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 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 and Pressure Gauges

MATERIALS

2.1 SCHEDULE OF PIPE AND FITTINGS

.1 Interior Drain and Vent Piping above Ground:
  .1 In lieu of cast iron and copper, piping may be PVC drain, waste and vent pipe and fittings and shall be certified to CSA B181.2. When combustible pipe and fittings are used in buildings required to be of non-combustible construction they shall be listed by ULC to the Standard CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating not exceeding 15. Certified firestopping devices are required whenever the system penetrates a vertical or horizontal separation, and shall be certified to CAN4-S115 and tested with a pressure differential of 50 Pa.
    .1 Standard of Acceptance:
      .1 IPEX System 15.
  .2 Where PVC pipe is used in non-combustible construction, high-rise buildings and air plenums, piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating of 0 and a smoke developed classification not exceeding 35. Certified firestopping devices are required whenever the system penetrates a vertical or horizontal separation, and shall be certified to CAN4-S115 and tested with a pressure differential of 50 Pa.
    .1 Standard of Acceptance:
      .1 IPEX System XFR.
.2 Interior Drain and Vent Piping Below Ground (Cast-Iron):
  .1 Cast-iron mechanical joint or pipe and fittings to CSA B70.
    .1 Standard of Acceptance:
      .1 Bibby-St. Croix Class 4000.
.3 Pool Water Distribution Piping
  .1 Pool water piping up to 50mm (2”) Sch 40 pipe Type 1 Grade 1 PVC conforming to A.S.T.M. D1785 and C.S.A. B137.0/B137.3, rated to 60ºC (140ºF) at working pressure.
  .2 Pool water piping larger than 50mm (2”) Sch 80 pipe Type 1 Grade 1 PVC conforming to A.S.T.M. D1785 and C.S.A. B137.0/B137.3, rated to 60ºC (140ºF) at working pressure.
  .3 Fittings shall be PVC of similar materials, schedule and be compatible approved by pipe manufacturer. Fittings shall conform to ASTM D2467.
  .4 Flanges shall be Sch 80 PCV Vanstone style 150 lb bolt pattern.
  .5 Fabricated fittings shall have the same pressure rating as that of the C.S.A. certified pipe used in the fabrication and be fibreglass reinforced.

.6 Use only cement and primer approved for installation as a system as per manufacturer.

.7 All metal to PVC thread transitions shall be made using stainless steel reinforced female adaptors.

.8 **Standard of Acceptance:**

.1 IPEX Xirtec 140

.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 Plumbing

.1 Cast iron screwed fittings shall be 125 pound standard.

.2 For silver brazing, on sizes up to 100 mm (4"), use wrought copper solder joint fittings; over 100 mm (4") use cast fittings.

.3 All underground water piping shall have couplings and bolts with high resistance to corrosive and alkaline conditions. Fittings and specials shall be class 250 or better to C.S.A. Specification B.121.9.

.2 Pool Water Distribution 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.

.4 PCV piping shall conform to A.S.T.M D1785.

.3 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.

.6 All fittings for copper piping shall be wrought copper up to 100 mm (4") and cast fittings on larger sizes.

.7 All fittings for PVC piping shall conform to A.S.T.M D2467.

.4 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 PVC flanges shall be Van Stone style 150 lb.

.7 All flange gaskets shall be pre-formed non-asbestos type.

.8 Site and shop cut gaskets will not be permitted.

2.3 VALVES

.1 The Mechanical Division 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 Mechanical Division 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 Where possible, valves shall be installed with the valve bonnet in an upright position to prevent deterioration or corrosion of the bonnet and packing..

.4 Valve body materials shall be compatible with piping system materials. Valves shall meet all pressure, temperature, and fluid handling requirements of the system.

.5 A valve drain shall be provided at the base of each riser and at the low points of the system. Manual air vents shall be provided at the top of each riser and at the high points of the system.

.6 Ball valves and butterfly valves shall be used in place of gate valves providing they meet the pressure, temperature, and fluid handling requirements of the system.

.7 Isolation shutoff valves shall be installed at each piece of equipment and each branch takeoff to facilitate shutdown for repair.

.8 Drain valves up to and including 19 mm (3/4") shall be compression stops or hose bibbs, rough brass, with garden hose thread outlet.

.9 Drain valves 25 mm (1") and larger shall be gate valves as specified below with discharge piped to a suitable drain.

.10 Valve Schedule

.1 Pool Water Distribution Valves:

.1 Up to 50mm (2”): Ball valves body, stem, ball and unions shall be made of PCV compound which meets or exceeds the requirements of cell classification 12454 according to A.S.T.M. D1784. Seats shall be PTFE which shall comply with NSF-61. Working pressure of 1.6 MPa (232 psi) at 23ºC (73ºF). Valve to be equal to IPEX VXE ball valve.

.2 63mm to 100mm (2½” to 4”): Ball valves body, stem, ball and unions shall be made of PCV compound which meets or exceeds the requirements of cell classification 12454 according to A.S.T.M. D1784. Seats shall be PTFE which shall comply with NSF-61. Working pressure of 1.6 MPa (232 psi) at 23ºC (73ºF). Shall be provided with locking lever handle. Valve to be equal to IPEX VKD ball valve

.3 100mm to 350mm (4” to 14”): Flanged PVC butterfly valves wafer style with gear operators. Valve body shall be glass reinforced polypropylene (GRPP). Valve disk shall be made of polypropylene. Disk liner and O-ring seals shall be EPDM. Valve shaft to be Stainless Steel. Valve to be equal to IPEX FK Series.

.4 Isolation/Shut-off valves 63mm (2½”) and over: Shall be as per the above Flanged PVC valve with a locking lever handle in-place of a mounted gear.

.5 Check valves 75mm to 200mm (3” to 8”): Valve body, bonnet, swing arm, and disc shall be made of PVC meeting or exceeding cell classification 12454 according to A.S.T.M. D1784 and shall meet the standard NSF-61. O-ring seals and shutter shall be made of EPDM. Bolts nuts and washers shall be made of 304 stainless steel. Valve must be rated to 0.5 MPa (70 psi) at 23ºC (73ºF). Valves to be equal to IPEX SC.

2.4 HANGERS AND SUPPORTS

.1 Provide adjustable Clevis type equal to Grinnell Fig. 65 for pipe sizes up to and including 50mm (2"). For pipe sizes 62mm (2½") and over, provide adjustable Clevis type equal to Grinnell Fig. 260 size to suit O.D. of insulation.

.2 Provide Grinnell FM approved Fig. 104 split-swivel or Fig. 69 swivel-type hangers on fire protection piping. Pipe suspension systems for fire suppression systems shall be designed and installed in conformance with applicable sections of NFPA.

.3 Plastic and Other Types of Piping: Support devices as recommended by Manufacturer. Spacing 1200 mm (4')

.4 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.

.5 The load on any hanger rod shall not exceed the capacity indicated in the following table:

2.1	**Rod Diameter**	**Max. Safe Load**
2.2	10 mm (3/8")	610 lbs.
2.3	13 mm (1/2")	1130 lbs.
2.4	16 mm (5/8")	1810 lbs.
2.5	19 mm (3/4")	2710 lbs.

.6 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.

.7 Provide fabricated steel supports as required to adequately support piping and equipment. Details to be approved by Contract Administrator.

.8 Above indicates general requirements. Provide hangers and supports of equal quality to suit job requirements where not covered by the above.

.9 Support groups of horizontal pipes by angle iron trapeze hangers.

.10 Rollers and chairs shall not be installed on trapeze hangers.

.11 Several individual hanger rods may be supported from a trapeze or individual inserts in concrete slab.

.12 Hangers to be adjustable after pipe is in place. Parts must be of adequate strength for weight to be supported with safety factor of 5 to 1.

2.5 FLEXIBLE PIPE CONNECTORS

.1 Supply and install at the discharge of each pump, flexible pipe connectors as manufactured by HYDRO FLEX INC.

.1 Up to 50 mm (2") - Connectors constructed of Phosphor corrugated bronze hose and bronze single braid with brass male ends.

.2 63 mm (2½") and over - Stainless steel connectors constructed of 300 series stainless corrugated hose and braid.

2.6 STRAINERS

.1 Strainer shall be Y-strainer type. Strainer body, end connectors, and unions shall be made of PVC compound which shall meet or exceed the requirements of cell classification 12454 according to A.S.T.M D1784 and shall comply with standards that are equivalent to NSF-61. O-ring seals shall be made of EPDM. The mesh screen shall be made of 304 stainless steel. Strainer shall have union ends. Strainer equal to IPEX RV.

.2 Alternate strainers permitted where wetted components are stainless steel or epoxy coated to withstand the nature of a pool water system.

2.7 THERMOMETERS

.1 Thermometers to be bi-metal dial thermometers, having stainless steel cases and rings with stainless steel stems, brass separable thermowells. Scale range to be as follows:

.1 10°C (50°F) to 150°C (300°F).

.2 Thermometers to be liquid filled 125 mm (5") diameter dials. Use back or bottom inlet stems, whichever is best suited for ease of reading.

.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 Trerice

2.8 PRESSURE GAUGES

.1 Pressure gauges on suctions and discharges of pumps and where noted shall be 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.

.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.

.5 Casing to be stainless steel.

.6 Dual scale ranges: 0-30psi/kPa, 0-60 psi/kPa, 0-100 psi/kPa

.7 **Standard of Acceptance:**

.1 Winter's

.2 Trerice

2.9 SUPPORTS, BASES, PADS, AND PITS

.1 Provide all special structural work required for installation of tanks, piping, pumps, fans, motors and other apparatus.

.2 Concrete pads, concrete for floating bases, curbs and pits to be supplied under Division 15.

.3 Supply all anchor bolts, fasteners and foundation drawings.

.4 Unless noted otherwise, provide housekeeping pads (equipment bases) at least 100mm (4") high under all floor-mounted equipment and as shown on the drawings. Provide minimum 150mm (6") high bases under equipment with cooling coils to provide sufficient clearance for deep seal condensate traps. Exact height to be determined by required condensate trap depth. Each pad shall extend 150mm (6") beyond the outside dimensions of the supported equipment. Housekeeping pad shall be reinforced with 10M @ 16" on-centre each-way top. Provide 10M hooked dowels at 16" on-centre around perimeter drilled in and epoxy-grouted min. 4" into existing floor. Concrete shall be Class N, 25 MPa, 20mm aggregate.

.5 Where not detailed elsewhere, mount equipment suspended above floor level on platform bracketed from wall. Where wall thickness is inadequate to permit such brackets, carry supports to either ceiling or floor, or both as required.

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.

.3 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.

.4 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.

.5 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.

.6 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.

.7 All flanged joints shall have gaskets of pre-formed non-asbestos. 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 thread lubricant prior to installation.

.8 Reducing tees, etc., which have any joint to be soldered with 95-5 solder.

.9 At flanged valves, etc., install silver braze joint copper companion flanges with suitable gasket, bolts.

.10 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.

.11 All PVC and CPVC pipe socket connections are to be with approved/manufacturer recommended cement and primer.

.12 Install check valves on the discharge piping from all pumps and shut-off valves on the suction and discharge piping at each pump.

.13 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.

.14 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.

.15 All accessible steel piping up to and including 50 mm (2") in size shall be screwed jointed with screwed fittings.

.16 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 Contract Administrator.

.17 Install shut off valves directly upstream of unions or flanges at each item of equipment.

.18 Install strainers upstream of all flow control equipment.

.19 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 di-electric insulating couplings or isolating flanges between all pipes or apparatus constructed of dissimilar metals.

.4 Grade all water piping up in the direction of flow so that air may be properly eliminated through connecting risers to fixtures.

.5 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.

.6 Install check valves in water piping wherever shown on drawings and wherever backflow might occur.

3.3 POOL WATER DISTRIBUTION SERVICES

.1 All PVC and CPVC piping to be assembled as per manufacturer's recommendation.

.2 Supply and install balancing valves on all return branches, all reheat coil and radiation return connections to return mains and where indicated on the drawings.

.3 All reductions in pipe size shall be made by using eccentric reducers or eccentric reducing couplings.

.4 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.

.5 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.

.6 All steel piping 63 mm (2½") and above in size, shall be jointed together by welding and all branch connections shall be welded using manufactured type butt welding fittings. All elbows shall be long radius type. All branch connections of 31 mm (1¼") size and above on mains of 63 mm (2½") size and above, shall be formed by using manufactured carbon steel Weld-O-Let welding fittings, which shall be full main size. Reductions in the main or branch, shall be made after the fittings, by using butt welding reducing fittings. The use of site or shop fabricated welded fittings shall not be permitted.

.7 All butt welding joints in 63 mm (2½") piping and above shall be made using Robvon backing rings, which shall be installed fully in accordance with the manufacturer's recommendations. All hubs shall be removed on completion of the joints.

.8 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.

.9 Install di-electric insulating couplings or isolating flanges between all pipes or apparatus constructed of dissimilar metals.

.10 All piping which will be concealed and as a result inaccessible shall have welded joints. Particular care must be exercised to ensure that all valves are easily accessible through access doors.

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 Cast iron hub and spigot shall be supported at every hub. Cast iron mechanical joint soil pipe shall be supported at both sides of each clamp and at intervals not exceeding 900 mm (36") if the length of pipe between adjacent fittings is 300 mm (12").

.3 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 Cast iron soil pipe: Max. span 3000 mm (10').

.4 Hangers in new concrete structural floor systems shall be supported by inserts placed prior to pouring of concrete. Inserts shall be Grinnell cast iron or wrought steel adjustable type.

.5 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.

.6 Groups of horizontal pipes may be supported by trapeze hangers constructed of angle iron with steel rods. They shall conform to the above concerning isolation of copper piping, pipe covering protection saddles and roller supports. Pipe covering protection saddles will be required on all insulated pipe at trapeze supports.

.7 Where desired, several individual hanger rods may be supported from a trapeze.

.8 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.

.9 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 Contract Administrator for approval before fabrication.

.10 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').

.11 Vertical piping other than risers through floors shall be provided with suitable supports, sway braces, etc.

.12 Vertical piping shall be supported at the base in an approved manner.

3.6 EXPANSION AND CONTRACTION OF PIPING

.1 Make proper provision for expansion and contraction of all piping due to temperature changes. Use swing connections where shown or necessary.

.2 All plastic drain pipes dropping into a slab on grade shall have an expansion joint arranged to take up movement of the concrete slab.

.3 Domestic hot water supply, recirculation, steam, hot water and chilled water piping shall be installed with expansion loops where shown and shall be anchored to the building structure by approved rigid anchors to the points indicated, in order to control expansion.

.4 If not otherwise indicated on the drawings 1200 mm x 1200 mm (4' x 4') expansion loops shall be installed on all copper hot water heating piping having a straight run in excess of 12 m (40'). The expansion loop shall be centred in the straight run, with alignment guides on each side of the loop and anchors at the extreme ends of the pipe run. Similar loops shall be installed on straight runs of steel steam, condensate and hot water piping which exceeds 18 m (60') in length.

.5 Alignment Guides

.1 Supply and install Flexonics pipe alignment guides, on each side of expansion loops, joints and compensators, in accordance with the manufacturer's recommendations.

.2 Support guides adequately on structural brackets braced to building support.

.6 Anchors

.1 Supply and install pipe anchors where shown on the drawings, and in accordance with expansion joint manufacturer's recommendations.

.2 The anchors shall be substantial and fabricated from channels and angles to suit the location and they shall be suitably braced to the building's structure.

.3 Anchors and guides in contact with copper pipe must be copper or copper plated.

3.7 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/cooling 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 wishes to use water for any system test, the Engineer 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.