 Supply and install on the cold water makeup to each hot water heating and chilled water system a Watts N256 19 mm (3/4") bronze body feed water pressure regulator, comprising of stop check valve strainer, reducing and regulating valve.
- .2 Fit an additional globe valve after the assembly complete with union. Install a union after the stop check and also fit a globe valve bypass with union around the assembly.
- .3 Included with the pressure reducing valve shall be a Watts Series 900 backflow preventer installed to the requirements of the local authorities.

2.2 PLATE & FRAME HEAT EXCHANGER – SUPPLIED BY OTHERS

- .1 Install a plate and frame, water to water, type heat exchanger of the sizes and capacities noted on the schedule. The heat exchanger shall consist of 0.0157 inch AISI 316 stainless steel heat transfer plates, steel end plates, and a zinc plated carrying bar, of single pass configuration. Unit shall be specifically designed for 150 PSIG working pressure at 210°F. Heat exchanger selection shall be optimized by the manufacturer to provide minimum heat transfer surface area requirements under specified capacity and pressure drops.
- .2 The plate heat exchanger shall be shipped to the Site as completely assembled units. The heat exchanger shall be pressure tested and flushed clean at the factory prior to shipment. All nozzle connections shall be factory sealed prior to shipment to prevent the entrance of foreign matter into the heat exchanger during shipment, storage, and installation.
- .3 Corrugated channel steel plates shall be of type 316 stainless steel. Channel plate ports shall be double gasketed to prevent cross contamination of hot and cold side fluids. Gaskets shall be of a one piece design formulated from Nitrile rubber. Plates shall be grooved to accept the gaskets and gasket clips to minimize movement.

- .4 Channel carrying bar shall be of AISI 316 stainless steel.
- .5 Fixed frame plates and movable pressure plates shall be constructed of type 316 stainless steel. Flow through the plates shall be of a counter flow design to maximize the heat transfer capability of the unit.
- .6 The hot side connections shall be shall be carbon steel NPT tapplings. The cold side connections shall be shall be AISI 316 stainless steel NPT tapplings.
- .7 Connection ports shall be integral to the frame or pressure plate.
- .8 Unit to be supplied with OSHA approved splash guard, enclosing exterior channel plate and gasketed surfaces. Heat exchanger shall be provided with the scheduled square footage of heat transfer area.
- .9 Unit shall be constructed in accordance with ASME Code Rules and shall have a manufacturer's data report for pressure vessels, form No. U-1. Form U-1 shall be furnished to the Contract Administrator upon request. An authorized inspector, holding a National Board commission, certifying that construction conforms to the latest ASME Code for pressure vessels must sign this form. The ASME "U" symbol should also be stamped on the Heat Exchanger(s). In addition, each unit must be registered with the National Board of Boiler and Pressure Vessel Inspectors.
- .10 **Standard of Acceptance:**
 - .1 Armstrong S-X13-500L-33

2.3 ELECTRIC HYDRONIC BOILERS – SUPPLIED BY OTHERS

- .1 Install two Cleaver-Brooks Model No. CWB-122 Electric Hot Water boilers.
- .2 The capacity of each boiler shall be rated at 737 MBTU/hr, 216 kW @ 600 / 3 / 60.
- .3 The pressure vessels shall be manufactured to ASME Section IV Code and designed for 150 psig.
- .4 The boiler construction shall be as per NEC & ULC & the package shall be approved and labelled for operation in the Province of Manitoba.
- .5 The casing shall be 16 gauge steel, filled with 4" fibreglass insulation.
- .6 The electrical control panel shall be provided with a key-locked door and mounted integral with the boiler on a common steel based.
- .7 Heating elements shall be 6 kW each, 75 WSI copper sheathed, individually mounted, for ease of replacement.
- .8 The boiler shall be provided with components as follows:
 - .1 ASME safety relief valve.
 - .2 Pressure gauge with cock.
 - .3 Digital temperature readout.
 - .4 120V fused control transformer.
 - .5 On-off switch with pilot light.
 - .6 Magnetic contactors rated for 500,000 cycles.
 - .7 Status pilot light for each step.
 - .8 KW demand interface terminal strip, 1 pt. per step.
 - .9 Manual KW limit switches for each step.
 - .10 Float-type low water cut-off w/ three-way water column test valves.
 - .11 Adjustable high limit cut-outs, manual reset.
 - .12 Automatic temperature control.
 - .13 Proportional sequencing step control for 6 at 36 kW each.
 - .14 Alarm buzzer with silencing switch and pilot light to signal low water and high temperature, with common alarm dry contact.
- .9 Upon notification of completion of the installation the boiler manufacturer shall provide the services of a field technician for a period of one (1) day per boiler to commission and test the operation of the boiler and train the operating personnel (cost to be carried by others).
 - .1 **Standard of Acceptance:**
 - .1 Cleaver-Brooks CWB-122

2.4 DIAPHRAGM TYPE EXPANSION TANK – SUPPLIED BY OTHERS

- .1 Generally as shown on the drawings and schedules, install in the heating systems pressurized diaphragm type expansion tanks. Tanks shall be air precharged to the initial fill pressure of the system. Tanks shall be suitable for maximum working pressure of 862 kPa (125 psi) and shall be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code with stamp and certification papers. Tanks shall have an integral heavy duty Butyl rubber diaphragm suitable for an operating temperature of (240°F) 118°C. Tank shall be furnished with base mount.

.1 **Standard of Acceptance:**

- .1 Armstrong AX-15.

2.5 CIRCULATING PUMPS – SUPPLIED BY OTHERS

- .1 Install circulating pumps where shown on the drawings, of the size and type and capacity as indicated in the Pump Schedule.
- .2 The pumps shall be of bronze fitted construction, vertical-in-line pump, close-coupled, capable of servicing without disturbing piping connections.
- .3 The motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the schedule. It shall have heavy-duty, grease lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.
- .4 The complete pumping unit shall be suitable for the service shown in the Pump Schedule and the pump manufacturer shall conduct running tests to verify the conditions of head capacity specified.
- .5 Renewable bronze wearing rings shall be provided on both the impeller and the wheel to prevent wear.
- .6 The pump manufacturer shall include checking and aligning all pumps prior to start up.
- .7 All piping adjacent to each pump shall be adequately supported from the structure so that no weight is carried on the pump casings. In addition, long sweep elbows shall be used on each pump section and discharge.
- .8 See clause "Sound Control" for vibration isolators.
- .9 Pumps shall be sized on the capacities, heads, motor sizes and RPM specified. However, the impeller size selected shall not be greater than 85% of the maximum size impeller.
- .10 Pumps shall be complete with triple-duty valve, with cast iron body, outlet grid vanes, removable stainless steel strainer and discharge combination shut-off, balancing and check valve with positive spring evaded seating flange cast iron body, bronze disc and seat and stainless steel stem and spring. Guide to be matched to pump flange and complete with support leg to carry pump. Supports shall be resiliently mounted on 3/8" U pad, neoprene washers to be used on lagdown bolt to eliminate short circuitry.
- .11 **Standard of Acceptance:**
- .1 Armstrong Series 4360

2.6 CHEMICAL TREATMENT

- .1 The Contractor shall supply, install and apply on the hydronic system the following:
- .1 One Neptune DBF-2, 2-gallon bypass feeder
- .2 One Filterite LMO – 10-3/4" Housing only
- .3 One Filter-Mate 3/4" Flow Indicator
- .4 One Carton 30-30 filter cartridges
- .5 20-kg GE Betz Ferroquest FQ7103 Pre-Operational Cleaner (applied at a concentration of 1-2%).
- .6 21-kg GE Betz Corrshield MD4102 Closed-System Inhibitor (control range is 60-80 ppm).

- .7 One Molybdenum Test Kit

EXECUTION PROCEDURES

3.1 SAFETY AND RELIEF VALVES

- .1 Supply on heating converters, relief valves, which shall be lever operated, National Board certified, rate at 25% accumulation.
- .2 Safety and relief valves shall be sized and installed in accordance with Provincial department requirements or any other authority having jurisdiction.
- .3 All high pressure safety and relief valve discharges and steam vents shall be piped to the outside of the building.

3.2 HEATING CONVERTORS

- .1 Converters that do not have side outlet connections shall be provided with bends fitted at the inlet and outlet with nipples and flanges set horizontally, with sufficient clearance between flanges to remove the tube bundle with ease and without dismantling any piping. The distance between companion flanges and converter tube plate flanges shall be a minimum of 100 mm (4") and a maximum of 300 mm (12").

3.3 PUMP CONNECTIONS

- .1 All piping adjacent to each pump shall be adequately supported from the structure so that no weight is carried on the pump casings. In addition long sweep elbows shall be used on each pump suction and discharge.

3.4 CLEANING AND DE-GREASING

- .1 Hydronic System
 - .1 Clean and de-grease the closed circulating system.
 - .2 The Contractor shall arrange with the water treatment supplier to be on the Site to provide the cleaning and de-greasing supervision.
 - .3 The Contractor shall operate the system throughout this procedure. The water treatment consultant shall supervise only, and then submit to the Contract Administrator a written signed report on the procedures followed.
 - .4 Each closed circulating system shall be cleaned and de-greased with Dearborn #11 new system cleaner and #690 dispersing according to instructions provided by the water treatment supplier.
 - .5 The Dearborn #11 cleaner and #690 dispersing shall be introduced and circulated from 12 to 24 hours and removed from the system by the Contractor by dumping the system.
 - .6 The system shall then be flushed until the conductivity of the water in the system is back to the conductivity of the make-up water.
 - .7 The water treatment supplier shall conduct a conductivity test before, during, and after cleaning, and report the procedures followed and conductivity readings to the Contract Administrator and the Contractor in writing.
 - .8 The Contractor shall not use the system for heating purposes or cooling purpose until this cleaning procedure has been carried out and supervised by the water treatment supplier.
 - .9 The Contractor shall remove "Y" strainers and clean them during the flushing procedures.
- .2 Temporary Heat
 - .1 Systems shall not be used for temporary heat unless they have first been cleaned and de-greased under the supervision of the water treatment

- consultant and a report submitted on the procedures followed, unless special permission is given by the Contract Administrator to do so.
- .2 If weather conditions do not permit the draining and flushing of the system because temporary heat is not available, the Contractor shall provide enough additional corrosion inhibitor to protect the system until weather conditions are such that the system can be flushed, drained, refilled and treated with the required amount of corrosion inhibitor.
 - .3 Treatment Closed Circulating Systems (Hot Water)
 - .1 The Contractor shall provide Dearborn 537 corrosion inhibitor to be introduced through a by-pass pot feeder installed across the circulating pumps under the supervision of the water treatment supplier.
 - .4 A test unit for testing the corrosion inhibitor concentrations shall be provided by the water treatment supplier who will train the operator in the use and maintenance of the corrosion inhibitor.
 - .5 Hydronic System Procedure
 - .1 Prior to final inspection, adjust all water systems to provide the design flows required in accordance with flow diagrams.
 - .2 Where calibrated venturi tubes, orifices, or other metered fittings and pressure gauges are installed in piping system, use with flow meter to determine system flow rates.

3.5 HYDRONIC SYSTEM PROCEDURE

- .1 Prior to final inspection, adjust all water systems to provide the design flows required in accordance with flow diagrams.
- .2 Where calibrated venturi tubes, orifices, or other metered fittings and pressure gauges are installed in piping system, use with flow meter to determine system flow rates.