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1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 SCOPE OF WORK

- .1 Work to include all labour, material and equipment required for installing, testing and placing in initial operation the following systems as detailed in specifications of each section and as shown on drawings.
 - .1 Section 15051 Acceptable Materials & Equipment
 - .2 Section 15180 Insulation
 - .3 Section 15400 Plumbing
 - .4 Section 15500 Fire Protection
 - .5 Section 15600 Liquid Heat Transfer
 - .6 Section 15800 Air Distribution
 - .7 Section 15900 Controls/Instrumentation
 - .8 Section 15990 Testing, Adjusting and Balancing

1.3 EXISTING CONDITIONS

- .1 Examine Site, existing adjacent buildings and local conditions affecting Work under this Contract. Examine Structural, Architectural, Mechanical and Electrical and all other Contract drawings to ensure Work can be performed without changes to the building as shown on plans. No allowance will be made later for necessary changes, unless notified in accordance with B4.

1.4 REGULATIONS

- .1 Comply with, most stringent requirements of Manitoba Building Code, National Building Code and local regulations and by-laws, with specified standards and codes and this specification. Before any Work is proceeded with, approved layouts to be filed with and approved by proper authorities.
 - .2 Provide necessary notices, obtain permits and pay all fees, in order that Work specified may be carried out. Charges and alterations required by authorized inspector of any authority having jurisdiction, to be carried out without charge or expense to the City of Winnipeg. Pay all charges for service connections to municipal mains.
 - .3 Furnish certificates confirming Work installed conforms to requirements of authorities having jurisdiction.
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1.5 LIABILITY

- .1 Install Work in advance of concrete pouring or similar Work. Provide and set pipe sleeves as required.
- .2 Install concealed pipes and ducts neatly, close to building structure so furring is minimum size. Pipes, ducts and equipment installed improperly, to be removed and replaced without cost to the City of Winnipeg.
- .3 Protect and maintain Work until building has been completed and accepted. Protect Work against damage during installation. Cover with tarpaulins if necessary. Repair all damage to floor and wall surfaces resulting from carrying out of Work, without expense to the City of Winnipeg.
- .4 During welding or soldering ensure structure is protected against fire, shield with fire-rated sheets and galvanized iron sheets. Mount portable fire extinguishers in welding or soldering areas.
- .5 Co-ordinate Work with other sections to avoid conflict and to ensure proper installation of all equipment. Review all Contract drawings.
- .6 On completion of Work, remove tools, surplus and waste material and leave Work in clean, perfect condition.

1.6 GUARANTEE

- .1 Guarantee satisfactory operation of all Work and apparatus installed under this Contract. Replace, at no expense to the City of Winnipeg, all items which fail or prove defective within a period of one year after final acceptance of complete Contract by the City of Winnipeg, always provided such failure is not due to improper usage by the City of Winnipeg. Make good all damage to building incurred as a result of failure or repair of mechanical Work.
 - .2 No certification given, payment made, partial or entire use of equipment by the City of Winnipeg, shall be construed as acceptance of defective Work or acceptance of improper materials. Make good at once, without cost to the City of Winnipeg all such defective Work or materials and consequence resulting therefrom, within one year of final acceptance date.
 - .3 This general guarantee shall not act as a waiver for any specified guarantee and/or warranty of greater length of time noted elsewhere in these documents.
 - .4 Domestic hot water tanks shall have manufacturer's warrantee for period of (5) five years.
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- .5 Plumbing brass shall have manufacturer's warrantee for period of five (5) years.
- .6 Refrigeration compressor circuit connected to air-conditioning systems shall have manufacturer's warrantee period of four (4) years after initial one year guarantee.

1.7 ENGINEERING OBSERVATIONS

- .1 Contractor's Work will be observed periodically by the City of Winnipeg, and/or Contract Administrator or their representatives, solely for purpose of determining general quality of Work, and not for any other purpose. Guidance will be offered to Contractor in interpretation of plans and specifications to assist him to carry out Work. Observations and directives given to Contractor does not relieve Contractor and his agents, servants and employees of their responsibility to erect and install Work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose upon the City of Winnipeg, and/or Contract Administrator or their representatives, any responsibility to supervise or oversee erection or installation of any Work.

1.8 WELDING REGULATIONS

- .1 Do not weld when temp. of base metal is lower than -17 deg. C except with consent of Contract Administrator. At temp. below 0 deg. C, surface of all areas within 75mm (3") of point where weld is to be started to be heated to temp. at least warm to hand before welding is commenced. At all temperatures below +4 deg. C, operator and Work to be protected against direct effect of wind and snow.
- .2 Welding shall be performed by welder holding current welder's certificate from Provincial Department of Labour.
- .3 Comply with CSA W117.2 "Safety in Welding, Cutting, and Allied Processes".

1.9 MECHANICAL SHOP DRAWINGS

- .1 Submit for review a minimum of six sets of detailed shop drawings. Refer to Section 15051 "Acceptable Materials & Equipment" for shop drawings requirements.
 - .2 Check shop drawings for conformity to plans and specifications before submission.
 - .3 Each drawing to bear a signed stamp including project name and Contractor's Firm name verifying drawings have been checked prior to submission to Contract Administrator. Signature of stamp shall
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signify the Contractor has checked and found all dimensions to be compatible with the Contract drawings and all capacities, quantities, sizes and other data contained in the Contract documents have been listed by the supplier on the drawings and have been checked by the undersigned and found correct.

- .4 Clearly show division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Other's or By Purchaser". Any item, equipment or description of Work shown on shop drawings shall form part of Contract, unless specifically noted to contrary.
- .5 Take full responsibility for securing and verifying field dimensions. In case where fabrication must proceed prior to field dimensions being available, check all shop drawings and approve for dimensions only. In this case guarantee that dimensions will be worked to and ensure that other Subcontractors are aware of these dimensions and shall comply to them.
- .6 Review by Contract Administrator shall be mutually understood to refer to general design only. If errors in detailed dimensions or interference with Work are noticed, attention of Contractor will be called to such errors of interferences, but Contract Administrator's review of drawings will not in any way relieve Contractor from responsibility for said errors or interferences, or from necessity of furnishing such Work, and materials as may be required for completion of Work as called for in Contract documents.

1.10 MECHANICAL SUBCONTRACTORS

- .1 In accordance with D11, state names of all Subcontractors to be used in sublet Work. Also, state extent of any Work so sublet. Request and receive Contract Administrator's approval in writing, of all Subcontractors for such Work before placing Subcontractors Contract.
- .2 Contractor to have minimum five years experience in field of mechanical contracting and to have successfully performed Work of similar nature and approximate size to that indicated in specifications and on drawings. Subcontractor shall employ, on this project, foremen or supervisory personnel who have had similar experience to that required of Contractor.

1.11 DRAWINGS

- .1 Drawings are diagrammatic only and do not show all details. Information involving accurate measurements of building to be taken from Architectural Drawings and/or at building. Make, without additional expense to the City of Winnipeg, all necessary changes or additions to runs to accomodate structural conditions. Locations of pipes, ducts and other equipment to be altered
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without charge to the City of Winnipeg, provided change is made before installation and does not necessitate additional materials and that all such changes are ratified by Contract Administrator, recorded on Record Set of Drawings.

- .2 Drawings and specifications to be considered as an integral part of Contract Documents. Neither drawings nor specifications to be used alone. Misinterpretation of requirements of plans or specifications shall not relieve Contractor of responsibility of properly completing Work to approval of Contract Administrator.
- .3 As Work progresses and before installing piping, ductwork, fixtures and equipment interfering with interior treatment and use of building, consult Contract Administrator for comments. This applies to all levels and proper grading of piping. If Contractor fails to perform above checking and fails to inform Contract Administrator of such interference, Contractor to bear all subsequent expense to make good the installation.
- .4 Drawings indicate general location and route to be followed by pipes and ducts. Where required pipes and/or ducts are not shown on plans or only shown diagrammatically, install in such a way as to conserve head room and interfere as little as possible with free use or space through which they pass.
- .5 Refer to Architectural Drawings for roof construction details. These shall relate to roof supports, piping penetrating roofs, etc. as indicated on mechanical detail sheets.

1.12 MATERIALS

- .1 Materials and equipment specified and acceptable manufacturers are named in this specification for the purpose of establishing the standard of materials and workmanship to which Contractor shall adhere. Bid Submission shall be based on the use of materials and equipment as specified.
 - .2
 - .1 Materials of same general type to be of same manufacture (e.g. all air supply units shall be of same manufacturer). Contractor to ensure that all Subcontractors provide products of same manufacturer.
 - .1 Follow manufacturer's recommendations for safety, adequate access for inspection, maintenance and repairs of individual equipment installed.
 - .2 Permit equipment maintenance and disassembly with minimum disturbance to connecting piping and duct systems and without interference with building structure or other equipment.
 - .3 Provide accessible lubricating means for bearings, including permanent lubricated 'Lifetime' bearings.
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- .3 In accordance with B6, any substitutes or alternates the Contractor considers equal to that specified must not exceed available space limitations. All additional costs for mechanical, electrical, structural and/or architectural revisions required to incorporate materials substituted by Contractor shall be responsibility of Contractor.
- .4 Equipment listed as 'equal' in specifications or submitted in accordance with B6 shall meet all space requirements, specified capacities and must have equipment characteristics of specified equipment as interpreted by Contract Administrator. Install equipment in strict accordance with manufacturer's published recommendations.
- .5 Equipment and materials shown on drawings and not specified herein, or specified herein and not shown on drawings, shall be included in this Contract as though both shown and specified.

1.13 REMOVAL AND DISCONNECTION OF THE CITY OF WINNIPEG'S EXISTING EQUIPMENT

- .1 Mechanical drawings indicate most mechanical equipment to be removed and/or disconnected. Mechanical equipment to be removed due to removal of walls of existing building, to be removed and pipes capped off by Contractor at no additional cost to the City of Winnipeg.

1.14 ELECTRIC MOTORS, STARTERS AND WIRING

- .1 Provide electric motors for all equipment supplied in this Division. Motors to operate at 29 r/S (1800 rpm), unless noted otherwise. Motor design shall comply with Canadian Electrical Code requirements. All electric motors supplied shall be capable of being serviced locally.
 - .2 All three phase motors shall have a service factor of 1.15 times nominal rated horsepower of the motor.
 - .3 Operating voltages: to CAN3-C235-83, motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
 - .4 Motors controlled by variable frequency drives (VFDs) shall comply with requirements of CSA Specification C22.2 No. 100-95, Clause 12.4 and shall be permanently marked with the following in addition to the normal marking requirements:
 - .1 Machine Application (Inverter Duty);
 - .2 Speed range over which the machine is designed to operate;
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.3 Type of torque application for which the machine is designed (e.g. VT (variable torque), CT (constant torque), Chp (constant horsepower) or equivalent;

.4 Type(s) of inverter(s) with which the machine is intended to be used e.g.: VSI or VVI (6-step voltage source), CSI (6-step current source), VPWM (voltage-source pulse width modulated), LCI (load commutated), cyclonverter, or equivalent.

- .5 Motors 0.75 kW (1 hp) and larger shall be high efficiency motors as defined in CSA C390 or IEEE 112B Nominal Standards. Minimum efficiency (%) shall be per the following table.

kW	Minimum efficiency (%)			
	3600 RPM	1800 RPM	1200 RPM	900 RPM
.75	79.0	82.4	81.1	74.4
1.11	81.0	82.8	83.8	76.8
1.50	81.7	83.8	84.4	83.8
2.24	84.6	86.1	86.4	83.6
3.73	86.4	86.9	87.2	85.4
5.60	87.4	88.4	88.2	86.2
7.46	88.4	89.4	88.6	88.6
11.19	89.3	90.1	89.0	88.0
14.92	89.7	90.9	89.8	89.8
18.65	90.0	91.1	90.9	89.6
22.38	90.6	91.5	91.1	90.3
29.84	91.0	92.0	91.6	90.1

List information on shop drawing submittals

- .6 Determine from electrical drawings and specifications, voltage characteristics applying to each individual motor. Where motor voltages are mentioned in this specification, confirmation to be made by reference to electrical drawings and specifications ordering motors.
- .7 Division 16 - Electrical to provide starters for all motors, except as otherwise noted. Division 16 - Electrical shall wire from starters to motors.
- .8 Wiring required between starters and switching apparatus such as wiring from starters to float switches, pressure switches and all control wiring to be by Division 16 - Electrical except as noted otherwise on drawings and in specifications. Provide proper terminal connections and lead wires at motors and other apparatus ready for connection by Division 16 - Electrical. Provide Division 16 - Electrical with accurate locations of electrical connection points and all necessary schematic and other drawings to facilitate electric Work.
- .9 Wiring required under Section 15900 to be performed by Section 15900 except as noted otherwise. Refer also to Section 15900 for further requirements.

- .10
 - .1 Division 16 - Electrical to perform all wiring and make final connections to all controls for roof-top HVAC units and all mechanical equipment where controls are supplied with equipment.
 - .2 Division 15 shall provide wiring diagrams indicating all power and control wiring requirements.
- .11 Division 16 - Electrical to perform all wiring and make final connections to all controls for air cooled condensing units. Refer to Clause "Refrigeration Piping and Accessories".
- .12 Division 15 shall provide wiring diagrams indicating all power and control wiring requirements for equipment supplied by Division 15.

1.15 IDENTIFICATION OF VALVES

- .1 Provide engraved lamacoid color coded tags secured to items with non-ferrous chains or "S" hooks. Use for valves and operating controllers of all systems. Consecutively number valves in each piping system i.e. domestic water, steam, etc.
- .2 For each building, provide tag schedule, designating number, service, function, colour code, and location of each tagged item.
- .3 Provide one plastic laminated copy and secure to mechanical room wall where instructed. Place one copy in each maintenance instruction manual.
- .4 Identify controls and gauges by labels of 3mm (1/8") plastic engraving stock with white lettering on black background. Size approximately 62mm x 25mm (2-1/2" x 1") high.

1.16 HANGERS AND SUPPORTS

- .1 General
 - .1 Piping, ductwork and equipment shall be securely supported from building structure. Perforated strap or wire hangers are not permitted.
 - .2 Support components shall conform to Manufacturers Standardization Society Specification SP-38.
 - .2 Installation - Horizontal
 - .1 Hangers shall adequately support piping system. Locate hangers near or at changes in piping direction and concentrated loads. Provide vertical adjustment to maintain pitch required for proper drainage. Allow for piping expansion and contraction. Piping weight and stresses shall be supported independently of any equipment.
 - .2 Maximum spacing between pipe supports:
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- .1 Steel Pipe:
 - .1 Up to 50mm (2") diam. - 2.4m (8 ft.)
 - .2 62mm (2-1/2") and larger - 3.6m (12 ft.)
 - .2 Copper Tubing (Hard):
 - .1 Up to 25mm (1") diam. - 1.8m (6 ft.)
 - .2 32mm and larger - 2.4m (8 ft.)
 - .3 Cast Iron Pipe
 - .1 Maximum spacing - in accordance with Plumbing Code. Locate hangers adjacent to hubs or joints.
 - .2 Support M.J. pipe on both sides of joint. Provide with sway braces and anchors to Contract Administrator's approval. At multiple fittings or short lengths provide sufficient hangers to support all joints to Contract Administrator's satisfaction.
 - .4 Plastic Pipe As recommended by manufacturer.
- .3 Installation - Vertical Piping
- .1 Support vertical pipes at each floor by Grinnell Fig. 261 riser clamps. Locate clamps immediately below coupling if possible. Support soil pipe at hub. Brace risers up to 50mm (2") size at intervals not over 2.13m (7'). Support base in approved manner.
- .4 Structural Attachments
- .1 To Concrete:
 - .1 Place inserts in structural floors for support of piping and equipment prior to pouring of concrete. Inserts in concrete slabs shall be Grinnell Fig. 285 Light Weight Concrete Insert for loads up to 182 Kg (400#) or Grinnell Fig. 281 Wedge type concrete insert for loads up to 544 Kg (1200#).
 - .2 Support hangers in corrugated steel deck by 50mm (2") piece of 3mm (1/8") thick steel plate placed across top of steel deck, secured to hanger rod by washer and nut; prior to pouring of concrete topping.
 - .3 Where inserts must be placed in existing concrete use Hilti H.D.I. steel anchors as recommended by manufacturer, or if heavy weights must be supported, drill hole through slab and provide 50mm x 50mm (2" x 2") washer and nut above rough slab before floor finish is poured.
 - .2 To Steel Beams:
 - .1 Where pipe size is 50mm (2") or less, use Grinnell Fig. 87 Malleable Iron C-Clamp and Retaining Clip, or equal.
 - .2 Where pipe size is over 50mm (2"), use Grinnell Fig. 229 Malleable Beam Clamp or Fig. 228 Forged Steel Beam Clamp.
 - .3 Miscellaneous:
 - .1 Provide suitable attachments equal in quality to above where required.
- .5 Hangers and Supports
- .1 Steel Pipe: Up to 50mm (2") - Grinnell Fig. 65 light clevis - size to suit O.D. of pipe. 62mm (2-1/2") and larger - Fig. 260 clevis - size to suit O.D. of insulation.
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- .2 Copper Tubing (Hard):
 - .1 Up to 50mm (2") - Grinnell CT65 copper plated clevis - size to suit O.D. of pipe. Fig. 65 may be used if isolation is provided - see below.
 - .2 62mm (2-1/2") and larger - Fig. 260 clevis - size to suit O.D. of insulation - on uninsulated pipe provide isolation as specified below.
 - .3 Cast Iron Pipe:
 - .1 All sizes - Fig. 260 clevis - size to suit O.D. of pipe.
 - .4 Plastic and Other Types of Piping: Support as recommended by manufacturer.
 - .5 Provide fabricated steel supports as detailed on drawings or as required to adequately support piping and equipment. Details to be approved by Contract Administrator. Supports shall be of welded construction except where adjustment is required.
 - .6 Where thermal expansion in excess of 12mm (1/2") axially is anticipated, or where indicated, use Grinnell Fig. 171 Adjustable Pipe Roll or Grinnell Fig. 271 Pipe Roll Stand.
 - .7 For vertical piping support, use Grinnell Fig. 261 clamp. For vertical copper piping, use Fig. CT-121-C.
 - .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.
 - .13 Hanger Rod:
 - .1 Support hangers with mild steel rod. Load on hanger not to exceed capacity indicated in following table:
 - .2 Rod Diam. Max. Safe Load
 - .1 9.5mm(3/8") 277 Kg(610 lbs.)
 - .2 13mm(1/2") 514 Kg(1130 lbs.)
 - .3 16mm(5/8") 822 Kg(1818 lbs.)
 - .4 19mm(3/4") 1232 Kg(2710 lbs.)
 - .3 Rods to have sufficient threaded length to allow for vertical adjustment after pipe is in place. Use two nuts in each rod, one above clevis or angle iron, and one below.
 - .6 Isolation
 - .1 Copper piping shall be isolated from steel supports by copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators. Where no pipe movement or abrasion is expected, suitable plastic electricians tape may be wrapped around pipe at hangers.
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.7 Protection Saddles

.1 On piping 50mm (2") and smaller, carry insulation over pipe hangers. Canvas jacket shall be neatly cut and formed to fit over hangers. On chilled and cold water piping, insert sections of insulation into space above pipe at each hanger. Seal saddle and pipe with insulation.

.2 On insulated steel pipe over 50mm (2") diam. use at each hanger or support, Grinnell Fig. 160, 161 or 162 to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.

.3 On copper piping over 50mm (2") diam. use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have minimum length of 300mm (12") to spread weight.

1.17 SUPPORTS, BASES, PITS

.1 Supply and erect all special structural Work required for installation of tanks, pumps, fans, motors and other apparatus.

.2 Concrete pads, concrete for floating bases, curbs and pits to be supplied under Division 3. Supply all anchor bolts, fasteners and foundation drawings. Unless noted otherwise, all major pieces of equipment such as pumps, compressors, fans, etc. to be mounted on 150mm (6") concrete pad. Refer to standard details for method of forming pump bases, etc.

.3 Mount equipment suspended above floor level but not detailed on platform bracketted from wall. Where wall thickness is inadequate to permit such brackets, carry supports to either ceiling or floor, or both as required.

.4 Fire hose cabinets to be c/w suitable bases or mounting brackets. Where shown on or in walls, angle or channel iron supports to be installed to bear equipment.

1.18 FLASHING

.1 Where pipes or ducts go through a roof or wall, they should be boxed-in and flashed as per Division 3. Allow for expansion and contraction of pipe. Flashing shall be waterproof.

1.19 ACCESS DOORS

.1 Division 15 - Mechanical Subcontractor to provide access doors where valves, dampers and/or any other mechanical equipment requiring access are built-in.

.2 In general terms, Mechanical Subcontractor responsible for supplying the valve, dampers etc. shall provide the access door required to get to the valve, damper etc.

- .3 Access door to be 2.5mm (12 ga.) steel, 300mm x 450mm (12" x 18"), finished prime coat only, with concealed hinges, anchor straps, plaster lock and without screws, all equal to Milcor manufacture. Where it is necessary for persons to enter through door, doors to be at least 450mm x 600mm (18" x 24").
- .4 In applied tile or exposed glaze or unglazed structural tile, access doors shall take the tile and be sized and located to suit tile patterns. In plaster ceilings, doors shall take the plaster. In masonry walls access doors to be sized and located to suit masonry unit sizes. In lay-in acoustic tile ceilings, no access doors are required, but install an approved coloured marking device in the ceiling tile below all points requiring access. Refer to Architectural Room Finish Schedule and details on architectural drawings.
- .5 Supply access doors for concealed valves or groups of valves, dampers, fire dampers, flush valves, shock arrestors, trap seal primers, etc.
- .6 Access doors located in fire rated ceilings and walls shall be an approved ULC stamped, fire rated door.

1.20 IDENTIFICATION OF EQUIPMENT

- .1 Provide manufacturer's nameplate on each piece of equipment.
- .2 In addition Mechanical Subcontractor shall provide equipment I.D. tag minimum size 87mm x 32mm x 2.3mm (3-1/2" x 1-1/2" x 3/32") nominal thickness laminated phenolic plastic with black face and white centre. Engraved 6mm (1/4") high lettering. For motors and controls and for larger equipment such as chillers, tanks, 25mm (1") high lettering; for hot equipment such as boilers and convertors, provide engraved brass or bronze plates with black paint filled identification.
- .3 Identify as follows: equipment type and number (e.g. pump no. 2), service or areas or zone building served (e.g. south zone chilled water primary).
- .4 Provide manufacturers' registration plates (e.g. pressure vessel, Underwriters' Laboratories and CSA approval plates) as required by respective agency and as specified.

1.21 FLOOR PLATES AND SLEEVES

- .1 Set sleeves in concrete forms for all pipes and ducts passing through concrete walls, beams and slabs.
 - .2 Pipe sleeves to extend above floor line as follows:
 - .1 Unfinished areas - 25mm (1")
 - .2 Finished areas (copper sleeves) - 6mm (1/4")
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- .3 Mechanical rooms, kitchens and washrooms - 100mm (4")
- .4 Caulk sleeves to provide watertight installation.

- .3 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated pressed floor plates.
- .4 Install galv. oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.
- .5 Sleeves and holes for cold water, chilled water and ice water lines to be large enough to accommodate pipe insulation. Insulation on hot water lines may stop at walls or floors.
- .6 Prior to installing sleeves in concrete beams, receive final jobsite approval by the Contract Administrator.

1.22 MECHANICAL EQUIPMENT GUARDS

- .1 Meet safety requirements of Provincial Department of Labour and local authorities having jurisdiction.

1.23 SCREWS, BOLTS AND FASTENERS

- .1 Use standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hex heads, semi-finished unless otherwise specified. Use non-ferrous material throughout for plumbing services. Use type 304 stainless steel for exterior areas.
- .3 Bolts used on fan equipment for access to motors, bearings, filters and the like shall be heavy-duty.
- .4 Bolts shall not project more than one diameter beyond nuts.
- .5 Washers
 - .1 Use plain-type washers on equipment, sheet metal and soft gaskets, lock-type washers where vibration occurs, and resilient washers with stainless steel.

1.24 SPECIAL TOOLS AND SPARE PARTS

- .1 Furnish the City of Winnipeg with spare parts as follows:
 - .1 One set of pump seals, packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One set of v-belts for each piece of machinery.
 - .4 One set of filters for each filter bank installed.
 - .5 One spare cartridge for each thermostatic mixing valve.
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- .2 Identify spare parts containers as to contents and replacement parts number.
- .3 Provide one set of all specialized tools required to service equipment as recommended by manufacturers.

1.25 PUMPS-GENERAL

- .1 Provide coupling guards on all pumps.
- .2 Submit certified pump curves with shop drawings. Pumps shall be selected such that head at design conditions does not exceed 85% of maximum possible head at design flow rate.
- .3 Manufacturer to include for checking and aligning pumps prior to start-up. Following completion of piping all base mounted pumps shall be aligned by a qualified millwright using a dial gauge. Alignment using a straightedge is not acceptable as it does not provide sufficient accuracy. The millwright shall provide a report indicating the degree of misalignment prior to carrying out the Work and the final readings when the alignment Work has been completed. Final payment will not be made until a satisfactory report has been submitted.
- .4 Piping adjacent to pump to be supported from structure so no weight is carried on pump casings. Use long sweep elbows at pump.
- .5 All pumps to have motor size large enough to not overload at runout condition. If this requires larger motor than specified, pay for larger motor starter, wiring and the like.
- .6 Provide mechanical seals on all pumps.

1.26 OPENINGS IN FIRE SEPARATIONS

- .1 Provide firestopping for all openings in fire separations for passage of pipes, ducts, etc. to maintain integrity of fire separations.
 - .2 Firestopping
 - .1 Firestopping to be Dow-Corning Fire Stop System.
 - .2 Material shall be Dow-Corning silicone elastomer Fire Stop penetration Seal and/or Dow-Corning liquid silicone elastomer Fire Stop Foam of density, width and depth to maintain assembly fire resistive rating.
 - .3 Components shall be ULC listed.
 - .3 Installation
 - .1 Prepare all surfaces so they are clean, dry, and frost free, as per manufacturer's published recommendations.
 - .2 Use Sealant around single pipes and/or ducts.
 - .3 Use Foam for multiple pipe installation.
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- .4 Follow manufacturer's published installation instructions precisely including field quality control after installation.
- .5 Submit to Contract Administrator, suitable document signed by manufacturer's local representative, stating:
 - .1 Div. 15 Subcontractor received sufficient installation instruction from manufacturer's representative.
- .6 Remove firestopping assembly for random inspection by Contract Administrator and replace at no extra cost to the City of Winnipeg.

1.27 TRIAL USAGE

- .1 The City of Winnipeg reserves right to use any piece of mechanical equipment, device or material installed under this Contract, for such reasonable lengths of time and at such times as Contract Administrator may require, to make complete and thorough test of same, before final completion and acceptance of any part of Contract. It is agreed and understood, that no claim for damage will be made for any injury or breakage to any part or parts of the above due to aforementioned tests, whether caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever. Supply all labour and equipment for such tests.

1.28 SAFETY DEVICE TESTING

- .1 Make complete inspection of all safety devices to ensure:
 - .1 That safety devices are complete and in accordance with specifications and manufacturer's recommendations.
 - .2 That the safety devices are connected and operating according to all local regulations.
- .2 Safety devices to be inspected shall include, but not be limited to:
 - .1 Pressure relief valves
 - .2 Sprinkler alarm valves
 - .3 Freeze protection devices
 - .4 Fire dampers
 - .5 Ceiling fire stops
- .3 On completion of inspections, supply to Contract Administrator letters and/or certificates for their record, confirming that inspections have been completed.

1.29 TEMPORARY USE OF EQUIPMENT

- .1 Permanent systems and/or equipment not to be used during construction period, without Contract Administrator's written permission.
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- .2 Heating systems may be used for temporary heating within limitations specified under clause 'Temporary Heating'. Refer also to 'General Conditions'.
 - .3 Equipment used during construction period to be thoroughly cleaned and overhauled. Replace worn or damaged parts so equipment is in perfect condition, to entire satisfaction of Contract Administrator and the City of Winnipeg.
 - .4 Provide proper care, attention and maintenance for equipment while it is being used. If, in opinion of Contract Administrator, sufficient care and maintenance is not being given to equipment and systems, Contract Administrator reserves right to forbid further use of said equipment and systems.
 - .5 Temporary use of equipment shall in no way relieve Contractor of providing twelve month guarantee on all equipment so used this guarantee period to commence as of date of final acceptance of building by the City of Winnipeg as interpreted by Contract Administrator.
 - .6 All air filters shall have bi-monthly inspection. Filters shall be cleaned and/or replaced depending on filter type during period in which ventilation units are being used for temporary heat and/or commissioning of system. Contractor to be responsible for and pay all costs for air filter cleaning service. Filters to operate between pressure drops noted in filter manufacturer's catalogue.
 - .7 During temporary heating period, retain boiler manufacturer to perform following inspections:
 - .1 Boiler manufacturer to inspect boiler bi-monthly when boiler is being used for temporary heat. Forward report to Contract Administrator after each inspection indicating condition and operation of boiler and recommend any maintenance and repairs, which should be carried out to ensure boiler is in first class operating condition.
 - .2 Boiler manufacturer to thoroughly inspect boiler four weeks prior to final acceptance of Contract. Manufacturer to forward report to Contract Administrator stating condition of boiler and listing any parts which require repair, replacement or cleaning, to place boiler in perfect first class operating condition.
 - .3 On completion of any repairs and cleaning, etc. boiler manufacturer to issue certificate to Contract Administrator guaranteeing specified efficiency and first class condition of boiler.
 - .4 Pay all costs for boiler inspection service, repairs, cleaning and replacement parts, etc. recommended by boiler manufacturer.
 - .8 Steam, condensate and hot water heating systems used for temporary heating shall have proper chemical treatment under supervision of chemical treatment manufacturer as per Section 15600.
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1.30 RECORD DRAWINGS

- .1 Provide one set of Contract prints to form Record Drawings, marked clearly in red pencil with all changes and deviations from piping and ductwork, including all Contract Changes.
- .2 Update Record drawings on a regular basis to ensure they are accurate.
- .3 This information will be used by others to create Record Drawings on CAD.

1.30 INSTRUCTIONS TO THE CITY OF WINNIPEG'S PERSONNEL

- .1 In addition to start-up supervision and instruction of the City of Winnipeg's personnel required of individual equipment manufacturers and systems as noted, Contractor's construction supervisor to instruct the City of Winnipeg's personnel in operation and maintenance of all equipment and systems to satisfaction of Contract Administrator.
 - .2
 - .1 All instructions to the City of Winnipeg's personnel shall be video taped by the Contractor.
 - .2 This video will remain property of the the City of Winnipeg and will be used for the sole purpose of training and orientation of the City of Winnipeg's maintenance staff.
 - .3 Instruction shall include visual materials such as drawings, diagrams, and printed handouts.
 - .4 Instructor(s) shall provide the necessary audio-visual equipment and other aids necessary to convey thorough understanding of system and/or equipment operation and maintenance.
 - .5 Provide the City of Winnipeg with one copy of video taped session in VHS or DVD format. The City of Winnipeg to decide, and confirm format.
 - .3 Provide the City of Winnipeg with four copies of manuals incorporating following:
 - .1 Service instructions - including lists of spare and replacement parts and names and addresses of suppliers.
 - .2 Maintenance & Operating instructions.
 - .3 Revised shop drawings.
 - .4 Forward manuals to Contract Administrator for review. Final payment will not be made until all required manuals have been received.
 - .5 Review instructions with the City of Winnipeg's representative to ensure the City of Winnipeg's representative has a thorough understanding of equipment and its operation.
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- .6 Contractor shall submit to Contract Administrator, suitable document signed by the City of Winnipeg's representative, stating:
 - .1 The City of Winnipeg has received satisfactory instruction in operation and maintenance of all equipment and systems.
 - .2 Operation and maintenance manuals have been reviewed with the City of Winnipeg.
 - .3 Specified spare parts, keys, removable handles and the like, have been turned over to the City of Winnipeg.

1.31 TEMPORARY HEATING

- .1 Obtain written permission from Contract Administrator to use permanent heating system for temporary heat. Operate systems in strict accordance with equipment manufacturer and Contract Administrator's recommendations.

1.32 PAINTING

- .1 Finish painting of mechanical equipment, piping and the like, to be performed by Section 09900.
 - .1 Co-operate with Section 09900 in identifying equipment and piping where required for colour coding, pipe stencilling and the like.

1.33 IDENTIFICATION OF PIPING

- .1 Division 15 shall provide mechanical pipe identification with exception that Section 09900 shall provide Primary Color painting for identification.
- .2 Identify fluids in piping with Mystic markers showing name and service, including temperature and pressure where relevant, and with Mystic arrows to indicate flow direction.
- .3 Apply primary colours in exposed areas only on finished piping surfaces, including secondary colour bands, to indicate type and degree of hazard.
- .4 For building additions and alterations, use existing coding system. For new buildings, use CGSB 24-GP-3a and CSA and B53 colour codings and identification systems, using CGSB 1-GP-12c colour coding system schedule.

.1	<u>Primary Classification</u>	<u>Secondary Classification</u>	<u>Legend and Direction Arrows</u>
	Yellow 505-101	Orange 508-102	Yellow
	Green 503-107	Purple 511-101	Black 512-101
	Blue 202-101	Black 512-101	White 513-101
	Red 505-102	Yellow 505-101	
	White 513-101		

- .6 Pipe Markers and Secondary Colour Bands
- .1 Plastic coated cloth material with protective overcoating on outside and waterproof contact adhesive on underside, suitable for continuous operating temperature of 149 deg. C (300 deg. F) and intermittent temperature of 204 deg. C (400 deg. F).
 - .2 For secondary colour bands apply 50mm (2") wide tape single wrap around pipe or pipe covering with ends overlapping 25mm (1") minimum.
 - .3 Use block capital letters 50mm (2") high for pipes of 75mm (3") or larger od (including insulation) and not less than 18mm (3/4") high for smaller diameters.
 - .4 Use direction arrows 150mm (6") long by 50mm (2") wide for piping of 75mm (3") or larger od including insulation and 100mm (4") long by 18mm (3/4") wide for smaller diameters. Use double head arrows where direction of flow is reversible.
 - .5 Use waterproof and heat resistant plastic marker tags for pipes and tubing of 18mm (3/4") and smaller od.
 - .6 Use black pipe marker letters and direction arrows except use white on red background for protection piping.
- .7 Standard of Acceptance: WH Brady identification tapes, bands, markers.
- .8 Location of Identification
- .1 Locate markers and classifying colours on piping systems, so that they can be seen from floor or platform.
 - .2 Identify piping runs at least once in each room.
- .9 Legends and colour classifications: Submit to Contract Administrator for approval, where differing from following table, at least two weeks before ordering material.
- .10 Table: Pipe and valve identification. Note: Information in brackets under Pipe Marker Legend column is explanatory and need not be included as part of legend test.

<u>PIPE MARKER LEGEND</u>	<u>VALVE TAG LEGEND</u>	<u>PRIMARY COLOUR</u>	<u>SECONDARY COLOUR</u>
Natural gas	N.G.	Yellow	Orange
Hot water heating supply (up to 121 C (250 F))	H.W.H.S.	Yellow	Black
Hot water heating return (up to 121 C (250 F))	H.W.H.R.	Yellow	Black
City water	CI.W	Green	None
Cold water	C.W.	Green	None
Dom hot water supply	D.H.W.S.	Green	None
Dom hot water recirc	D.H.W.R.	Green	None
Make-up water	M.U.W.	Yellow	Black
Storm sewer	S.S.	Green	None
San sewer	SAN.S	Green	None
Comb san storm sewer	C.S.S.S.	Green	None
Refrigerant suction (include refrigerant no.)	REF.S. (N.O.)	Yellow	Black

Sprinkler water	S.W.	Red	White
Vent (plumbing)	V.P.	Green	None
Vent	V.	Yellow	Black

1.34 IDENTIFICATION OF DUCTWORK

- .1 Use black 50mm (2") high stencilled letters (e.g. "Cold", "Hot", "Return", "Sanitary Exhaust", "Kitchen Exhaust") with arrow indicating air flow direction.
- .2 Distance between markings 15m (50') maximum.
- .3 Identify ducts on each side of dividing walls or partitions and beside each access door.
- .4 Stencil only over final finish.
- .5 Prior to installation, review general application of identification with Contract Administrator.

1.35 CUTTING AND PATCHING

- .1 Refer to Section 01600.
 - .1 Div. 15 shall mark all openings required for pipes, ducts, grilles and the like.
 - .2 Cutting to be 'neat' sizes. Patch all edges so grille frames hide cut edges.

1.36 SALVAGE

- .1 Mechanical equipment, ductwork, and piping for mechanical systems not required in new layout to become property of Contractor. Remove material from Site. Wall-mount A/C unit c/w condensing units shall be returned to the City of Winnipeg.
- .2 Mechanical drawings indicate most mechanical equipment to be removed and/or disconnected. Mechanical equipment not indicated on drawings as being removed or disconnected, but which has to be removed due to removal of walls of existing building, to be removed and pipes capped off by Contractor at no additional cost to the City of Winnipeg.

1.37 CLEANING AND FLUSHING OF PIPING SYSTEMS

- .1 On completion, each piping system shall be flushed out before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.
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- .2 Flush with water, unless noted otherwise in individual mechanical sections of specifications.
- .3 All plumbing fixtures and all equipment shall be thoroughly cleaned and left in first class operating condition.

1.38 ASBESTOS CONTROL PROCEDURES

- .1 This building contains asbestos in the existing piping and equipment insulation.
- .2 For further information regarding procedures contact: Workplace Safety and Health, Department of Labour, Province of Manitoba.
- .3 The Contractor shall inform the City of Winnipeg about any encountered asbestos, which will be removed by the City of Winnipeg.
- .4 All boiler room asbestos will be removed by the City of Winnipeg.

1.1 GENERAL

- .1 Following Appendix of Manufacturers lists manufacturers of equipment and materials acceptable to Contract Administrator, subject to individual clauses under the various sub-sections of Mechanical Work Specifications. See item 'Materials' under this section of specification.
- .2 Product noted in individual specification clauses is an item that meets specification in all respects regarding performance, quality of material and workmanship, and is acceptable to Contract Administrator without qualification. Equipment proposed from other manufacturers listed as 'Approved Manufacturers' and alternates shall meet same standards.
- .3 Sound pressure data shall be submitted for any fan, blowers, air handlers, etc. which will be located on the Call Centre Level. Sound pressure levels of any proposed equal or alternate pieces of equipment shall not exceed sound pressure levels of the specified equipment where documents list such data.
- .4 Contractor to submit within forty-eight hours of notification from Contract Administrator, one (1) copy of fully and properly completed Appendix of Manufacturers listing thereon names of manufacturers of products which shall be used to execute Work of Contract. If list is not submitted within 48 hours, Contractor must use product named in each individual clause.
- .5 Submit shop drawings for all items marked with asterisk(*).

1.2 EQUIPMENT OR MATERIAL & APPROVED MANUFACTURERS

.1 ELECTRIC MOTORS

.1 G.E.; Siemens; Tamper; Reliance; Leland; Lincoln; U.S. Electric; Century; Baldor; WEG; Toshiba

.2 INSULATION

.1 Pipe Insulation Manville; Owens Corning; Knauf; Pabco; Fibreglas

.2 External Duct Insulation Manville; Fibreglas; Knauf

.3 Fire Retardant Canvas Fattal; Radley

.4 Lagging Adhesive/Coating Bakor; Childers; Fosters

.5 Refrigerant piping Armstrong; Rubatex

.6 Aluminum pipe jacket Childers; Permaclad; Pabco

.7 PVC pipe jacket Sure-Fit

.3 PLUMBING

- .1 Grooved copper piping Gruvlok; Victaulic system*
 - .2 Drainage of Waste
 - .1 Cast iron soil pipe Bibby-Ste-Croix
 - .3 Valves (gate & globe)* Crane; Toyo; Kitz; Nibco
 - .4 Valves (butterfly)* Keystone; Center Line; Kurimoto; Victaulic; Gruvlok
 - .5 Valves (ball)* Toyo; Kitz; Nibco; Anvil
 - .6 Check valves to 2" diam.*
 - .1 Horizontal piping Crane; Toyo; Kitz; Nibco
 - .2 Vertical piping Val-Matic
 - .7 Check valves 2-1/2" diam. & up*
 - .1 Horizontal piping Check-Rite; Moyes & Groves
 - .2 Vertical piping Val-Matic; Durabla; Keystone-Prince
 - .8 Hangers and Supports Anvil; Crane; Myatt
 - .9 Drainage specialties* Watts; Zurn; J.R. Smith; (floor drains, roof drains, Mifab cleanouts, chair carriers, etc.)
 - .10 Dielectric Watts
 - .11 Shock absorbers* Zurn; Watts; J.R. Smith; Mifab
 - .12 Strainers* Spirax-Sarco; Muessco; Toyo; Crane; Colton
 - .13 Expansion joints* Fulton; Flexonics; Hyspan; Flextech
 - .14 Pressure gauges* Ashcroft; Kunkle; Morrison; Winters; Marshalltown; Ametek; Trerice; Weiss
 - .15 Thermometers* Ashcroft; Trerice; Taylor; Weiss; Marshalltown; Winters
 - .16 Compression stops* Powers Crane; Brass Craft
 - .17 Plumbing fixtures* Crane; American-Standard; Kohler
 - .18 Plumbing brass* American Standard; Crane; Cambridge
 - .19 Flush valves* Crane; Teck; Sloan; Zurn
 - .20 Stainless steel sinks* American-Standard; K.I.L.; Briggs & Wessan; Kindred Industries; Architectural Metals Industries; Aristaline
 - .21 Toilet seats* Olsonite; Moldex; Centoco; Bemis
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- .22 Electric water heaters* State; John Wood; A.O. Smith
 - .23 Hot water recirc. pumps* Armstrong; B & G; Grundfos
 - .24 Shower controls* Symmons; Powers; Bradley
 - .25 Shower heads* Symmons; Powers; Bradley
 - .26 Backflow preventers* Watts; Conbraco; Ames
 - .4 FIRE PROTECTION
 - .1 Automatic sprinkler Reliable; Viking; Victaulic; equipment* Tyco Fire Products (Gem, Star, Central)
 - .2 Gate valves* Kennedy; McAvity; Mueller; Watts; Nibco
 - .3 Ball Valves* Milwaukee; Global
 - .4 Check valves* Crane; Check-Rite; Val-matic; Victaulic; Gruvlok
 - .5 Butterfly valves* Crane; Victaulic; Mueller; Watts; Gruvlok; Global; Nibco
 - .6 Pressure gauges* Dresser; Morrison; Marshalltown; H.O. Trerice; Ametek; Kunkle; Winters; Tyco
 - .7 Fire extinguishers* Pyrene; Diamond; LynCar; Flag; Badger; Kidd; Ansul
 - .8 Mechanical joints* Victaulic; Gruvlok
 - .9 Pre-action control valves* Reliable; Griswold; Claval; Tyco Fire Products (Gem, Star, Central)
 - .10 Backflow preventers* Watts; Conbraco; Ames
 - .11 Valve monitor and flow switches* Potter; Tectra; Edson; Canswiss
 - .12 Foam system* Ansul
 - .5 LIQUID HEAT TRANSFER
 - .1 Welding fittings Anvil; Crane; Tube Turn
 - .2 Malleable iron fittings, Crane; Gourd; Anvil; flange, flange gaskets International Malleable
 - .1 Mechanical joints Victaulic; Gruvlok
 - .3 Pipe hangers Anvil; Crane; Myatt
 - .4 Floor plates Crane
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- .5 Gate, globe valves* Crane; Toyo; Kitz; Nibco
 - .6 Radiator valves* Crane; Dahl; Toyo
 - .7 Check valves (up to 2" diam.)
 - .1 Horizontal piping* Crane; Toyo; Kitz; Nibco
 - .2 Vertical piping* Durabla; Nibco
 - .8 Check valves (2-1/2" diam. & up)
 - .1 Horizontal piping* Moyes & Groves; Chek-Rite; Keystone-Prince; Victaulic; Gruvlok
 - .2 Vertical piping* Val-Matic; Durabla; Victaulic; Gruvlok
 - .9 Ball Valves* Toyo; Kitz; Nibco; Victaulic; Newman Hattersley; Jenkins; Anvil
 - .10 Circuit balancing valves* Armstrong; Tour & Andersson; Gruvlok
 - .11 Triple duty valves* Armstrong; B&G; Gruvlok; Victaulic
 - .12 Expansion joints* Fulton; Flexonics; Hyspan
 - .13 Alignment guides* Adscos; Flexon; Fulton; Flexonics; Hyspan
 - .14 Air vents* Dole; Hoffman; Maid-O-Mist
 - .15 Strainers* Spirax-Sarco; Mueller; Victaulic; Gruvlok; Colton
 - .16 Thermometers* Ashcroft; H.O. Trerice; Winters; Taylor; Weiss; Marshalltown
 - .17 Pressure gauges* Kunkle; Winters; Ametek; Ashcroft; Trerice; Weiss; Marshalltown
 - .18 Water pressure reducing valve; Fisher 95-R; Braukmann chilled/hot water systems*
 - .19 Expansion tanks* Amtrol; Expanflex; Wessels; B & G; Taco; John Wood
 - .20 Air supply units* McQuay; Carrier; York
 - .21 Relief valves (water)* Conbraco; Spence; Farris
 - .22 Wall fin, convectors* Rosemex; Engineered Air; Rittling
 - .23 Forced flow, unit heaters* Rosemex; Engineered Air; McQuay
 - .24 Radiant panels* Airtex; Frenger; TWA; Rosemex
 - .25 Boilers*
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- .1 Condensing* Aerco; Viessmann
 - .26 Boiler feed controls* Honeywell; Johnson
 - .27 Vertical in-line pumps* Armstrong; B & G
 - .28 Flexible pipe connectors* Flexonics; Hydro-Flex; United Flexible
 - .29 Chemical treatment* GE Betz
 - .30 Welded pipe backing rings* Robvon; Anvil
 - .31 Vibration control* Vibron; Vibro-Acoustic; Airmaster
 - .6 AIR DISTRIBUTION
 - .1 Ducturns, damper hardware, fan connections* Duro-Dyne
 - .2 Duct Sealer Duro-Dyne; 3M; Flexa-Duct; United; Bakelite
 - .3 Fire Damper* Controlled Air; Penn; Air Balance; C.A.A.; Hart & Cooley; Ruskin; Nailor; Cesco
 - .4 Fire/smoke dampers* Greenheck; Controlled Air; Prefco Lawson; Nailor; Taylor
 - .5 Pitot tube enclosures* Lawson Taylor
 - .6 Manometers* Dwyer
 - .7 Filters* A.A.F.; Camfill-Farr; Cambridge; Continental; Airguard
 - .8 Louvres* Airolite; Carnes; Penn; Air-O Vent; Canadian Advanced Air; H & C; Westvent; Ventex
 - .9 Belt driven in-line fans* Greenheck; Loren Cook
 - .10 Air cooled condensing units* Carrier; McQuay; Keeprite; Engineered Air; York; Lennox
 - .11 Electric duct heaters* Wright; Temro Electric; Chromolux; White Star; Thermolec; Brasch
 - .12 Diffusers, registers E.H. Price; Hart & Cooley; & grilles* Titus; Carnes; Nailor
 - .13 Acoustic duct insulation* Manville; Fibreglas; Ultralite; Knauf
 - .14 Variable volume air valves* E.H. Price; Nailor; Titus; Hart & Cooley; Anemostat
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- .15 Duct silencers* Vibro-Acoustics; Commercial Acoustics;
Vibron; Kinetics
- .16 Vibration control* Airmaster; Vibro-Acoustics; Vibron;
Kinetics
- .17 Positive pressure chimney* Metalbestos; Metal Fab; Van
Packer; Security; Ampco; Cheminée Lining
- .18 Refrigerant piping and Henry; Mueller accessories*
- .19 Spiral ductwork* AMS; Basar; United; Vent Air; Pellaers
- .7 CONTROLS/INSTRUMENTATION
 - .1 Temperature control system* Honeywell; Johnson;
Siemens-Landis; Delta
 - .2 Flow switch*
 - .1 (Fluid) McDonnell & Miller
 - .2 (Air) Cleaveland Controls AFS-222
- .8 H.V.A.C. BALANCE AND TESTING
 - .1 H.V.A.C. Balance & Airdronics Inc.; DFC; AHS; Testing
Agency Air Movement

1.1 GENERAL

- .1 All drawings and all sections of the specification shall apply to and form an integral part of this section.

1.2 WORK INCLUDED

- .1 Labour, material, plant, tools, equipment and services necessary and reasonably incidental to completion of external insulation for mechanical equipment, piping, ductwork.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
- .2 Section 15051 Acceptable Materials & Equipment
- .3 Section 15400 Plumbing
- .4 Section 15500 Fire Protection
- .5 Section 15600 Liquid Heat Transfer
- .6 Section 15800 Air Distribution

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 All materials shall be equivalent in all respects to specified products and shall be used only in applications intended by the manufacturer. Materials not specifically intended for the purpose shall not be used. Approved materials shall not be diluted or blended with other materials unless specifically recommended by the manufacturer of the approved material.
 - .2 All final pipe and duct installations including insulation, covering and adhesive shall have a ULC Certified flame spread rating of not greater than 25, and a smoke developed classification of not more than 50.
 - .3 All canvas shall be treated to be fire retardant in accordance with ULC standards.
 - .4 Wire to be 1.2mm (18 ga.) stainless steel, dead soft annealed, type 304.
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2.2 COMPATIBILITY OF COMPONENTS

- .1 All adhesives, sealers, vapour coating, mastics, laggings and bedding compounds, shall be compatible with materials to which they are applied. They shall not soften, corrode, or otherwise attack such material in either wet or dry state and shall only be those recommended by manufacturer of insulation as suitable for application proposed. They shall be applied at ambient conditions acceptable to the manufacturer.

2.3 COLD INSULATION - PLUMBING

- .1 Material
 - .1 On pipes 50mm (2") diam. and under, use 12mm (1/2") Fibreglas 112 kg/m³ (7 lb./cu. ft.) density pipe insulation with ASJ jacket. 13mm (1/2") Armstrong Armaflex AP or Rubatex equal may be used for domestic cold water and cooling coil condensate drains piping only.
 - .2 On pipes 62mm (2-1/2") diam. and larger, use 25mm (1") Fibreglas 88 kg/m³ (5-1/2 lb./cu. ft.) density pipe insulation with ASJ jacket, c/w vapor barrier.
 - .3 Vent piping in cold attics shall be less vapor barrier jacket and wired on.
- .2 Location
 - .1 All domestic cold water piping.
 - .2 All cooling coil condensate drains.
 - .3 Roof hoppers, vertical and horizontal storm drains except in crawlspaces.
 - .4 Vent piping for a developed length of 3m (10'-0') from roof terminals.
 - .5 Vent piping located in cold attics and in other cold locations.
 - .6 Sump pump discharge lines that pass through ceiling spaces.
 - .7 Water meters.
 - .8 Run outs from mixing valves to shower heads.

2.4 HOT INSULATION - PLUMBING

- .1 Material
 - .1 Fibreglas insulation with all service jacket (ASJ) and self seal lagging adhesive.
 - .2 On pipes 50mm (2") diam. and under, use 25mm (1") Fibreglas 112 kg/m³ (7 lb./cu. ft.) density insulation.
 - .3 On pipes 62mm (2-1/2") diam. and larger, use 38mm (1-1/2") Fibreglas 88 kg/m³ (5-1/2 lb./cu. ft.) density insulation.
 - .2 Location
 - .1 All domestic hot water, and tempered water supply and hot water recirculation piping.
-

2.5 HOT INSULATION - HEATING

.1 Materials

.1 On piping 50mm (2") diam. and under, use 25 (1") Fibreglas 88 kg/m³ (5-1/2 lb./cu. ft) density pipe insulation with ASJ all service jacket and self seal lagging adhesive.

.2 On piping 62mm (2-1/2") diam. and larger, use 37mm (1-1/2") Fibreglas 88 kg/m³.

.2 Location

.1 All new hot water heating supply and return piping, including accessory apparatus such as air eliminators and the like. Existing (to remain) insulated lines to retain existing insulation.

2.6 WHITE PVC INSULATION COVER

.1 Cover insulation and insulated fittings with white PVC fitting covers.

.2 The fitting cover system shall consist of one-piece pre-molded high impact PVC fitting covers with fiber glass inserts and accessories, including elbows, tee/valves, end caps, mechanical line couplings, specialty fittings, jacketing, tacks, and PVC tape.

.3 Cover shall have a flame spread rating of not more than 25 and a smoke developed classification of not more than 50.

.4 Cover shall be resistant to and not promote growth of fungi or bacteria.

.5 Cover shall be UV resistant for use indoors or outdoors. Paint outdoor fittings for further UV and colorfast protection.

.6 Locations

.1 All exposed piping in public areas and storage rooms.

2.7 VAPOUR BARRIER FLEXIBLE DUCT INSULATION

.1 Following duct externally insulated with Fibreglas RFFRK reinforced foil-faced vapour seal duct insulation PF335, 340 g. (3/4 lb./cu. ft.) density.

.1 25mm (1") Thickness

.1 All round supply air ductwork, and all rectangular supply air ductwork, less than 1200mm (48") wide on discharge of fan systems with cooling coils.

.2 All supply air ductwork on discharge of boiler room ventilation fan.

.3

- .2 50mm (2") Thickness
 - .1 All round exhaust and relief ducts, supply and return air ducts from/to RTUs not shown acoustically lined from roof or wall back for a length of 1.8m (6'-0") or from wall or roof discharge back to damper, whichever is greater.
 - .2 All round roof ducting to centrifugal exhaust fans located on roofs.
 - .3 All outside air ductwork.

2.8 VAPOUR BARRIER RIGID INSULATION

- .1 Following ducts externally insulated with Fibreglas RFFRK reinforced foil-faced vapour seal duct insulation type FF 340 g. (4.5 lb./cu.ft.) density.
 - .1 25mm (1") Thickness
 - .1 All rectangular supply air ductwork, greater than 1200mm (48") wide, on discharge of fan systems with cooling coils.
 - .2 50mm (2") Thickness
 - .1 All rectangular exhaust and relief ducts, supply and return air ducts from/to RTUs not shown acoustically lined from roof or wall back for a length of 1.8m (6'-0") or from wall or roof discharge back to damper, whichever is greater.
 - .2 All rectangular roof ducting to washroom exhaust fans located in ceiling.
 - .3 Relief air ducts from F-1 to louvre and relief air duct in Electrical Room.
 - .4 Fresh air intake duct from roof to AHU-1.
 - .5 Exhaust smoke duct from roof to main floor apply to F-4, F-5, F-6, F-7, F-8.

2.9 REFRIGERANT PIPE INSULATION

- .1 Insulate all refrigerant piping lines with 12mm (1/2") Armstrong Armaflex AP sealed with Armstrong 520 adhesive. Refinish exposed and exterior insulation with Armstrong WB Armaflex finish.
 - .2 Cover outdoor insulation with aluminum jacket CSA HA Series-M1980.
 - .1 Crimped or embossed alloy jacketing 0.4mm thick with longitudinal slip joints and 50mm end laps with factory attached protective liner on interior surface. Aluminum alloy butt straps with mechanical fastener.
 - .2 Jackets on fittings, 0.4mm thick, die shaped components of alloy with factory attached protective liner on interior surface.
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PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Work shall be performed by licensed journeymen.
 - .2 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
 - .3 Do not apply coverings until hydrostatic tests have been completed, surfaces are free of grease, scale, moisture, and heat tracing where required has been installed. Insulation shall be clean and dry when installed and during application of any finish.
 - .4 Apply insulation and coverings to equipment and piping which will operate with hot or warm liquid vapour, while surface is hot. Provide any required temporary heat to accomplish this.
 - .5 Cold surfaces to be dry and ferrous surfaces to be coated with rust penetrating protective paint before applying insulation and vapour barriers.
 - .6 Vapour barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, duct or seams, and without interruption at sleeves, pipe and fittings.
 - .7 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.
 - .8 Pack solid around all pipes where they pass through sleeves in walls, floor slabs, etc. for full thickness of floor with fibreglas or rockwool. Refer to firestopping clause where piping passes through fire separations. On all services, carry full insulation thickness through walls, floors, etc. Protect insulation of exposed pipes passing through floors with 1.2mm (18 ga.) galv. iron 150mm (6") from finished floor.
 - .9 On piping, gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Closely and neatly trim around extending parts of pipe saddles, supports, hangers and clamp guides. Seal with insulating cement.
 - .10 Use pipe covering protection saddles with roll type hangers unless otherwise indicated.
 - .11 Butt joints
 - .1 Place joints on top of duct wherever practical. Butt joints on side of duct for flexible duct insulation.
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- .2 Adhere and seal laps of vapour barrier cover or vapour barrier strip of 100mm (4") minimum width furnished with insulation, using vapour seal adhesives.
- .12 Sagging of duct insulation will not be acceptable.
- .13 Stagger both longitudinal and horizontal joints, on duct insulation of multilayered construction.
- .14 Duct insulation with vapour barrier shall be continuous, except at fire dampers.
- .15 Ducts acoustically lined need no external insulation, unless specifically noted otherwise.
- .16 Existing duct and pipe covering damaged or cut back during installation Work to be made good with same insulation as specified for new Work.
- .17 Protect insulation against elements during all stages of application.
- .18 Do not cover manufacturer's nameplates. Cut insulation on 45 deg. angle to nameplate edge and seal.
- .19 Covering to be uniform in diameter, smooth in finish. Place longitudinal seams so as to be invisible.

3.2 COLD INSULATION - PLUMBING

- .1 Fibreglass
 - .1 Insulate flanges, fittings and valve bodies, etc.
 - .2 Fasten longitudinal laps with staples and seal with Swifts Adhesive #3218.
 - .3 Butt joints wrapped with a 100mm (4") strip of ASJ. Stagger joints on multiple layers.
 - .4 Refinish exposed piping with canvas and coat with Bakor 120-18 white fire retardant lagging adhesive.
 - .5 All fittings shall be insulated by wrapping with 25mm (1") thick layers of 340 g. (3/4 lb.) density flexible fibreglass attached with jute twine. Surface shall be wrapped with Friction Tape and sealed with and asphaltic sealing compound. Over this to be applied a smooth coating of insulating cement. Recover fittings with ASJ vapour seal jacket and brush coat with fire retardant white lagging adhesive.
 - .2 Armaflex
 - .1 Insulate fittings, valve bodies, etc.
 - .2 All fittings shall be insulated with mitre-cut pieces of Armaflex AP pipe insulation the same size as on adjacent piping.
 - .3 Seal joints and seams with Armstrong 520 adhesive, and refinish exposed fitting with Armstrong Armaflex finish.
-

.4 Refinish all exposed piping with two coats of Armstrong Armaflex finish, colour selected by Contract Administrator.

.5 Where Armaflex insulation comes in close contact with adjacent equipment or piping having surface temperatures above 100 deg. C, Section 15180 shall provide additional protection to ensure against deterioration of insulation by heat.

3.3 HOT INSULATION - PLUMBING

.1 Application as per Clause "Cold Insulation - Plumbing".

3.4 HOT INSULATION - HEATING

.1 Application as per Clause "Cold Insulation- Plumbing".

3.5 INSULATION CLADDING

.1 For aluminum jacketting installation, install in strict accordance with manufacturer's published recommendations.

3.6 WHITE PVC INSULATION COVER

.1 Preparation

.1 Proto Fitting Covers shall be applied on clean, dry surfaces.

.2 Application

.1 General

.1 The matching fiber glass insert shall either be wrapped completely around the fitting or snugly positioned inside the Proto Fitting cover for proper fit. The insert shall cover the full inner surface area of the Proto Fitting Cover. The Proto Fitting Cover shall then be applied over the fitting and insert, and the throat secured by either tack fastening, taping, sealing with a solvent type PVC adhesive, or banding.

.2 Cold Pipe

.1 Fitting systems below ambient temperature must have a continuous vapor retarder, either with Proto PVC Tape, Proto Butt Strips, Proto PVC Adhesive, or a vapor retarder mastic as specified by the Contract Administrator. When using Proto PVC Tape, a 2" (51mm) minimum downward overlap is recommended for optimum performance. Care should be taken not to stretch the last 2" (51mm) of Proto PVC Tape, to avoid stretching or creeping.

.3 Hot Pipe

.1 Insulate as per General Instructions given above. Due to PVC softening point at approximately 150 deg. F (70.6 deg. C), care should be taken to ensure sufficient insulation thicknesses are applied. For hot piping which

requires Knauf Pipe insulation over 1-1/2" (38mm) wall thickness, an extra fiber glass insert shall be applied for each additional inch of pipe insulation wall thickness. Knauf recommends the surface temperature of the pipe insulation and PVC to be no higher than 125 deg. F (52 deg. C). To complete application of Proto PVC Fittings on hot piping, the throat seam shall be riveted or tacked.

.4 Outdoor Pipe

.1 Insulate as per above instructions. When installing Proto PVC fittings outdoors, add one layer aluminum foil over the first fiberglass insert applied, making sure the aluminum foil is extended over the adjacent pipe insulation. A second fiber glass insert shall then be applied over the aluminum foil, and the Proto PVC fitting applied.

.2 Minimum Proto PVC jacketing thickness for outdoor application should be .020" (.5mm). The PVC jacketing shall be overlapped a minimum of 2" (51mm) on the down side so as to shed water. Longitudinal joints shall be completely weather sealed with solvent type PVC sealer. Circumferential joints shall be wrapped with a minimum 2" (51mm) wide butt strips and completely sealed using a solvent type PVC sealer. On hot piping, insulation shall be of sufficient thickness to keep the surface temperature below 125 deg. F (52 deg. C). Additionally, a slip type expansion joint of 4" (101mm) minimum width shall be applied at least every 20 lineal feet (6.1 lineal meters).

3.7 VAPOR BARRIER FLEXIBLE DUCT INSULATION

.1 Rectangular Ductwork

.1 On ducts 600mm (24") wide and wider apply fasteners to bottom surface of duct by impaling on welded pins on 300mm (12") centres. Spot adhesive on 300mm (12") centres on all sides of duct. Apply insulation with edges tightly butted together and secured with 100% coverage of 3-M No. 17 or approved alternate. Staple joints and seal with 100mm (4") strips of vapor barrier foil of same quality as duct insulation membrane sealed with BF85-15.

.2 On ducts 575mm (23") wide or less insulation applied as above but welded pins may be omitted.

.2 Round Ducts

.1 Adhere to duct surface applied in strips 150mm (6") wide, 300mm (12") o.c. Butt all edges of insulation, staple and seal all joints with tape adhered over the joint. Seal all breaks with vapor barrier type.

.3 Exposed Ducts

.1 Recover ducts exposed to view with 170 g. (6 oz.) canvas secured with Bakor 120-18 white fire retardant lagging adhesive. Finish with brush coat of same adhesive.

- .4 Outdoor Ducts
 - .1 On roof and other ductwork located outside of building, provide 26 ga. G.I. sheet metal cover to protect insulation. Seal all joints and make weathertight.
 - .2 On square or rectangular ductwork provide slight peak along top centre line so moisture will run off.

3.8 VAPOR BARRIER RIGID DUCT INSULATION

- .1 Insulation applied with edges tightly butted and secured by impaling on pins welded to duct. Pins to be staggered, minimum 300mm (12") o.c. in every direction. This applies to all sides. Secure insulation to pins with metal fasteners. Pins shall be long enough to bend after fasteners have been applied. Install two fasteners to all insulation on roof. Dab adhesive over pins and fasteners.
- .2 Seal all joints, edges and breaks in vapor seal jacket with vapor barrier foil of the same quality as that of duct membrane 100mm (4") wide with BF 85-15 lagging adhesive.
- .3 Wrap exposed ducts with fire retardant paper recovered with 170 g. (6 oz.) canvas secured with Bakor 120-18 white fire retardant lagging. Brush coat with same adhesive. Do not use staples.
- .4 Outdoor Ducts
 - .1 On roof and other ductwork located outside of building, provide 26 ga. G.I. sheet metal cover to protect insulation. Seal all joints and make weathertight.
 - .2 Provide slight peak along top centre line so moisture will run off.

3.9 REFRIGERANT PIPE INSULATION

- .1 Insulate fittings, valve bodies, etc.
 - .2 All fittings shall be insulated with mitre-cut pieces of Armaflex AP pipe insulation the same size as on adjacent piping.
 - .3 Seal joints and seams with adhesive, and refinish exposed fittings with specified finish. Refinish all exposed piping with two additional coats.
 - .4 Where insulation comes in close contact with adjacent equipment or piping having surface temperatures above 100 deg. C, provide additional protection to ensure against deterioration of insulation by heat.
 - .5 Allow adhesive joints of Pipe insulation to dry 24 hours to 36 hours before applying finish. Apply finish directly to clean, dry insulation in two coats. Wipe surface with cloth dampened with
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non-oily solvent such as alcohol or toluol to clean surface and remove powdered lubricant. Allow first coat to dry minimum of two hours before applying second coat. Before applying finish, read precautionary information on can label.

.6

.1 Finish insulation located outdoor with Armstrong WB black Armaflex finish. Do not apply over joints freshly cemented with 520 adhesive. Allow adhesive joints of Armaflex pipe insulation to dry 24 hours to 36 hours before applying finish. Apply finish directly to clean, dry Armaflex insulation in two coats. Wipe surface with cloth dampened with non-oily solvent such as alcohol or toluol to clean surface and remove powdered lubricant. Allow first coat to dry minimum of two hours before applying second coat. Before applying Armaflex WB finish, read precautionary information on can label.

.7

For aluminum jacketting installation install in strict accordance with manufacturer's published recommendations. Make weathertight application.

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 WORK INCLUDED

- .1 Provide labour, material, equipment and services necessary for and incidental to the supply and installation of the systems shown on the drawings and hereinafter specified.
- .2 Generally this shall include:
 - .1 Sanitary Drainage System
 - .2 Cold and Hot Water Supply System
 - .3 Natural Gas Piping System
 - .4 Plumbing Fixtures and Equipment

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
- .2 Section 15051 Acceptable Materials & Equipment
- .3 Section 15180 Insulation
- .4 Section 15500 Fire Protection
- .5 Section 15600 Liquid Heat Transfer
- .6 Section 15800 Air Distribution
- .7 Section 15900 Controls/Instrumentation
- .8 Section 16010 Electrical General Provisions

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- .1 General
 - .1 Pipe and fittings shall conform to the standards listed in the applicable Building Code (latest revision).
 - .1 Flanged joints must have suitable gasket and bolts.
 - .2 Use brass nipples between copper piping and flush valves or c.p. brass goods.
 - .3 Where alternate piping materials or jointing are specified a uniform type of pipe and fittings shall be used throughout each system.
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- .2 Drains and vents - sanitary
 - .1 Drains and vent pipes shall be in accordance with local or provincial regulations with the following exceptions, unless otherwise specified.
 - .2 All cast iron soil pipe shall be class 4000.
 - .3 Cast iron soil pipe may be hub and spigot or mechanical joint. Mechanical joint couplings shall have a corrugated stainless steel sleeve over the joint with stainless steel worm drive securing bands tack welded to the sleeve. Titan or approved equal.
 - .4 No plastic, asbestos cement or aluminum pipe will be accepted unless specifically called for by the Contract Administrator.
- .3 Water Piping - Domestic Cold, Hot, Hot Water Recirculating
 - .1 Pipe - Type 'L' third party certified hard copper tube to ASTM B.88. Fittings - Wrought copper or cast brass, solder joint pressure fitting. Flanges - Cast brass 1034 kPa (150 lb.) ANSI B16.24.
- .4 Natural Gas
 - .1 Pipe
 - .1 Up to 150mm (6"): - Schedule 40 carbon steel, continuous weld or electric resistance weld pipe conforming to ASTM A53 Grade B.
 - .2 Fittings
 - .1 Up to 50mm (2"):
 - .1 Screwed fittings - 1034 kPa (150 psi) black malleable iron, banded.
 - .2 Socket weld fittings - 13,800 kPa (2000 psi) forged steel.
 - .3 Unions - 1034 kPa (150 psi) brass to iron seat.
 - .2 64mm (2-1/2") and larger:
 - .1 Butt welding fittings to be Crane manufactured to ASTM A234. Flanges to be Grinnell forged carbon slip-on welding flanges conforming to ASTM A181, Grade 1. Gaskets to be Cranite pre-formed asbestos. Site or shop cut gaskets unacceptable. Use ring gaskets on raised face flanges and full faced gaskets on flat faced flanges. Use 1034 kPa (150 psi) flanges on systems to 689 kPa (100 psi). Thread-O-Lets and Weld-O-Lets to be manufactured to ASTM A181, Grade 1.

2.2 VALVES

.1 General

- .1 Valve parts must be of material recommended by mfg. for service specified. Valves must be installed with stems upright or horizontal, not inverted. Valves not specifically covered herein shall be of comparable quality to those specified.
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.2 Water

.1 Domestic cold, hot, hot recirculating:

.1 Gate valves up to 50mm (2"): Crane 1334, Newman Hattersley T609, Kitz 43, Nibco S-134.

.2 Globe valves up to 50mm (2") - Toyo 221, Crane 1310, Newman Hattersley Fig. 13, Kitz 10, Nibco S-235Y.

.3 Valves 64mm (2-1/2") and up - Keystone Fig. 1000-CBF2, Newman Hattersley 45-11332.

.4 Swing check valves up to 50mm (2"): Toyo 237, Crane 1342, Newman Hattersley A61, Nibco S413B.

.5 Spring loaded check valves up to 50mm (2"): MAS-700.

.6 Check valves 64mm (2-1/2") and up: Check Rite #12 CBT wafer type

.7 Ball balancing valves with balancing plate up to 50mm (2"): Toyo Fig. 5049A, Newman Hattersley 1979, Kitz 59, Crane 9322, Nibco S-585-70.

.8 Ball valves up to 50mm (2"): Toyo Fig. 5049A, Newman Hattersley 1979, Kitz 59, Crane 9322, Nibco S-585-70.

.2 Drain valves up to and including 19mm (3/4"): Toyo Fig. 5046 ball valve with garden hose threaded outlet c/w chain and cap.

.3 Drain valves 25mm (1") and larger: Gate valves as specified above, with discharge piped to suitable drain.

.3 Natural Gas

.1 Valves up to 50mm (2") size - Toyo 5044A and Kitz Code No. 58 ball valve or Newman Hattersley 1969F. Newman-Milliken 200M, lubricated screwed plug valve.

.2 Valves 64mm (2-1/2") and larger: Newman-Milliken 201M flanged plug valve. Newman-Milliken 200M, lubricated screwed plug valve.

2.3 THERMOMETERS

.1 Ashcroft Series EI, bi-metal dial thermometers, having stainless steel cases and rings with bronze or stainless steel stems and brass separable threaded wells. Temperature range 0 deg. to 100 deg.C (32 deg. to 212 deg.F) unless otherwise noted. Accuracy to 1% of full span.

.2 Thermometers located up to 1.5m (5'-0") above finished floor to have 75mm (3") diam. dials; and located above 1.5m (5'-0"), 125mm (5") diam. 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 installed. Stem type to be approved by Contract Administrator.

.3 Separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Stems and wells to be immersed in liquid flow, minimum length of stems to be 150mm (6").

- .4 Where separable well is mounted in pipe 38mm (1-1/2") diam. or less, enlarge pipe to 50mm (2") diam. for well length plus 75mm (3").

2.4 TRAP PRIMERS

- .1 Provide approved Zurn trap primers where noted on plans and/or as required by Plumbing Code, to maintain trap seals.

2.5 SHOCK ABSORBERS

- .1 Where shock absorbers are called for on water lines shall be Zurn Shoktrol sized in accordance with Plumbing and Drainage Institute standards.

2.6 CLEANOUTS

- .1 Cleanouts in cast iron soil pipe shall consist of cast iron ferrule with brass plug having raised head.
- .2 Cleanouts in copper drainage: Brass screwed plugs with raised head.
- .3 Cleanouts in cast iron screwed drainage fittings, (galvanized waste lines) shall consist of nipple and cap. Iron plugs not accepted. Exposed c.o. caps shall be chrome plated.

2.7 CLEANOUT ACCESS COVERS

- .1 Finished and unfinished areas:
 - .1 Zurn ZANB-1460-13 175mm (7") diam. polished nickel bronze frame and cover.
 - .2 Select cleanout access covers in areas having floor finish such as sheet vinyl tile, terrazzo, or carpet, to suit the finish. Cooperate with appropriate Contractors to apply finish to cleanout covers so they will be flush with floor, inconspicuous, and accessible. Floor cleanouts for sheet vinyl flooring shall be clamping type, Zurn ZXN-211R6-ST style, to properly seal (SVF) sheet vinyl flooring to cover. Refer to architectural room finish schedules for locations.
 - .3 On special floor, rough-in properly to conform to adjacent flooring material as per manufacturer's installation instructions.
 - .2 Cleanouts in walls to be located adjacent to access door, or to have a suitable finished access cover flush with wall so as to present a neat finished appearance and leave cleanout easily accessible.
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2.8 PLUMBING FIXTURES AND EQUIPMENT

.1 General

.1 Supply, install and connect up, complete, all plumbing fixtures shown on mechanical and architectural drawings. Be responsible for protection of all fixtures until building is accepted by the City of Winnipeg.

.2 All fixtures including trim shall be CSA approved, free from flaws or blemishes and subject to approval of Contract Administrator. All finished surfaces shall be clear, smooth and bright, and guaranteed not to craze, discolour or scale. All fixtures shall be completely installed and connected to drain, vent, hot and cold water supply piping in approved manner.

.3 All visible parts of trimmings of all fixtures, including faucets, shower heads, piping, escutcheons, wastes, strainers, traps, tail pieces, supplies, stops, etc. shall be heavily chrome-plated. This shall also apply to Work at all NIC equipment and fixtures in finished areas.

.4 Except where specifically noted otherwise, supply and install screwdriver stop valve on hot and cold water supply to every fixture on project, in addition to valve or faucets on fixture itself.

.5 Provide adequate supports for all fixtures. Have these built into walls with back-up plates where required.

.6 Provide traps, and stops on supplies, for all fixtures and equipment.

.7 Provide domestic water, vent and waste connections to all equipment requiring plumbing services. This shall include NIC items shown on architectural and mechanical drawings.

.8 Provide shut-off valve on water supply connections at each piece of equipment.

.9 Contractor shall confirm mounting heights for all fixtures before roughing in water, waste and vent piping.

.10 Heating/Air-Conditioning Equipment:

.1 Connect water and drain to all heating and air-conditioning systems and equipment wherever noted in the specifications or on the drawings.

.11 Miscellaneous Equipment:

.1 Rough-in and connect services as required to all items of equipment requiring same.

.12 Silicone Sealing of Fixtures:

.1 Silicone seal perimeter edges of fixtures as specified herein.

.2 Silicone to be mildew-resistant, translucent white silicone, General Electric Sanitary Silicone Sealant #SCS 1752.

.3 Section 15400 shall provide silicone sealing of following fixtures: china drinking fountains, urinals, water closets, sinks (all types), and lavatories (china and enamelled steel).

.4 Application of sealant shall be by experienced applicators, regularly employed for sealant application.

.5 Properly adjust and align fixtures prior to sealant application.

.6 Sealant bead to be smooth and neat, with proper proportions. Apply sealant in strict accordance with manf. published data.

.7 For wall hung fixtures, seal only 3 edges; top and both sides, not bottom.

.8 For china and enamel steel lavatories, seal perimeter edge between countertop and lavatory.

.9 Do not apply silicone sealant onto stainless steel fixtures, unless noted otherwise.

.10 Unless noted otherwise, silicone sealing of tubs, shower stalls and shower bases to be responsibility of architectural division, under direction of Contract Administrator.

.2 Fixtures

.1 W.C.-1

.1 TOTO Drake, vitreous china, floor mounted, elongated rim, insulated tank, bolt caps, 6 litres per flush.

.2 Bemis 955SCC open front seat less cover, stainless steel, self-sustaining with external check hinge, colour white.

.2 W.C.-2

.1 TOTO Drake, vitreous china, floor mounted, elongated rim, insulated tank with bolt down lid, bolt caps, 6 litres per flush.

.2 Bemis 955SCC open front seat with cover, stainless steel, self-sustaining with external check hinge, colour white.

.3 W.C.-3

.1 TOTO Drake, vitreous china, floor mounted, elongated rim, insulated tank with bolt down lid, bolt caps, 6 litres per flush.

.2 Bemis 955SCC open front seat with cover, stainless steel, self-sustaining with external check hinge, colour white.

.3 Provide custom order right hand trip lever.

.4 UR-1

.1 TOTO UT447, vitreous china, wall hung, low consumption, washout flush action.

.2 Zurn ZER6003AV-CPM exposed Aquaflush urinal valve with automatic sensor actuation, battery powered, screwdriver angle stop, vacuum breaker, flush tube, coverplate, vandal proof screws, escutcheon plate and nut.

.5 LAV.-1 (Handicap)

.1 Kindred OV1719 stainless steel countertop lavatory 4" (100mm) centres, self rimming.

.2 Zurn Z6915-F Aquasense battery powered centreset, automatic sensor, 1.9 lpm (0.5 USgpm) aerator.

.3 Delta Commercial 33T290 chrome plated offset p.o. plug with open grid strainer.

.4 Supply and install Truebro LAV GUARD undersink protective p-trap/water stop, cover and insulation assembly.

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- .6 MV-1
 - .1 Symmons Thermixer Model 5-120B-T-CKX, thermostatic mixing valve c/w stainless steel cabinet and locking door, separate check stops, valve mounting bracket.
 - .7 S-1
 - .1 Kindred LBS1306-1 single compartment stainless steel with ledge, self-rimming, 15" x 15" x 6" deep (375mm x 375mm x 150mm) 2 hole drilling, 4" (100mm) centres, 3-1/2" (90mm) basket strainer and tailpiece assembly, baked-on undercoating, under deck clamps.
 - .2 Delta Commercial 27C4952, 4" (100mm) centreset, Gooseneck spout, v.p. 1.9 lpm (0.5 Usqpm) aerator, 4" (100mm) hooded blade handles.
 - .3 Powers Crane P-4005 cast brass 1-1/2 (38mm) adjustable P trap with cleanout plug.
 - .4 Speedway chrome plated flexible supplies with screwdriver angle stops, chrome plated inlet extension tubes, chrome plated escutcheon plates.
 - .8 S-2
 - .1 Kindred ALBD6405-1 two compartment with ledge, stainless steel sink, self-rimming, 21" x 31" x 5" deep (525mm x 775mm x 125mm) 3 hole drilling, 8" (200mm) centres, 3-1/2" (90mm) basket strainer and tailpiece assembly, baked-on undercoating, under deck clamps.
 - .2 Powers Crane S5910-V5 single lever 8" (200mm) centreset, swing spout, v.p. 1.9 lpm (0.5 USqpm) aerator, cover plate, lever handle, ceramic disc cartridge.
 - .3 Powers Crane P-4005 cast brass 1-1/2 (38mm) adjustable P trap with cleanout plug.
 - .4 Speedway chrome plated flexible supplies with screwdriver angle stops, chrome plated inlet extension tubes, chrome plated escutcheon plates.
 - .9 SH-1
 - .1 Kohler Sonata II acrylic shower enclosure, 36" x 36" x 84" (900mm x 900mm x 2100mm), integral soap ledge, integral high-dome ceiling, white, shower rod, shower curtain. Division 16 to provide light fixture and wiring. Division 15 to coordinate for light fixture opening.
 - .2 Symmons Model 96-1-X-L Temptrol Shower System, Pressure-Balancing mixing valve with adjustable stop screw to limit handle turn, clear-flo shower head with arm and flange, integral service stops, single blade lever handle.
 - .10 SH-2
 - .1 Hytec Model H6836LT acrylic shower enclosure, 68" x 35.5" x 84" (1700mm x 888mm x 2100mm), threshold design for barrier free wheelchair access, stainless steel wrap-around grab bar, 1" stainless steel shower curtain rod, brass drain with stainless steel strainer, right-hand fold-up seat, standard white. Division 16 to provide light fixture and wiring. Division 15 to coordinate for light fixture opening.
 - .2 Symmons Model 96-500-B30-L-V-X Temptrol Shower System with hand spray, Pressure-Balancing mixing valve with lever handle, adjustable stop screw to limit handle turn, levertrol diverter with integral volume control, clear-flo
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shower head with arm and flange, wall/hand shower with in-line vacuum breaker, flexible 5' metal hose, wall connection and flange, 30" slide bar for hand shower mounting, integral service stops.

.3 Equipment

.1 Floor Drains

.1 FD #1:

.1 Zurn Z-415-R cast iron, adjustable nickel bronze strainer, cast iron collar, floor level clamping ring, vandalproof screws. Rough-in to adjacent flooring material as per manf. installation recommendations.

.2 Use in areas where sheet vinyl, sheet rubber, or sheet metal flooring material is used.

.2 FD #2:

.1 Zurn ZZN-415-A cast iron floor drain with 6" (150mm) diam. adjustable 1/2" (13mm) thick nickel bronze strainer.

.2 Roof Drains

.1 RD #1:

.1 Zurn ZA-100-CERA with cast iron body, aluminum dome strainer, deck clamp, waterproofing flange, roof sump receiver, extension frame. Extension to suit insulation thickness.

.3 Domestic Water Heater (Electric)

.1 The heater(s) shall be Dura-Power Commercial Electric Model Number DVE-120 as manufactured by A.O. Smith Water Products Company or equivalent. Heater(s) shall be rated at 24 KW. Tank(s) shall be 119 gallon capacity with 150 psi working pressure and equipped with dual extruded high density anodes. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1400°F to 1600°F. Electric heating elements shall be medium watt density screw-in type with Incoloy sheath and ceramic terminal block. Internal power circuit fusing shall be provided. Element operation shall be sequenced with thermostats switched through individual magnetic contactors. Control circuit shall be factory fused and include manual reset high temperature cutoff switch and thermostat with sensing element in tin-plated well, immersed in water. Control cabinet and jacket shall be of baked enamel finish and shall provide full size control and element compartment for complete service and maintenance performance through front hinged compartment door, and enclose tank with foam insulation. 1-1/4" inlet and outlet connection shall be provided. The heater tank shall have a three year limited warranty and controls and accessories shall have a one year limited warranty as outlined in the written warranty.

.4 Central Vacuum System

.1 Central vacuum power unit shall be a Vacuflo model 960 with two high performance Ametek Premier motors producing 990 Maximum Air Watts of cleaning power, 51 litre dirt

container and True Cyclonic filtration requiring neither bags nor filters to clean or replace. Power unit shall have a self contained low voltage control system allowing on/off switching from all inlet valves, overload heat protection, 1.83 m power cord, external exhaust and a one (1) year factory warranty. A dedicated 30 AMP circuit with a NEMA type L5-30R receptacle shall be supplied by others.

.2 Provide one (1) 10.7 m x 3.2 cm I.D. Primaflex commercial grade hose complete with ends and metal storage rack.

.3 Provide one (1) commercial grade cleaning kit complete with 35.6 cm wide Floatamatic rug tool, 35.6 cm wide Premium floor brush, dusting tool, crevice tool, upholstery tool, tool caddy and one-piece aluminum wand.

.4 Supply and install fifteen (15) inlet valves complete with low voltage contacts and all PVC pipe, fittings, LVT wire and fire stops required to complete the system as per code.

.5 Vacuflo equipment distributor is:

Vacuflo Manitoba
895 Century St.
Winnipeg, Manitoba, R3H 0M3
Phone: (204) 783-8505
Email: vacuflo@mts.net
Contact is Mr. Alan Gray.

2.9 BACKFILL MATERIAL

- .1 Bedding and backfill material to 300mm (12") above the pipe shall conform to standard WCA 3 for granular fill.
 - .1 Passing 3/4" 100%
 - .2 No. 4 80-90%
 - .3 No. 50 5-30%
 - .4 No. 200 0-5%
- .2 Granular backfill material other than as described in .1 above shall conform to standard WCA 2.
 - .1 Passing 3" 100%
 - .2 No. 4 40-80%
 - .3 No. 200 5-20%

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- .1 Copper pipe shall not be buried except where specifically noted on drawings.
 - .2 All pipe shall be cut accurately to measurements taken at Site, installed without springing or forcing. All changes in direction made with fittings.
 - .3 All connections to equipment made with unions or flanges.
 - .4 Remove valve working parts during installation to prevent damage from heat where brazing, soldering, or welding is used.
 - .5 Comply with latest CSA Standard W117.2 "Code for Safety in Welding and Cutting".
 - .6 Drain pipes dropping into slab on grade shall have sisson joint arranged to take up movement of slab.
 - .7 Run all piping in accessible pipe spaces in such a way that it does not interfere with free access into pipe space.
 - .8 Co-operate with all Subcontractors to properly locate all equipment connections.
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- .9 Provide a shutoff valve on supply connections at each piece of equipment.

3.2 DRAINAGE SYSTEMS

.1 Sanitary Drains

- .1 Provide complete systems of sanitary drainage and venting to serve all fixtures and equipment. This includes local drains from equipment in Contract such as fan units, pump bases, etc.
- .2 All drainage piping to W.C.'s shall be 100mm (4") dia. min.
- .3 Provide trap primers where noted on drawings. Connect to trap in an approved manner.
- .4 Cleanouts:
 - .1 Install cleanouts at all changes of direction, at intervals of not over 15m (50') in horizontal runs, at all points where obstructions might be formed and at points required by plumbing regulations or shown on drawings.
 - .2 Cleanouts shall be accessible. Cleanouts above furred ceilings or in concrete slabs on grade shall be extended to floor level with cleanout access cover and frame.
 - .3 Cleanouts on sink waste and vent pipes shall have a chrome-plated cap installed tight to wall. Cleanouts behind walls shall have access panel. Cooperate in locating cleanouts adjacent to access panels, etc. All cleanout plugs lubricated/sealed with mixture of graphite and linseed oil or Teflon tape. Check all cleanouts immediately prior to turning the job over to the City of Winnipeg. Remove plugs, re-lubricate with graphite and oil, and re-install using only enough force to insure permanent joint, depending on location.
- .5 Flash vents through roof in approved manner. Drains in floors shall be flashed or clamped to membrane water-proofing where required.

3.3 WATER SUPPLY SYSTEM

.1 General

- .1 Provide complete system of water supply piping to serve all fixtures, equipment, etc. This shall include cold water, hot water and hot water recirc. piping. Tempered water piping shall be considered to be hot water piping if water temp. is above 29 deg.C (85 deg.F).
 - .2 Grade horizontal runs of piping to drain through risers.
 - .3 Install drain valves with hose thread outlet at water meter, hot water tanks and in mains where shown and/or necessary for complete drainage.
 - .4 Install shut off valves at hot water tanks and heaters, at all connections to major pieces of equipment, in all branches to fixtures or groups of fixtures.
 - .5 Install dielectric insulating unions between all pipes or apparatus constructed of dis-similar metals. Use brass nipples at flush valves, etc.
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.6 Connect ends of all hot water risers to recirculation main and continue this main back through recirculating pump. Recirculating piping shall be so arranged as to provide continuous and positive circulation of hot water throughout system at all times.

.7 Each recirculating branch shall have balancing valve.

.2 Water Pipe Sizes to Fixtures

	<u>Cold</u>	<u>Hot</u>
Lavatory basins	13mm (1/2")	13mm (1/2")
Flush valves	25mm (1")	
Flush tanks	13mm (1/2")	
Sinks	13mm (1/2")	13mm (1/2")
Showers	13mm (1/2")	13mm (1/2")

.3 Shock Absorbers

.1 Supply and install shock absorbers on hot and cold water lines at each group of fixtures, each isolated fixture, and where noted on drawings. Sizes shall be as noted or in accordance with Plumbing and Drainage Institute Standard WH-201.

.2 Provide shock absorber upstream of every solenoid valve or quick closing valve. This applies also to NIC equipment having solenoid valves supplied by other divisions, such as washing machines, dishwashers, etc.

.3 Review proposed location and type of shock absorbers with Contract Administrator prior to installation.

.4 Backflow Preventers

.1 Provide approved backflow preventers on all potable water supplies as noted on drawings, specified herein, or as required by provincial/municipal authorities.

.2 Test backflow preventers in accordance with manufacturer's recommendations, Contract Administrator or as required by provincial/ municipal authorities.

3.4 NATURAL GAS PIPING SYSTEM

.1 Make arrangements with gas utility company to replace meter and regulator if required. Pay all service and installation charges.

.2 Run piping as shown to serve equipment. Take out permits and connect equipment ready for use. Provide gas regulators as specified under Products section of this specification. Run vent piping from relief valves to atmosphere. Install gas piping in accordance with Provincial Department of Labour regulations. Provide gas cock at each piece of equipment. Provide drip pockets at each piece of equipment and at low points. Grade horizontal piping 1:500 (1" in 40 ft.) to drain through risers.

.3 All natural gas piping concealed above lay-in tile ceilings, in walls or other inaccessible locations shall have all welded joints and shall be stamped by the welder with his number.

- .4 Where gas piping is welded, arrange with provincial authorities to inspect and provide written approval to Contract Administrator prior to system use.

3.5 EXCAVATION AND BACKFILL

.1 General:

- .1 Perform all excavating and backfilling required in connection with this Contract.
- .2 Place bracing, sheet piling, barricades, warning light, ladders, etc. as required by municipal ordinances and the Workplace Health & Safety.
- .3 Excavating machines may be used where existing buildings or property are not endangered.
- .4 Examine architectural drawings to determine where excavations interfere with curbs, walks, concrete floors, etc. Where this does occur, backfill with sand and employ the particular Contractor and pay all costs to match all surfaces damaged by new Work.
- .5 Trenches shall be properly lined and graded. Levels shall be checked continuously. Augering will not be permitted except on written application and approval.
- .6 All damage to pipe shall be repaired.
- .7 Excavations shall be protected to prevent damage by weather or other conditions. Remove water so pipe is laid in dry trench.

.2 Piping Support

- .1 No portion of pipe shall bear directly against rock or other hard surface. Shape bottom to fit pipes and sockets. Form to support minimum 1/3 of outside circumference of pipe. This applies also to additional reinforced supports as noted below. Bed pipe on 4" layer of sand.
- .2 Provide concrete pad or continuous footing properly reinforced where solid undisturbed earth bed is not obtainable.
- .3 If excavation is carried to greater depth than shown, replace with well compacted sand fill or 15 mPa (2170 psi) concrete to give bearing value equal to that provided by adjacent soil.
- .4 Connections which cross over excavated area deeper than elevation of pipe shall be backfilled from bottom of excavation up to pipe with 15 mPa (2170 psi) unshrinkable concrete fill.
- .5 Any excavation below 45 deg. line drawn down from bottom edge of a footing shall be backfilled to said line with 15 mPa (2170 psi) unshrinkable concrete fill.

.3 Backfill

- .1 Backfill below pipe crown shall be sand and gravel, to height of 300mm (12") above pipe. It shall be hand placed and hand tamped and compacted. Remaining backfill shall be as follows:
 - .1 Inside building - All backfilling to distance of 900mm (36") outside foundation walls shall be with sand and gravel 19mm (3/4") dia. max. No earth backfill will be accepted.
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.2 Outside building - Where pipes pass under present or future paving; concrete slabs; roads, sidewalks, or parking lots, paved or unpaved; or where noted on drawings, backfilling shall be with sand and gravel 19mm (3/4") dia. max. All other backfill material free of organic material, excessive fines, boulders exceeding 75mm (3"), and frozen lumps.

.3 Backfill shall be compacted in layers not exceeding 600mm (24") in height by suitable mechanical means. All backfill must be brought up to original surface level or elevation noted on drawings.

.4 Settlement of Backfill

.1 Make good any settlement of fill and pay costs involved in making good paving, surfacing lawns, curbs and all other surfaces damaged by such settlement and subsequent restoration.

.5 Excess Excavation Material

.1 Excavation materials shall be piled, stored and/or disposed of as directed by Contract Administrator.

3.6 JOINTING

.1 All joints shall be made in accordance with manufacturer's recommendations.

.2 Cast iron soil pipe shall be installed as recommended by manufacturer. Fittings shall be braced where necessary to prevent joints coming apart under pressure.

.3 Cast iron hub and spigot soil pipe may be joined with oakum and lead, or Bibby Bi-Seal compression sleeve. Do not use oakum on hot water drain lines where suspended in finished area.

.4 Screwed joints in steel piping shall be made with full cut standard taper pipe threads, with approved non-toxic joint compound applied to male threads only. Joint compound shall not be applied to the first thread. Avoid squeezing excess compound into pipes. All pipes must be reamed or filed and left full bore, clean and free of scale.

.5 Victaulic pipe, joints, couplings, gaskets, and fittings, etc, shall be in strict accordance with manufacturers published recommendations.

.6 Joints in copper drainage and water tube shall be in strict accordance with manufacturer's published recommendations and as follows:

.1 Water tube up to and including 50mm (2") and drainage tube all sizes shall be lead free solder consisting of tin, copper and silver (Silvabrite 100 or equal).

.2 Water Piping over 50mm (2") shall be brazed (Sil-Fos). Valve bonnets and inner parts must be removed from valve bodies when silver brazing valves and adjacent joints.

- .7 Where black steel pipe and welding fittings are specified or permitted, welding to be performed by welder holding current welder's certificate from Provincial Department of Labour.

3.7 EXPANSION AND CONTRACTION OF PIPING

- .1 Make provision for expansion and contraction of all piping. Use swing connections where shown or necessary.

3.8 CLEANING AND FLUSHING

- .1 On completion, flush out piping systems before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.
- .2 Clean out all plumbing fixtures and equipment and leave in first class operating condition.

3.9 TESTING

- .1 All piping systems shall be pressure tested as follows:
- .1 Plumbing, drainage and natural gas systems - in accordance with local regulations.
- .2 Water supply piping - test with water to 690 kPa (100 psig) at the highest point of system. Maintain pressure without loss for 4 hours.

PART 1 - GENERAL CONDITIONS

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section

1.2 WORK INCLUDED

- .1 Labour, material, plant, tools, equipment and services necessary and reasonably incidental to completion of fire protection work including:
 - .1 Conventional wet pipe automatic sprinkler system.
 - .2 Single-Interlock preaction automatic sprinkler system.
 - .3 Fire extinguishers, cabinets and mounting.
 - .4 Fire, Jockey and Excess Pressure Pump(s).
 - .5 Connection to domestic water supply
 - .6 Preparation of shop drawings, approvals of same by authorities having jurisdiction, inspecting, testing and approval as specified herein and as required by authorities having jurisdiction.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 - Mechanical general provisions
 - .2 Section 15051 - Acceptable materials and equipment
 - .3 Section 15180 - Insulation
 - .4 Section 15400 - Plumbing
 - .5 Section 15600 - Liquid heat transfer
 - .6 Section 15800 - Air distribution
 - .7 Section 15900 - Controls/Instrumentation
 - .8 Section 16010 - Electrical general provisions
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- .9 Section 16100 - Electrical materials & installation (including fire alarm systems)

1.4 WORK BY OTHER SUBCONTRACTORS

- .1 Floor drains and hub drains shall be by section 15400.
- .2 Compressed air supplies by 15500.
- .3 Concrete bases, pits, housekeeping pads, etc. by division 3 - Concrete.
- .4 Electrical wiring shall be by division 16 - Electrical.
- .5 Insulating of piping shall be by section 15180.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 General
 - .1 Materials shall be defined for the purposes of this section as, "All piping and equipment constituting or used in the installation of the fire protection system(s) and all appurtenances attached during or after installation of the fire protection system(s).".
 - .2 All materials shall be in accordance with the requirements of the applicable NFPA fire codes including NFPA 13 - *Installation of Sprinkler Systems*.
 - .3 All materials shall conform to the appropriate standards listed in the most current published National Building Code of Canada (NBC), National Fire Code of Canada (NFC), and the requirements and standards required by the authority having jurisdiction.
 - .4 All materials shall be listed, labelled and approved for intended use by Underwriters Laboratories of Canada (ULC), Underwriters Laboratories (UL).
 - .5 All materials shall be new, unused products of a current design produced by a manufacturer regularly engaged in the production of products intended for use in fire protection systems.
 - .2 Pipe
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- .1 Steel pipe shall meet the requirements of NFPA 13 - *Installation of Sprinkler Systems* and shall meet the requirements of ASTM A53 - *Welded and Seamless Pipe*.
 - .2 All piping in sprinkler systems shall be schedule 40, black or galvanized steel.
 - .3 Type K or L copper tubing may be used in sprinkler systems where indicated on drawings and shall meet the requirements of NFPA 13 - *Installation of Sprinkler Systems*, the Contract Administrator, and the authority having jurisdiction.
 - .4 Stainless steel pipe shall meet the requirements of NFPA 13 - *Installation of Sprinkler Systems* and shall meet the requirements of ASTM B446 - *Alloy Materials* and/or ASTM A-312. Stainless steel piping shall be of a schedule no less than schedule 10, grade 304.
 - .5 Pipe 50mm (2") and smaller shall be joined by threaded connections or by welding and shall meet the threaded joining requirements and methods in NFPA 13 - *Installation of Sprinkler Systems*.
 - .6 Pipe 64mm (2½") and larger shall be joined by roll groove joints and mechanical groove couplings or by welding and shall meet the grooved or welded joining requirements and methods in NFPA 13 - *Installation of Sprinkler Systems*.
 - .7 Copper tubing shall be joined by UL, ULC, and FM approved methods for sprinkler systems and shall meet the joining requirements and methods in NFPA 13 - *Installation of Sprinkler Systems*.
 - .8 Schedule 10, 304 stainless steel piping shall be joined by roll groove connections only and shall be of 32mm (1¼") or larger nominal diameter.
 - .9 Schedule 40, 304 stainless steel piping shall be joined by threaded connections, roll groove connections or welding as follows:
 - .1 38mm (1½") and larger piping shall be roll grooved or welded.
 - .2 32mm (1¼") and smaller piping shall be threaded.
 - .10 All welded pipes shall be shop welded and shall meet the requirements, standards, and procedures of NFPA 13 - *Installation of Sprinkler Systems*, NFPA 14 - *Standpipe and Hose Systems* and the NBC. Submit documentation confirming that shop welding methods and procedures comply with AWS B2.1 - *Specification for Qualification of Welding Procedures and*
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Welders for Piping and Tubing. Sprinkler contractor shall provide during shop drawing submittal to Contract Administrator their written quality assurance procedure ensuring compliance with above-mentioned standards. Upon completion of all welds the piping immediately adjacent the weld shall be stamped with an identification number or code identifying the welder (welder's certification number). Welded joints found leaking during testing stages shall be replaced with a new shop welded section of piping.

- .11 All joining methods shall meet the requirements and standards listed in or by the NBC, NFC, applicable NFPA standards, the Contract Administrator, and the authority having jurisdiction.

.3 Fittings

- .1 Weld fittings up to and including 38mm shall be 13,790 kPa socket weld, 50mm and larger shall be butt weld.
 - .2 Pipe flanges shall be class 150 forged steel except for welded pipe connections, flanges for pipe 64mm and larger shall have a grooved extension for connection to pipe using mechanical groove coupling, flanges for pipe 50mm and smaller shall be threaded. Slip on or welding neck flanges may be used on shop fabricated components. Valve companion flanges shall be flat or raised face to suit valve flange. Provide suitable red rubber ring or full-face gasket, machine bolts and hex nuts unless otherwise recommended by manufacturer of connecting valve or equipment.
 - .3 Threaded fittings shall be class 125/150, rated for 1210 kPa water service, shall meet the requirements of NFPA 13 - *Installation of Sprinkler Systems*. Where rating differs on drawings the more stringent or higher rated fitting shall be used.
 - .4 Thread fittings shall be cast iron, steel, forged steel, galvanized malleable iron or brass.
 - .5 Close thread nipples are not permitted.
 - .6 Grooved fittings shall be Victaulic Groove End or Victaulic Firelock fittings as appropriate for supplied couplings. Drain elbows shall be Victaulic No. 10-DR, Drain Elbow.
 - .7 Mechanical grooved couplings shall be Victaulic style 005 Firelock rigid coupling.
 - .8 Mechanical grooved reducing couplings are not permitted.
 - .9 Grooved flange adapters shall be Victaulic Style 744 Firelock Flange Adapter or Victaulic Style 741 Flange Adapter, as
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indicated on drawings. Where style or pressure rating is not indicated on drawings Style 741 shall be used. See clause 2.1.4 - "Gaskets, Nuts, Bolts and Hardware".

- .10 Mechanical tees may be used where shown on drawings and where approved by the Contract Administrator. Mechanical tees shall be Victaulic Style 920/920N Mechanical-T Bolted Branch Outlet or Victaulic Style 922 Firelock Outlet-T.
 - .11 Grooved reducers shall be Victaulic No. 50 or No. 51. Where reduction to threads is necessary Victaulic No. 52 Reducer Small End shall be used.
 - .12 Thread to groove adapters shall be Victaulic No. 80 Female Thread Adapter or Victaulic No. 40 Groove to Thread Nipple.
 - .13 Groove to flange adapters shall be Victaulic No. 45 Flange Adapter Nipple or Victaulic No. 41 Flange Adapter Nipple.
 - .14 All grooved fittings and couplings shall be coated with either a rust inhibiting alkyd enamel paint, hot dip galvanizing to ASTM A-153 or zinc electroplating to ASTM B-633.
 - .15 Victaulic Style 073 Firelock Outlet Couplings are not permitted.
 - .16 Victaulic No. 66 Vic-End end of run sprinkler fittings are not permitted. Victaulic No. 67 Vic-End II end of run fittings may be used on 64mm piping lines.
 - .17 Victaulic Style 925 Snap-Let fittings are not permitted.
 - .18 Victaulic Style 923 Vic-Let fittings are not permitted.
 - .19 Victaulic PressFit, FIT, and Plain End systems and products are not permitted.
 - .20 Victaulic grooved end copper system and products may be used where approved by Contract Administrator. Submit to Contract Administrator for review and approval shop drawings and product data sheets for approval of all materials, products, and equipment when using this system.
 - .21 Victaulic stainless steel grooved piping system and products may be used where approved by Contract Administrator. Fittings shall be schedule 10S, 304 stainless steel conforming to ASTM A-403. Submit to Contract Administrator for review and approval shop drawings and product data sheets for approval of all materials, products, and equipment when using this system.
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- .22 Restricted orifice unions for use with inspectors test stations shall be a 25mm brass union fitting with an integral 13mm, machined orifice, LynCar Products Model No. 80534.

- .4 Gaskets, Nuts, Bolts and Hardware

- .1 Mechanical groove couplings shall have an EPDM gasket installed, suitable for use in fire protection systems; Victaulic Grade E, Type A or Victaulic Grade E standard gasket. All dry pipe systems shall have a flush seal gasket, Victaulic Grade E, FlushSeal.
- .2 Flange gaskets shall be 1.6mm, full faced red rubber gaskets, as manufactured by LynCar Products. Grooved flange gaskets shall be as supplied by flange manufacturer.
 - .1 Where grooved flange adapters mate to raised, serrated, rubber faced or AWWA cast flanges a suitable red rubber gasket and a flat 304 stainless steel, brass or phenolic flange washer (spacer ring) size identical to gasket shall be used as follows:
 - .1 Flange washers shall be metal unless used on grooved copper flange adapters, in such cases a type F phenolic flange washer shall be used. Victaulic Flange Washer, Type F Phenolic or Metal.
 - .2 When a grooved flange adapter mates to a raised face or serrated flange or system components; a flange gasket shall be installed adjacent to the serrated flange, the flange washer is installed between the flange gasket and grooved flange adapter.
 - .3 When a grooved flange adapter mates to a wafer valve where valves are rubber lined and partially rubber faced (smooth or not), the flange washer shall be placed between the valve and the grooved flange adapter.
 - .4 When a grooved flange adapter mates to a rubber faced flange the flange washer shall be placed between the grooved flange adapter and the rubber faced flange.
 - .5 When mating AWWA cast flanges to IPS grooved flanges the flange washer or transition ring shall be placed between two grooved flange adapters with the hinge points oriented 90-degrees to each other. Where one flange is not a grooved flange adapter a flange gasket shall be installed adjacent to the non-grooved flange and the flange washer inserted

between the flange gasket and grooved flange adapter. Transition rings shall only be used in piping 350mm and larger.

- .2 Where threaded or welded flanges mate a flange gasket shall be installed in conformance with the following requirements:
 - .1 Flange washers shall be metal unless used on copper or brass flange adapters, in such cases a phenolic flange washer shall be used.
 - .2 When flange mates to a raised face or serrated flange two flange gaskets with a flange washer between gaskets shall be installed between flanges.
 - .3 When flange mates to a wafer valve where valves are rubber lined and partially rubber faced (smooth or not) or when flange mates to a rubber faced flange no flange gasket or washer shall be installed.
 - .4 When two rubber faced flanges mate a flange washer shall be installed between flanges.
 - .3 Provide dielectric fittings, dielectric unions, flange isolation kits and other dielectric and isolation products where shown on drawings and whenever transitions are made between dissimilar metals. All thread to thread dielectric fittings shall transition by one brass threaded union or flange with a dielectric transition fitting. All grooved products shall transition with an approved dielectric waterway. Submit cut sheets for all dielectric and isolation products not listed below or any equal:
 - .1 Thread to groove, thread to thread, groove to groove and groove to groove dielectric fittings, Victaulic Style 47-GT/TT/GG Dielectric Waterway.
 - .2 Brass pipe nipples and unions may be used when approved by Contract Administrator.
 - .3 UL/ULC listed dielectric flanges and dielectric unions.
 - .4 Dielectric flange isolation kits 65mm and larger, Minton composition, one-piece integral sleeves and washers kit as manufactured by Advance Products & Systems, Inc. or equal.
 - .4 Hex head bolts and heavy hex nuts meeting ASTM A-183 and zinc electroplated in conformance with ASTM B-663 shall be used on all grooved products.
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- .5 Hex head bolts, heavy hex nuts and washers used on flanges and for general use shall meet the requirements of ASTM A-183 and be zinc electroplated in conformance with ASTM B-663.
 - .6 All thread, continuous or intermittent thread rod shall have a nickel-cadmium or zinc electroplating in conformance with ASTM B-663. All thread, continuous or intermittent thread rod shall meet the requirements of NFPA 13 - *Installation of Sprinkler Systems*.
- .5 Pressure Gauges, Miscellaneous Equipment and Supplies
- .1 Provide pressure gauges where indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Gauges shall be ABS bodied, bronze-gear movement, friction poly-carbonate window and precision type pointer. Gauges shall be 90mm diameter with range selected so that pointer is approximately vertical at normal system operating pressure and shall have dual scale (psi/kPa) with 'psi' on outer scale. Connection to system shall be by 6mm (¼-inch NPT) male pipe threads and shall be installed with LynCar Products Model No. 8077014 6mm three-way test valve. Installation shall have sufficient clearance at test port to permit connection of 100mm-diameter test pressure gauge. Valve test port shall be plugged during normal system operation, Wet systems - LynCar Products Model No. 307600, Dry Systems - LynCar Products Model No. 307605.
 - .2 Manual release panel assemblies shall consist of a special normally closed ball valve attached to a steel enclosure. The enclosure door shall only be able to be closed when the ball valve handle is in the closed position. The assembly shall connect to the actuated valve assembly by 13mm (½-inch) schedule 40 galvanized piping and a union on either side of assembly to facilitate servicing, Victaulic series 755 Manual Release Panel.
 - .3 Sectional flow alarm and test and drain assemblies shall be factory assembled and rated for working pressures of up to 1,723 kPa. Assembly from factory shall consist of the manifold body, flow switch, test and drain station and connection for pressure gauge. Victaulic style 747 Riser Manifold Assembly. Pressure gauge c/w three-way test valve shall be field installed, see clause 2.1.5.1 - Materials, Pressure Gauges and Miscellaneous Equipment in this section. AGF Model 8000 Commercial Riser Pack may be used on threaded connections up to and including 50mm. AGF models may use factory installed 3-way test valve and pressure gauge, ensure test port is plugged.
- .6 Valves
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- .1 Provide valves of types indicated on drawings or where not indicated of suitable type listed in this section. Valves shall be located where shown on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction.
 - .2 Valves shall be UL, ULC, and FM approved for use in fire protection systems. Valves shall be permanently marked with the manufacturers name or trademark, UL and ULC trademark, FM identification figure number and pressure ratings.
 - .3 Valves shall be of an indicating type with easy identification of open or closed position. Globe valves and OS&Y gate valves shall be of a rising stem design. Post or wall indicators shall visibly indicate open or closed position. Ball valves shall be designed so the handle points inline of the piping to which it is attached and the direction of water flow in the open position. Butterfly and supervisory type ball valves shall have a flag type indicator that visibly shows, open or closed position.
 - .4 Where valves control the flow of water into, between, through, or within fire protection systems they shall be considered supervisory valves. Supervisory valves shall be equipped with a UL, ULC, and FM approved supervisory switch. Wiring shall be by division 16.
 - .5 Gate valves 50mm and smaller shall be bronze, OS&Y pattern with threaded connections, rated for 1,210 kPa service, Crane Figure 459.
 - .6 Gate valves 64mm and larger shall be iron body, tapered solid wedge disc, renewable bronze seat rings, flanged ends, and rated for 1,210 kPa service, Crane Figure 467.
 - .7 Ball valves, non-supervisory 50mm and smaller shall be full port, threaded ends, chrome plated brass ball, rated for 4,140 kPa service, Crane Figure 9203-B.
 - .8 Bleeder, lever type ball valves used for testing pressure devices on shall be bronze body, zinc plated steel handle, rated for 1,210 kPa service, 3mm exhaust port and 13mm threaded connections, LynCar Products Model No. 4075.
 - .9 Globe valves, non-supervisory, 50mm and smaller shall be Class 150, bronze body, rising stem, renewable PTFE disc, with threaded ends, Crane Figure 7TF. Globe type 6mm three way valve for connection of pressure gauges shall be LynCar Products Model No. 8077014.
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- .10 Angle valves, non-supervisory, 50mm and smaller shall be class 150, bronze body, rising stem, renewable PTFE disc, with threaded ends, Crane Figure 17TF.
 - .11 Ball valves 50mm and smaller shall be brass body, standard port, brass gearbox, brass stem, chrome plated brass ball, TFE seats, rated for 2,410 kPa service, threaded ends, c/w two single pole double throw pre-wired switches for supervision, Victaulic Series 728 Firelock Ball Valve.
 - .12 Butterfly valves 64mm and larger shall be grooved end, heat fused polyphenylene sulfide coated ductile iron body, EPDM coated disc, gear operated valve position indicator, two single pole double throw pre-wired switches for supervision, Victaulic Series 705W Firelock Butterfly Valve complete with weatherproof actuator. Butterfly valves 64mm and larger where flanged connections are required shall be iron body, lug style, with aluminium-bronze disc and replaceable EPDM seat, manual gear operator with valve position indicator, rated for 1,379 kPa service, Anvil Series 8000FP wafer style butterfly valve complete with supervisory switches.
 - .13 Alarm test modules 50mm and smaller shall be bronze body, dual poly-carbonate sight glasses, test and drain ports, threaded ends, rated for 2,068 kPa service, Victaulic Style 720 Testmaster II Alarm Test Module, AGF Model 1000 TestAnDrain.
 - .14 Check valves 50mm and smaller shall be bronze body, class 150, y-pattern, PTFE renewable disc, with threaded ends, Crane Figure 141TF. Check valves 64mm and larger shall be a ductile iron body, PPS coated welded nickel seat, EPDM coated disc, upstream and downstream drain ports, rated for 2,065 kPa service, with grooved ends, Victaulic Series 717 Firelock Check Valve.
 - .15 Backflow preventers in AWWA class 1, 2, 3 installations shall be as follows:
 - .1 50mm and smaller double check assembly, bronze body, captured springs, top mounted access panels, replaceable seats and seat discs, with threaded ends, Watts Series 007 Double Check Backflow Assembly.
 - .2 64mm and 75mm double check assembly, epoxy coated cast iron body, captured springs, top mounted access panels, replaceable seats and seat discs, with flanged ends, Watts Series 007 Double Check Backflow Assembly.
 - .3 100mm and larger double check assembly, epoxy coated body, captured spring check, replaceable seats and seat discs, with flanged ends, Watts 709 OSYRW Double Check Assembly.
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- .4 All valves on backflow preventers shall be supervised.
 - .16 Backflow preventers in AWWA class 4, 5, 6 installations shall be as follows:
 - .1 50mm and smaller reduced pressure backflow preventer assembly, bronze body, threaded ends, captured springs, bolted access covers, replaceable seats and discs, Watts Series 909QT Reduced Pressure Backflow Preventer.
 - .2 64mm and larger reduced pressure backflow preventer assembly, captured springs, bolted access covers, replaceable seats and discs, fusion bonded epoxy coated body, with flanged ends, Watts Series 909OSYRW Reduced Pressure Backflow Preventer Assembly.
 - .3 All valves on backflow preventers shall be supervised.
 - .17 Ball drip valves shall be brass, 13mm or 19mm male to male threads and shall be available with a 13mm spring-loaded option, LynCar Products Model No. 803026x. Ball drip valves shall be piped locally over floor drains or directly into drain riser or line as indicated on drawings.
 - .18 Wet, Dry, Deluge and Preaction Alarm Valves
 - .1 Alarm check valves shall be rated for working pressures of up to 1206 kPa and shall be factory hydrostatically tested to 2413 kPa. Ductile iron body and clapper conforming to ASTM A-395/A-536, 304 series stainless steel shafts, 300 series stainless steel springs and EPDM clapper seal and seat O-rings. Alarm valve shall be capable of installation in both vertical and horizontal positions, Victaulic style 759.
 - .2 Actuated system valves (Deluge and Preaction), 38mm to 152mm shall be rated for working pressures of up to 2068 kPa and shall be factory hydrostatically tested to 4136 kPa. 203mm valves shall be rated for working pressures of up to 1551 kPa and shall be factory hydrostatically tested to 3102 kPa. Ductile iron bodied conforming to ASTM A-395/A-536, aluminium bronze clapper, aluminium bronze latch and piston, 17-4 series stainless steel shafts, EPDM clapper seal, nitrile rubber seat O-rings and 300 series stainless steel springs, Victaulic style 758-D and 758-P.
 - .19 Dry pipe accelerator valves shall be pneumatically actuated, bronze body, EPDM diaphragm and seal, 316 series stainless steel spring and porous stainless steel restrictor, Victaulic series 746 Firelock Dry Accelerator.
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- .20 Anti-flood/dry actuation valves shall be pneumatically actuated, rated for working pressures up to 2068 kPa, cast bronze lower chamber, brass upper chamber, EPDM seals and 316 series stainless steel fasteners, Victaulic series 753-A Firelock Dry Actuator/Anti-Flood Device.
 - .21 Electric release solenoid valves shall be rated for working pressure of up to 2068 kPa, forged brass body, 300 series stainless steel spring, fluoroelastomer seal and diaphragm. Electrical characteristics shall be 24 VDC, 8.7 Watts, 66 Ohms and 0.364 Amps, Victaulic series 753-E Firelock 300 psi Solenoid. Wiring by division 16.
 - .22 Auto drain valves used in the trim piping for dry and actuated system alarm valves shall be rated for working pressure of up to 2,068 kPa. Valve shall be solenoid type c/w brass body, stem, fittings, seal retainer and set screw, EPDM seal, stainless steel fasteners and spring, low density polyethylene (LDPE) protective cap and poly-vinyl chloride (PVC) drain hose. Victaulic series 749 Firelock Auto Drain.
 - .23 Ball check valves used in the trim piping for air supply to dry and actuated system alarm valves shall be rated for 2068 kPa, brass body and plug, Delrin ball and Buna-N O-ring, Victaulic series 748 Firelock Ball Check.
 - .24 Low pressure actuator valves used in the trim piping for actuated system alarm valves shall be rated for pressure up to 2068 kPa, pneumatically actuated, cast bronze lower chamber, brass middle and upper chambers, brass internal components, stainless steel fasteners and springs, brass strainer and eyelets, EPDM seals and diaphragm, and Buna-N O-rings, Victaulic series 776 Low Pressure Actuator.
- .7 Electronic Supervision and Tamper Devices
- .1 Vane type waterflow alarm switches shall be rated for service up to 3102 kPa, rated for surges of up to 5.4 M/s and alarm activation at 0.63 l/s. Switch configuration shall consist of two sets of single pole double throw (S.P.D.T.) Form C synchronized contacts rated at 15A, 125 VAC and 2A, 24 VDC, Switch enclosure shall meet NEMA 4 rating, be equipped with a 0-90 second range adjustable retard. Enclosure cover shall be held captive by tamper resistant screws or supervised for removal by a cover tamper switch. Flow switch saddles shall have a factory installed non-corrosive insert. Waterflow alarm vane switch shall be provided and installed at each sprinkler system connection to the wet pipe main where indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction, Potter Model VSR-F.
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- .2 Waterflow alarm pressure switches shall be rated for service up to 1723 kPa, operate on increasing pressure at the alarm port to 41.3 kPa. Switch configuration shall consist of two sets of single pole, double throw (S.P.D.T.) Form C synchronized contacts rated at 15A, 125VAC and 2A, 24VDC. Switch enclosure shall meet NEMA 4 rating, be equipped with a 0-90 second range adjustable retard. Enclosure cover shall be held captive by tamper resistant screws or supervised for removal by a cover tamper switch. Connection to the system shall be by 13mm male NPT pipe threads, in line valves shall be electrically supervised in their fully open position. Waterflow alarm pressure switch shall be provided and installed at each sprinkler system connection to the dry pipe alarm port, where indicated on the drawings, and as required by NBC, NFC, NFPA standards and the authority having jurisdiction, Potter Model PS10-2A
- .3 Air pressure supervisory switches shall be rated for service up to 1723 kPa, employ independent pressure elements for each switch, factory set to operate on decreasing pressure at 30 PSI, on increasing pressure at 50 PSI, and field adjustable between 68.9-1206 kPa. Switch configuration shall consist of two sets of single pole, double throw (S.P.D.T.) Form C independent contacts rated at 15A, 125VAC and 2A, 24VDC. Switch enclosure shall be die cast zinc, meet NEMA 4 rating and the cover shall be held captive by tamper resistant screws or supervised for removal by a cover tamper switch. Connection to the system shall be by 13mm male NPT pipe threads to a bleeder valve installed between the pressure supervisory switch and the pressure source to permit testing. Air pressure supervisory switch shall be provided and installed at the pressure system connection to the dry pipe, where indicated on the drawings, and as required by NBC, NFC, NFPA standards and the authority having jurisdiction, Potter Model PS40-2A.
- .4 Valve supervisory switches shall contain two sets of single pole double throw (S.P.D.T.) Form C contacts rated at 15A, 125/250 VAC and 2.5A, 0-30 VDC resistive. Switch enclosure shall have a die cast zinc base with two 13mm electrical conduit knockout connections, a die cast zinc cover with factory installed gasket and tamper resistant stainless steel screws. All components shall have a corrosion resistant finish. Units shall be mounted using a clamp bar and carriage bolt or by means of a detachable threaded 13mm nipple. Valves installed in line with pressure type alarm devices shall be supervised for their full open position via an integral valve position switch. Enclosure shall meet NEMA 6P requirements, totally submersible where required. Trip rod shall be fully adjustable in length, made of stainless steel and be held captive by a set screw. Provide and install valve supervisory switches for each sprinkler system control valve, which can be used to shut off the flow of the fire protection water supply
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to any zone or portion of. Valve supervisory switches shall be installed where indicated on the drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Switches used on outside stem and yolk valves shall be Potter OSYSU-2. Switches for post indicating or butterfly valves shall be Potter PCVS-2. Switches in line with pressure type alarm devices shall be Potter Model BVS-1/2", 3/4" or 1".

- .5 Valve supervisory switches for use on ball valves with lever or tee handles on listed backflow preventors not containing integral tamper switches shall contain two sets of single pole double throw (S.P.D.T.) Form C contacts rated at 10A, 125/250 VAC and 2A, 30 VDC resistive. Switch enclosure and cover shall be a non-corrosive composite material with one 13mm electrical conduit knockout connection, factory installed gasket and cover supervised for removal with integral tamper switch. All components shall have a corrosion resistant finish. Units shall be mounted using a mounting bracket, clamp bar and carriage bolt assembly. Valves shall be supervised for their full open position by valve position switch. Enclosure shall meet NEMA 6P requirements, totally submersible where required. Provide and install valve supervisory switches for each sprinkler system control valve, which can be used to shut off the flow of the fire protection water supply to any zone or portion of. Valve supervisory switches shall be installed where indicated on the drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction, Potter Model RBVS-T.
- .6 Water pressure supervisory switch shall be rated for service up to 1723 kPa, signal pump failure on a factory pre-setting of decreasing pressure of 758.4 kPa, signal an over pressure condition on increasing pressure to 896.3 kPa, and field adjustable from 68.9-1206 kPa. Switch configuration shall consist of two sets of single pole double throw (S.P.D.T.) Form C independent contacts rated at 15A, 125 VAC and 2A, 24 VDC and employ independent pressure elements for each switch. Switch enclosure shall meet NEMA 4 rating and the cover shall be held captive by tamper resistant screws or supervised for removal by a cover tamper switch. Connection to the system shall be by 13mm male NPT pipe thread to a bleeder valve installed between the pressure supervisory switch and the pressure source to permit testing. Water pressure supervisory switch shall be provided and installed on each wet pipe sprinkler system utilizing an excess pressure pump as a means to signal an alarm and as required by NBC, NFC, NFPA standards and the authority having jurisdiction, Potter Model PS120-2A.

.8 Sprinkler Heads, Cabinets and Wrenches

- .1 Provide chrome plated recessed automatic sprinklers with white escutcheon finish in areas with finished ceilings, as indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be factory tested to 3447 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 15mm (½-inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.). Sprinkler heads shall be a glycerine solution frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a beryllium-nickel spring and die cast brass frame. Victaulic Frame V27, K5.6, Models V2707 and V2708.
 - .2 Provide brass upright automatic sprinklers in unfinished areas where sprinkler piping cannot be concealed, as indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be factory tested to 3447 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 15mm (½-inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.). Sprinkler heads shall be a glycerine solution frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a beryllium-nickel spring and die cast brass frame. Victaulic Frame V27, K5.6, Models V2703 and V2704.
 - .3 Provide brass standard horizontal sidewall automatic sprinklers and chrome plated recessed horizontal sidewall automatic sprinklers with white escutcheon finish where shown on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be factory tested to 3447 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 15mm (½-inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.). Sprinkler heads shall be a glycerine solution frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a beryllium-nickel spring and die cast brass frame. Victaulic Frame V27, K5.6, Models V2709 and V2710.
 - .4 Provide automatic sprinklers to protect combustible structure above the sprinkler and/or floor space below or in fur vaults as indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be factory tested to 3447 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 15mm (½-inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.). Sprinkler heads shall be a glycerine solution
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frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a beryllium-nickel spring and die cast brass frame. Victaulic Frame V27, K5.6, Models V2725 and V2726.

- .5 Provide adjustable concealed automatic sprinklers with white escutcheon plate where indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be factory tested to 3447 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 15mm ($\frac{1}{2}$ -inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.). Sprinkler heads shall be a glycerine solution frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a beryllium-nickel spring, die cast brass frame, zinc chrome plated cold rolled steel cup and fusible solder cover plate. Victaulic Frame V38, K5.6, Models V3801 and V3802. In clean room applications provide a white nitrile rubber sealing gasket, Victaulic part number S380P00020.
- .6 Provide chrome plated flush or semi-recessed dry pendent and horizontal sidewall automatic sprinklers, dry concealed and dry brass upright automatic sprinklers where indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Escutcheon plates shall have a white finish. Sprinkler heads shall be factory tested to 3450 kPa and suitable for a working pressure of 1206 or 1723 kPa. Connection to system shall be by 33.7mm (1-inch NPT) pipe thread. Sprinkler heads shall have a 13 or 20mm nominal orifice size with 8,1 or 11,5 S.I. (5.6 or 8.0 Imp.) K-factor. Sprinkler heads shall be a glycerine solution frangible-bulb type, available in standard (5mm-bulb) or quick (3mm-bulb) response, shall have a Teflon coated beryllium-nickel alloy and brass spring assembly and die cast brass frame. Victaulic Frame V36, K5.6/K8.0, Models V3601, V3602, V3603, V604, V3605, V3606, V3607, V3608, V3609, V3610, V3611, V3612, V3617, V3618, V3619 and V3620.
- .7 Provide chrome-plated pendent and horizontal sidewall institutional sprinkler heads where shown on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Sprinkler heads shall be suitable for a working pressure of 1206 kPa. Connection to system shall be by 15mm ($\frac{1}{2}$ -inch NPT) pipe thread. Sprinkler heads shall have a 13mm nominal orifice size with a K-factor of 8,1 S.I. (5.6 Imp.) and shall be standard response and coverage. Sprinkler heads shall be a tamper resistant design with solder operating element and linkage mechanism, shall be brass bodied, beryllium-nickel and Teflon sealing assembly, copper - stainless steel - solder element and bronze deflector, core, post, pin, lever release spring, compression screw and hood.

Sprinkler shall be complete with chrome plated steel dust cover/escutcheon plate. Installation shall be in accordance with manufacturer installation and technical data sheet, Tyco Fire Products - Technical Data Sheet 650 and 654.

- .8 Provide Victaulic model V27 or V34 guard with or without intermediate shield as required on all sprinkler heads exposed to damage, where indicated on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction.
 - .9 Provide sprinkler head storage cabinet(s) to store stock of spare sprinkler heads as required by and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Cabinet(s) shall have room to facilitate storage of and shall contain for each type of sprinkler head stored in storage cabinet one sprinkler head installation wrench. Victaulic part numbers SA1-000-0000, SA2-000-0000, SA3-000-0000 and SA4-000-0000.
 - .9 Fire Department Connection(s) and Wall Hydrant(s)
 - .1 Provide 100mm hard-coated aluminium Storz 30-degree angle fire department connection with c/w strainer where shown on drawings and as required by NBC, NFC, NFPA standards and the authority having jurisdiction. Attachment to system by 100mm (4-inch NPT) pipe thread. LynCar Products model number 6624STZ.
 - .2 Provide 100mm hard-coated aluminium blind Storz cap with lock and securing wire or chain on all Storz connections. LynCar Products model number 6644STZ.
 - .3 Provide ring style wall plate for all Storz fire department connection(s), finish as indicated on drawings. Lettering to be of size, type and wording as required by the local fire department, NBC, NFC, NFPA standards and the authority having jurisdiction. LynCar Products product numbers 7097, 7097A, 7097C.
 - .4 Provide wall signage/placard complete with wording indicating interconnected sprinkler and standpipes, interconnected standpipes, combined sprinkler and standpipe or as required by local fire department. Sign shall have a red background with white 25mm block lettering. Sign shall be of weatherproof plastic or aluminium construction and permanently mounted with non-removable (drill out only) type fasteners.
 - .5 Provide ball drip on all check valves to system piping from fire department connections. See clause 2.1.6 - Materials, Valves in this section for make and model.
 - .10 Floor Plates and Sleeves
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- .1 Where piping passes through masonry walls provide steel pipe sleeves full thickness of wall.
- .2 Where riser piping passes through floor penetrations watertight floor sleeves shall be provided.
- .3 Provide split or solid round escutcheon plates on all exposed piping passing through walls, floors or ceilings.
- .4 Piping or equipment passing through fire or smoke separations shall be firestopped to the equivalent wall rating. Firestopping shall be UL and ULC listed and FMRC approved. All firestopping shall be by section 07840.

2.2 HANGERS, SUPPORTS AND BRACING

- .1 All piping, system components and appurtenances constituting the sprinkler and/or standpipe system(s) shall be supported in accordance with NFPA standards, NBC, NFC, the requirements of the authority having jurisdiction, the requirements of the Contract Administrator.
- .2 Pipe rings shall be zinc coated Anvil figure 69 or approved equal.
- .3 Hanger rods shall be electro-galvanized or cadmium plated of minimum 9.5mm diameter, rod size shall be in accordance with NFPA 13 - *Installation of Sprinkler Systems*.
- .4 In no case shall the sprinkler system piping and fittings be improperly braced so as to cause damage to other building systems or the building itself and its appurtenances.
- .5 Section 15500 shall submit all design documents and reports detailing the anchoring system and bracing with shop drawings prior to construction as part of submission of sprinkler shop drawings.
- .6 Contractor to include for testing concrete inserts for pipe hangers, pull test to be carried out at the discretion of the site inspector to approximately 20% of hangers installed. All test results are to be logged by contractor and submitted to Contract Administrator.

2.3 AUTOMATIC SPRINKLER SYSTEMS

- .1 Conventional wet automatic sprinkler systems shall be designed and installed in accordance with NFPA 13 - Standard for the Installation of Sprinkler Systems, NBC, NFC, local building codes, the authority having jurisdiction's requirements and the requirements of the Contract Administrator.
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- .1 Wet sprinkler systems shall only be installed in locations that are not subject to freezing conditions.
 - .2 All wet sprinkler systems connected to potable and non-potable water supplies shall be equipped with the backflow prevention devices as shown on drawings and as required by NFPA, NBC, NFC, local building codes and the authority having jurisdiction.
 - .3 Provide and install sectional flow alarm and test and drain assemblies when wet sprinkler systems have individual zones or multiple zones per floor level. Assembly shall be equipped with pressure gauge and sectional zone control valve complete with tamper switch.
 - .4 Provide pressure gauge complete with three-way test valve at top of all risers.
 - .5 Provide inspectors test station where shown on drawings and/or where required by NFPA standards. Inspectors test stations shall be complete with external splash pad. Where piping and fittings protrude through wall fittings and piping shall be galvanized.
 - .6 Provide and install wet alarm check valve where shown on drawings. Wet alarm valve shall be complete with factory supplied trimming kit including the following items:
 - .1 Alarm, pressure and flow switch. Wiring by division 16.
 - .2 Excess pressure pump.
 - .3 Water supply and system pressure gauges.
 - .4 By-pass line check valve.
 - .5 Alarm line (normally open) and alarm test line (normally closed) ball valves.
 - .6 Alarm line 1.6mm drain restrictor.
 - .7 Main system drain valve.
 - .8 Main control valve complete with tamper switch. Wiring by division 16.
 - .7 Provide and install all fittings, piping, appurtenances, etc. necessary and as required by NFPA standards, by this sub-section and as intended by the contract drawings and this specification to properly install a complete wet automatic sprinkler system.
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- .2 Single-interlock preaction, automatic sprinkler systems shall be designed and installed in accordance with NFPA 13 - Standard for the Installation of Sprinkler Systems, NBC, NFC, local building codes, the authority having jurisdiction's requirements and the requirements of the Contract Administrator.
- .1 Individual preaction systems shall not exceed a maximum system capacity of 2,839 litres, where system design allows water to reach the test connection in under 60 seconds systems may contain up to a maximum of 5,678 litres. Where larger systems are required additional actuated system preaction alarm valves shall be installed.
 - .2 Preaction systems connected to potable and non-potable water supplies shall be equipped with backflow prevention devices as shown on drawings and as required by NFPA, NBC, NFC, local building codes and the authority having jurisdiction.
 - .3 Provide pressure gauge complete with three-way test valve at top of all risers.
 - .4 Actuated system preaction alarm valves shall be of low air pressure (69 kPa) design.
 - .5 Provide inspectors test station where shown on drawings and/or where required by NFPA standards. Inspectors test stations shall be complete with external splash pad. Where piping and fittings protrude through wall fittings and piping shall be galvanized.
 - .6 Provide all piping, fittings, appurtenances, etc. necessary to connect the actuated system preaction alarm valve to the system piping.
 - .7 Provide and install an alarm pressure switch, supervisory switch, solenoid release valve (if required) and butterfly valve c/w supervisory tamper switch. Wiring by division 16.
 - .8 Provide and install low-pressure dry actuator. Dry actuator and auto drain valves installed within the valve trimming shall have the venting relief piped directly into a designated standpipe drain riser/line or piped locally over nearest floor drain when floor drains are located within 1,524mm of device.
 - .9 Actuated systems preaction alarm valve shall be complete with factory supplied trimming kit including the following items:
 - .1 Alarm pressure/flow switch and supervisory low pressure switch. Wiring by division 16.
 - .2 Water supply and system pressure gauges.
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- .3 Piston charge line ball valve (normally open), strainer, check valve, 1.8mm restrictor, pressure gauge and gauge valve.
 - .4 Alarm line ball valve (normally open), alarm test line (normally closed) ball valve, alarm drain line ball valve (normally closed), alarm line 1.6mm drain restrictor and drip check valve.
 - .5 Main system drain valve and flow test valve.
 - .6 Drip cup and drip cup check valve.
 - .7 Auto drain, check valves, ball check and dry actuator.
 - .8 Air line strainer and 1.6mm air line restrictor and Victaulic Series 757 Air Maintenance Device.
 - .9 Electric release solenoid valve.
 - .10 Manual pull station.
 - .11 Main control valve, complete with tamper switch. Wiring by division 16.
 - .10 Provide air compressor sized in accordance with the manufacturer data sheet of actuated system preaction valve. Air compressor shall be factory assembled and shall conform to the following criteria:
 - .1 Compressor shall be a cast iron head single or dual cylinder with 37.85, 75.7, or 113.5 litre (10, 20, or 30 gallon) tank. Tank size shall be selected based upon the following equation:
 - .1 $0.02 \times SC = TS$
 - TS = Tank capacity in litres
 - SC = System capacity in litres
 - *** For gallons divide by 3.785
 - .2 The tank size shall be rounded up to the nearest above listed capacity.
 - .2 Compressor shall be capable of restoring system to normal operating pressure from zero (0) pressure within 30 minutes. Required flow rate shall be determined by the following equation:
 - .1 $(2.4935 \times 10^{-7}) \times SC = FR$
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FR = Required flow rate in m³/s

SC = System capacity in litres

*** For CFM (ft³/min) multiply m³/s by 2119

- .3 Air compressor shall be set to automatically start at 34.5 kPa above system air pressure for sprinkler system and shall fill compressor air tank to 690.5 kPa.
- .4 Air compressor shall be complete with the following accessories:
 - .1 All fitting, gauges, piping, appurtenances, etc. required for connection of air tank to piston compressor.
 - .2 All fitting, gauges, piping, appurtenances, etc. required for connection of air tank to system air maintenance device.
 - .3 Electric motor, manufacturer recommended starter pre-wired to motor at factory if required (see Division 16 motor schedule) and any necessary controls or controllers. See division 16 motor schedule for voltages and electrical characteristics. Wiring by division 16.
- .11 All preaction sprinkler systems shall be properly braced to prevent movement, vibration, etc. that may compromise the systems integrity. Submit bracing details to Contract Administrator for review prior to installation.
- .12 Electric release panel and/or fire alarm panel supplied by division 16 shall contain primary power supply, emergency batteries, battery charger, transfer switches, pilot lights and auxiliary contacts as required for operation of the actuated system preaction alarm valve. Panel shall be capable of release control. Provide normally open and normally closed contacts for fire alarm system as required by division 16.
- .13 All smoke/heat detector heads that activate this system shall be identified. Co-ordinate with division 16 - Electrical.
- .14 Provide complete instructions for normal/emergency operation of system and for routine testing, draining, and pre-activating system. Mount on wall adjacent to valve station at approximately 1500mm above floor. Instructions shall be mounted in a frame complete with Plexiglas.
- .15 Provide and install all fittings, piping, appurtenances, etc. necessary and as required by NFPA standards, by this sub-

section and as intended by the contract drawings and this specification to properly install a complete preaction automatic sprinkler system.

- .16 All valve equipment shall be pre-assembled. Provide Victaulic Series 745 Firelock Fire-Pac pre-assembled unit.

2.4 FIRE EXTINGUISHERS, CABINETS, MOUNTING AND LOCATIONS

- .1 Provide new fire extinguishers, cabinets, surface mounting hardware, etc. as indicated on drawings. All fire extinguishers and appurtenances shall be UL and ULC listed.
- .2 Class A, B and C rated fire extinguishers used in general office areas, mechanical rooms, janitor rooms, water closets, warehousing areas, apartment blocks, parking garages, light manufacturing areas, and other similar areas shall use a mono ammonium phosphate based dry chemical agent. Extinguisher shall be Ansul SENTRY Model No. A05, 2.3 kg rated at 3-A, 10-BC.
- .3 Class C rated fire extinguishers used in computer, communications equipment, telecom equipment, information technology computer and network, data storage, irreplaceable data storage, irreplaceable document and art storage, laboratories, sensitive/expensive equipment and other similar areas/rooms shall use a Co2 based non-conductive agent. Extinguisher shall be Ansul SENTRY Model No. CD05A, 2.3 kg rated at 5-BC or Model No. CD10A, 4.6 kg rated at 10-BC as indicated on drawings.

2.5 Fire, Jockey, Excess Pressure Pumps and Controllers

- .1 See Division 15 and Division 16 motor schedule. Where conflicts or discrepancies in electrical characteristics occur between motor schedules and/or this section the electrical characteristics shown on the Division 16 motor schedule shall take precedence. Notify Contract Administrator prior to Bid Submission of any conflicts or discrepancies.
- .2 Excess Pressure Pump(s)
- .1 Excess pressure pump shall be Albany CEP series, bronze close-coupled rotary gear type. Pump shall be complete with motor available in 120V/0.25kW or 0.37kW/1-phase/60Hz. Pump shall be furnished with the following equipment; braided flexible hose connections, discharge check valve, suction strainer, mounting bracket and PRV set at 1085 kPa.
- .2 Minimum pump capacity shall be determined by the following equation:
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$$.1 \quad \frac{0.039 \times SC}{1800} + 0.096 = PC$$

PC = Pump capacity in litres per second (l/s)

SC = System volumetric capacity in litres

*** For GPM multiply l/s by 15.85

- .3 Provide and install an FDJ series jockey pump controller as manufactured by Cutler-Hammer. Controller unit shall meet the following requirements:
- .1 The jockey pump controller shall be UL and ULC listed and meet CSA requirements. Where approval agencies include Factory Mutual (FM) obtain FM approval of controller.
 - .2 Jockey pump controller shall be rated for the horsepower, voltage, phase and frequency rating as per division 16 motor schedule to match jockey pump.
 - .3 Controller shall be a full voltage, across-the-line type unit capable of sustaining an inrush current of approximately 600% of rated full load amperes.
 - .4 The unit shall be a wall mounted enclosure meeting NEMA/UL/CSA 3 and 3R (water splash protected) /NEMA/UL/CSA 4 (water tight) protection level and operational between 5°C and 50°C.
 - .5 The controller shall be factory assembled and tested and shall be identifiable by an individual serial number. All test reports for the jockey pump controller shall be available for review upon request.
 - .6 The controller shall be complete with 2 electrical rating labels located on the outside and the inside surface of the enclosure door. The labels shall clearly indicate the controller catalogue and serial no, line and control voltage, HP rating, phase, frequency, short circuit interrupting capacity, full load current, max. fusing, ampacity, options no., wiring diagram no. and production date.
 - .7 Complete installation and maintenance manuals including drawings of the controller shall be provided inside the controller enclosure.
 - .8 The controller shall be supplied with the following door mounted components approved to match the NEMA rating of the enclosure:
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- .1 One main disconnect switch complete with door interlock and padlock provision in the OFF position.
- .2 One Hand-Off-Auto rotary type, heavy duty selector switch.
- .9 The following control components shall be mounted inside the controller:
 - .1 One magnetic across-the-line motor contactor HP rated.
 - .2 One thermomagnetic motor protector complete with short circuit and motor overload protection.
 - .3 One pressure switch for clean water only complete with adjustable cut-in setting and independent differential adjustment (300 PSIG max.)
- .10 The controller shall be supplied with the following optional features:
 - .1 Extra "Pump Run" contacts.
 - .2 Extra "AC Power Failure" contacts.
 - .3 "Power on" light.
 - .4 "Run" light.
 - .5 Mercoid 10-300 PSI pressure switch.
 - .6 Low suction pressure switch and alarm pilot light.
 - .7 Low suction shutdown (requires low suction pressure switch).
 - .8 Running period timer.
 - .9 Elapsed run time meter.
 - .10 French labelling.

2.6 CONNECTION TO DOMESTIC WATER SUPPLY

- .1 Connect to domestic water supply as indicated on drawings. Coordinate connection with division 15400 - Plumbing and 15300 - Site Services. All connections to potable water sources shall have appropriate backflow prevention equipment installed as shown on drawings and as outlined in this specification.
 - .2 Wafer, resilient or single check valves are not considered as backflow prevention equipment.
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- .3 All piping up to listed backflow prevention equipment shall be schedule 40 or 10 series 304 stainless steel or Type-L copper. Where the authority having jurisdiction requires differing materials for connection to potable water source supply as required.
- .4 Valves, equipment and all appurtenances excluding piping up to and including backflow prevention equipment shall be epoxy or polyphenylene sulfide coated listed for use in potable water systems.
- .5 All couplings, fittings, materials, and appurtenances up to backflow preventer shall conform to the general materials section. Where stainless steel or copper tubing is used before the backflow preventor joining methods shall be as follows:
 - .1 Victaulic grooved stainless steel system complete with stainless steel fittings and rigid malleable iron mechanical couplings. Couplings shall be complete with flush-seal gaskets.
 - .2 Stainless steel piping may be shop-welded where and as required. Good welding practices including the preparation, cleaning and acid treatment of piping against corrosion shall be followed. Submit procedures to Contract Administrator for review.
 - .3 Victaulic grooved copper system complete with copper fittings and rigid malleable iron mechanical couplings. Couplings shall be complete with flush-seal gaskets.

PART 3 - EXECUTION

3.1 QUALIFICATION OF SUB-CONTRACTOR

- .1 Only experienced Fire Protection Sub-contractors, as determined by Contract Administrator, will be considered for this work. Sub-contractors must be able to show evidence of having performed work of similar type and size.

3.2 SHOP DRAWINGS, PERMITS, FEES

- .1 Prior to installation, prepare complete set of detailed shop drawings in accordance with requirements of NFPA Standard #13, and inspecting authority. Information as to architectural, structural, mechanical and electrical systems shall be obtained from respective drawings and/or from site. Carry out any necessary flow tests without extra compensation.
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- .2 Detail design shown on shop drawings shall conform to general piping layout and sprinkler arrangement shown on drawings. Contract Administrators approval is required for alternative designs or revisions other than as required for co-ordination with other Contractors and existing site conditions.
 - .3 If Contractor is requested to provide costing for a proposed change notice (PCN's) the pricing shall be complete with a detailed material, labour and services breakdown. Sufficient information shall be provided to allow and ensure verification of pricing. Failure to submit detailed price breakdowns for PCN's may result in hourly charges payable by sprinkler contractor for each additional review of PCN pricing to Contract Administrator and the City of Winnipeg. Charges shall not be applied to any party when detailed pricing is submitted and rejected due to cost of work or when re-pricing is requested.
 - .4 At completion of work, provide:
 - .1 Two (2) paper sets (hard copies) of "As-Built" drawings with all changes incorporated.
 - .2 Electronic data files in AutoCad (2000+) format including .DWG, .DWF, .DXF(R12) files and all external reference files (XREF) in same drawing formats. Binding files is considered acceptable. Provide all files on CD-ROM in a PC readable format.
 - .5 Submit shop drawings and calculations to Contract Administrator for review and to inspecting and inspection fees. Inspecting authorities for this project will be:
 - .1 Local building inspection department and/or fire department.
 - .2 The City of Winnipeg's Insurance Underwriters.
 - .6 Arrange for inspection and testing of all work, and make any changes required to comply with regulations of inspecting authority.
 - .7 Systems shall be designed in accordance with requirements of:
 - .1 The City of Winnipeg's Insurance Underwriters.
 - .2 National Building Code of Canada and National Fire Code of Canada.
 - .3 Manitoba Building Code and Manitoba Fire Code.
 - .4 Local building regulations.
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.5 All applicable NFPA Codes & Standards.

3.3 EXAMINATION OF DRAWINGS AND CO-OPERATION

- .1 Examine all architectural, structural, mechanical and electrical drawings before preparing shop drawings. Arrange position of sprinkler heads, pipes, etc. as required to prevent interference with work of other Contractors, and existing conditions.
- .2 Co-operate with all other sub-contractors installing equipment which may affect proper installation and operation of work and arrange sprinkler heads, etc. in proper relation to other apparatus, such as lighting fixtures, unit heaters, air inlets, air outlets etc., both new and existing.
- .3 Provide wiring diagrams, dimensions of concrete bases, dimensions of masonry openings, etc. as required by other Subcontractors.

3.4 EXISTING CONDITIONS

- .1 Before commencement of any work, examine work of other Contractors and make immediate report to Contract Administrators of any defect or interference affecting work or guarantee of this work.
- .2 In case of buildings or site conditions existing prior to Bid Submission, examination and report must be made at least seven (7) working days prior to closing of Bid Opportunity, otherwise existing conditions will be considered acceptable to Section 15500, and no later allowance will be made for extras relating to these conditions.

3.5 PIPING SYSTEMS

- .1 Inside of all pipe, fittings, valves and all other equipment to be left smooth, clean, and free from blisters, loose mill scale, sand and dirt.
 - .2 Install unions or flanges at all equipment connections, valves, etc.
 - .3 Install dielectric insulating couplings between all pipes or apparatus constructed of dis-similar metals.
 - .4 Pipe bending, other than wrought iron, permitted only if seamless steel pipe is used without distortion, rippling and reduction in wall thickness. Contract Administrator reserves right to have pipe section replaced with fittings if bending is not satisfactory.
 - .5 Cut all pipe accurately to measurements taken at site, and shall be installed without springing or forcing.
-

- .6 Run all piping in accessible pipe spaces in such a way that it does not interfere with free access into pipe space.
- .7 All pipe concealed in walls or inaccessible spaces shall have welded joints.
- .8 Welded pipe sections shall be shop fabricated as far as possible and/or to minimize field welding required. Welding on site is not permitted except with special approval of authorities having jurisdiction. If site welding is required obtain written approval of authorities having jurisdiction and follow all safety precautions required by such authorities.

3.6 HOLES IN STRUCTURAL MEMBERS

- .1 If drilling of structural beams or other load bearing members is required by design or by site conditions for passage of piping, obtain Contract Administrators approval for location and proposed drilling procedure before drilling. Drill only in locations previously approved by Contract Administrator. Where drilling required by design or existing site conditions be responsible for carrying out same to approved procedure.
- .2 Drilling shall be carried out by Section 15500. Co-ordinate as required for proper location and procedure.
- .3 Do not cut or install piping until final drilling locations are approved by Contract Administrator. Section 15500 will not be reimbursed for extra cost incurred to relocate piping previously installed on basis of unapproved drill locations.

3.7 HYDRAULIC DESIGN

- .1 Section 15500 shall use hydraulic design in preparing shop drawings for system. It shall be responsibility of Section 15500 to carry out necessary calculations and to submit calculations, data, and drawings in accordance with requirements of NFPA Standard #13 and authority having jurisdiction.

3.8 PROVISION FOR FUTURE EXPANSION/INTERCONNECTION

- .1 Due to project scheduling requirements, systems have been broken down into stages for phased installation under separate contracts.
 - .2 Where noted on drawings piping shall be capped off for future expansion, or connected to existing systems.
-

- .3 Where piping is shown capped off for future expansion, Section 15500 shall ensure adequate size piping is installed to feed future system expansion. Section 15500 shall:
 - .1 Provide hydraulic calculations acceptable to authority having jurisdiction and Contract Administrator to prove adequate sizing of supply piping to future system taking account of all future sprinklers required. Design area of operation shall not be reduced.
- .4 Where piping is shown connecting to existing system make all connections as required.
 - .1 When new system is supplied from existing system provide hydraulic calculations based on flow data, etc. for existing systems to prove adequate water supply to new system.
 - .2 When new system supplies existing provide hydraulic calculations for both systems to prove adequate water supply to both systems.

3.9 INSPECTION AND TESTING OF FIRE PROTECTION SYSTEMS

- .1 Provide all labour, material, equipment, etc. as required to carry out testing as specified herein and as required by authorities having jurisdiction to prove satisfactory completion, performance and acceptance of all systems.
 - .2 Testing shall include:
 - .1 Flow Tests
 - .2 Pressure Tests
 - .3 Inspectors Tests
 - .3 Conduct actual flow tests on water systems.
 - .4 Pressure Tests
 - .1 Perform pressure tests on all new or modified piping systems to requirements of NFPA #13 authority having jurisdiction, and additional requirements noted in this specification.
 - .2 All systems shall be pressure tested after final completion. If subsequent modifications are necessary; eg. relocation of sprinkler drops or similar minor revisions, pressure tests shall be repeated as directed by Contract Administrator.
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- .3 Sprinkler mains and branch piping above new ceilings shall be pressure tested and all leakage repaired before installation of ceiling tiles.
 - .4 Final pressure test shall be carried out after installation of sprinklers.
 - .5 In addition to hydrostatic pressure tests noted above, and operational tests noted below, all preaction sprinkler systems shall be subjected to a pneumatic test. This test shall be carried out after satisfactory completion of operational tests noted below. On completion of operational tests, drain entire pre-action system including each sprinkler drop leg to pendent sprinklers. Install new sprinkler heads and test system under 175 kPa air pressure for 24 hours. Test shall be considered satisfactory when observed pressure drop is less than 10 kPa over 24-hour period.
- .5 Inspectors Tests
- .1 Inspectors tests shall be performed at all dry pipe preaction and alarm check valve stations, at all zone stations, flow switches, etc., and at other locations as required by authority having jurisdiction.
 - .2 Tests shall prove satisfactory operation of all flow switches and other alarm devices and all fire detectors connected to preaction system.
- .6 Preaction System Test
- .1 Each preaction system shall be subject to a complete operational test after successful completion of hydrostatic pressure tests noted above.
 - .2 Notify Contract Administrator before testing and arrange suitable time for Contract Administrator to witness test.
 - .3 For each system, verify that main preaction water valve will trip through every associated fire alarm detector circuit. Coordinate testing with fire alarm supplier when fire alarm system is being verified. Verify that flow switch for building sprinkler system annunciates on building fire alarm system each time the main preaction sprinkler valve is tripped by an associated fire alarm control circuit.
 - .4 System control valve shall be open and all other system conditions shall be in normal 'ready' condition. System shall be allowed to flood completely and pressurize on at least one occasion. System(s) shall remain flooded with water and under normal pressure for a minimum 24-hour period.
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- .5 Verify correct operation of system and components, and provide test documentation of same per Clause .8 Documentation. Correct any deficiencies and re-test to satisfaction of Contract Administrator. Include copy of all test documentation in each maintenance/operating manual.
 - .6 Drain entire system after testing, including all sprinkler drop legs.
 - .7 Install sprinkler heads after testing is completed, if heads were installed during testing replace sprinkler heads with new. All sprinkler heads being replaced are to be stored and shown to Contract Administrator prior to disposal. The current market salvage value of these sprinkler heads is to be turned over to the City of Winnipeg.
 - .8 After replacing or installing sprinkler heads carry out pneumatic pressure test as noted in 4.3 above.
 - .7 Documentation
 - .1 Section 15500 shall properly document all testing distribute same to all authorities having jurisdiction, Contract Administrator, and the City of Winnipeg. Testing shall be repeated as required until acceptable results obtained as determined by authority having jurisdiction and Contract Administrator.
 - .2 On completion on inspections and testing submit to Contract Administrator and authorities having jurisdiction completed signed copies of appropriate NFPA-13 Contractor's Material & Test Certificate, Forms 85-A and 85-B.
 - .8 Advance Notice of Testing
 - .1 Arrange suitable times with authorities having jurisdiction, Contract Administrator and the City of Winnipeg in advance of all testing so that all have opportunity to witness testing.
 - .9 Activation
 - .1 All systems and fire pumps shall be left in normal active duty condition immediately following satisfactory completion of testing.
-

END

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 WORK INCLUDED

- .1 Labour, materials, plant, tools, equipment and services necessary for and reasonably incidental to completion of following services:
 - .1 hot water heating

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
- .2 Section 15180 Insulation
- .3 Section 15400 Plumbing
- .4 Section 15800 Air Distribution
- .5 Section 15900 Controls/Instrumentation
- .6 Section 15990 Testing, Adjusting and Balancing
- .7 Section 16010 Electrical General Provisions

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- .1 Low, Medium, & High Pressure Steam, Condensate, Condenser Water, Chilled Water, Hot Water Heating, Glycol Heating and Glycol Heat Recovery Services.
 - .1 Pipe Diameter:
 - .1 13mm to 250mm (1/2" to 10")- Schedule 40 carbon steel, continuous weld or electric resistance weld pipe conforming to A.S.T.M. A53 Grade B.
 - .2 300mm to 400mm (12" to 16") - Standard weight carbon steel, electric resistance weld pipe conforming to A.S.T.M. A53 Grade B.
 - .3 450mm and over (18") - Standard weight carbon steel, submerged arc welded pipe conforming to A.S.T.M. AP15L Grade X42.
 - .2 Fittings
 - .1 Unions to be brass to iron ground joint type. Screwed fittings on steel pipe to be best quality 1034 kPa (150 psi) black malleable iron, banded. Nipples to suit pipe type.

Thred-O-Lets and Weld-O-Lets to be manufactured to ASTM A181, Grade 1.

.2 Butt welding fittings to be Crane manufactured to ASTM A-234. Flanges to be Grinnell forged carbon slip-on welding flanges conforming to ASTM A181, Grade 1. Gaskets to be preformed non-asbestos. Site or shop cut gaskets unacceptable. Use ring gaskets on raised face flanges and full faced gaskets on flat face flanges. Use 1034 kPa (150 psi) flanges on water and low pressure steam systems to 682 kPa (99 psi). Above 682 kPa (99 psi) use 2069 kPa (300 psi) flanges.

.3 On high pressure steam and high pressure condensate lines 689 kPa (100 psi) and above, screwed fittings to be best quality 2068 kPa black malleable iron banded.

2.2 VALVES

.1 Schedule of Valves

.1 All valves of each type specified shall be of one manufacturer. Submit brochure of valves selected, showing make, figure numbers, material of construction and use.

.2 All valves shall conform to the requirements of the Manufacturers Standardization Society (MSS).

.2 Globe Valves - 0 to 682 kPa (0 to 99 psi)

.1 Sizes Up To and Including 50mm (2") - Screwed Ends: Straight - Crane Fig. 7TF, Toyo Fig. 221, Kitz Fig. 09, Nibco Fig. T-235Y, Grinnell Fig. 3240, Newman Hattersley Fig. 13 or Jenkins Fig. 106BJ. Angle - Crane Fig. 17TF, Kitz Fig. 38, Nibco Fig. T-335Y or Jenkins Fig. 108BJ. All valves to have Teflon discs.

.2 Sizes 64mm (2-1/2") and above - Flanged Ends: Straight - Crane Fig. 351, Toyo Fig. 400A, Nibco Fig. F-718-B, Grinnell Fig. 6200A, Newman Hattersley Fig. 731 or Jenkins Fig. 2342J. Angle - Crane Fig. 353, Kitz Fig. 76, Nibco Fig. F-818-B or Jenkins Fig. 2344J.

.3 Gate Valves 0 to 682 kPa (0 to 99 psi)

.1 Sizes up to and including 50mm (2") - Screwed Ends - Crane Fig. 428, Toyo Fig. 293, Kitz Fig. 24, Grinnell Fig. 3010, Nibco Fig. T-111 or Jenkins 810J.

.2 Sizes 64mm (2-1/2") and above - Flanged Ends - Crane Fig. 465½, Toyo Fig. 421E, Kitz Fig. 72, Grinnell Fig. 6020A, Nibco Fig. F-617-0, Newman Hattersley Fig. 504 or Jenkins fig. 454J.

.4 Butterfly Valves

.1 Valves to be rated at 1034 kPa (150 psig) with cast iron body, aluminum bronze disc, stainless steel shaft, Buna N shaft seals, E.P.D.M. seat, extended neck design allowing valve operator to clear insulation, bubble-tight shut-off to 1034 kPa (150 psig).

.2 Keystone Fig. ARI, Center Line Series 200, Grinnell Series 8000 or Nibco Fig. WD-2000.

- .3 Valves 200mm (8") and smaller to have lever-lock handles with 10-position throttling plates.
 - .4 Valves 250mm (10") and larger to have gear operators with position indicator.
 - .5 Butterfly valves shall be considered equal to gate valves for chilled water, condenser water, glycol and hot water heating installations.
 - .6 On flanged piping at all equipment (pumps, coils, chillers, boilers and the like), use valves conforming to requirements of above with fully tapped body lugs so that valve can be connected individually to adjacent flanges.
 - .7 Keystone Fig. AR2, Centre Line Series 200 Lug Body, Grinnell Series 8000 lug body or Nibco Fig. LD-2000.
- .5 Ball Valves
- .1 Valves to have brass body, screwed ends, brass ball and stem and teflon seating seal (175 deg. C).
 - .2 Ball valves shall be considered equal to gate valves for low pressure condensate, hot water heating, chilled water, condenser water and glycol installations.
 - .3 Toyo Fig. 5044A, Kitz Fig. 58, Grinnell Fig. 171N, Nibco Fig. T-FP600, Newman Hattersley Fig. 1969, Victaulic 721, 722 or Jenkins Fig. 201J.
- .6 Check Valves
- .1 Horizontal Piping
 - .1 Sizes up to and including 50mm (2") - Crane Fig. 41TF, Toyo Fig. 236T, Grinnell Fig. 3310, Kitz Fig. 22, Nibco Fig. T-413-Y, Victaulic 716 or Jenkins Fig. 4041TJ.
 - .2 Sizes 64mm (2-1/2") and above
 - .1 862 kPa wafer style with cast iron body, 316 stainless steel disc and stem, E.P.D.M. seat, Inconel-X spring and Teflon bushings, Chek-Rite Model 12-CET, Moyes & Groves Fig. W12A-I6V.
 - .2 Vertical Piping
 - .1 Sizes up to and including 50mm (2")
 - .1 862 kPa Grinnell Fig. 3600 bronze body spring loaded check valve with Teflon disc.
 - .2 Size 64mm (2-1/2") and above
 - .1 862 kPa Center Line, Series 800, wafer style check valve with ductile iron EPDM lined body, aluminum bronze check valve plates and stainless steel shaft, springs and travel stops.
- .7 Drain Valves - 3/4" Toyo Fig. 5046, Kitz Fig. 68C.C. c/w brass cap and chain, Newman Hattersley Fig. 1969 c/w brass cap and chain or Jenkins Fig. 201J c/w brass cap and chain.
- .8 Circuit Balancing Valves
- .1 13mm (1/2") to 19mm (3/4") soldered.
 - .1 Provide Armstrong Model CBV-CS solder type Circuit Balancing Valve.
 - .2 Each valve shall have metering ports incorporating EPT check valves, on both sides of the seat.
-

- .3 "Y" pattern globe style, designed for either presetting with balance schedule or for proportional balancing.
- .4 All metal parts bronze copper alloy. Each valve shall provide three functions.
 - .1 precise flow measurement
 - .2 precision flow balancing
 - .3 positive shutoff with no-drip soft seat
- .5 Valves shall have one 360 degree adjustment turn of handwheel with positive memory, allowing valve to be shut off and reopened to its balance setpoint.
- .6 Ship with pre-formed insulation to meet or exceed ASTM D 1784/cLASS 14253-c, MEA #7-87, ASTM-E-84 and ASTM-E-136 with flame spread rating of 25 or less and smoke development rating of 50 or less.
- .2 13mm (1/2") to 50mm (2") Soldered
 - .1 Provide Armstrong Model CBV-S solder type CBVs or Tour & Andersson.
 - .2 Each valve shall have metering ports incorporating EPT check valves, on both sides of the seat.
 - .3 "Y" pattern equal percentage globe style, designed either for presetting with balance schedule or for proportional balancing. All metal parts bronze copper alloy.
 - .4 Each valve shall provide three functions:
 - .1 Precise flow measurement.
 - .2 Precision flow balancing.
 - .3 Positive shutoff with no-drip soft seat.
 - .5 Provide 1/4" NPT tapped drain port on each side of valve seat.
 - .6 Valves shall have four (4) full 360 degree adjustment turns of handwheel (1440 degree) with micrometer type indicator and hidden memory feature to program valve for precise, tamper-proof balanced setting. When installed, handwheel and metering ports shall not be located on bottom of valve to prevent sediment deposits. Position handwheel scale so it may be clearly read without use of mirrors or any special tools.
 - .7 Metering ports interchangeable with drain ports to allow for read-out flexibility when installed in tight piping locations.
 - .8 Ship with pre-formed insulation to meet or exceed ASTM D 1784/cLASS 14253-c, MEA #7-87, ASTM-E-84 and ASTM-E-136 with flame spread rating of 25 or less and smoke development rating of 50 or less.
- .3 13mm (1/2") to 50mm (2") threaded
 - .1 Provide Armstrong Model CBV-T threaded type CBV.
 - .2 Each valve shall have metering ports incorporating EPT check valves, on both sides of the seat.
 - .3 "Y" pattern equal percentage globe style, designed either for presetting with balance schedule or for proportional balancing. All metal parts bronze copper alloy.
 - .4 Each valve shall provide three functions:
 - .1 Precise flow measurement.
 - .2 Precision flow balancing.

- .3 Positive shutoff with no-drip soft seat.
- .5 Provide 1/4" NPT tapped drain port on each side of valve seat.
- .6 Valves shall have four (4) full 360 degree adjustment turns of handwheel (1440 degree) with micrometer type indicator and hidden memory feature to program valve for precise, tamper-proof balanced setting. When installed, handwheel and metering ports shall not be located on bottom of valve to prevent sediment deposits. Position handwheel scale so it may be clearly read without use of mirrors or any special tools.
- .7 Metering ports interchangeable with drain ports to allow for read-out flexibility when installed in tight piping locations.
- .8 Ship with pre-formed insulation to meet or exceed ASTM D 1784/cLASS 14253-c, MEA #7-87, ASTM-E-84 and ASTM-E-136 with flame spread rating of 25 or less and smoke development rating of 50 or less.
- .4 Size 64mm (2-1/2") to 150mm (6") diameter.
 - .1 Provide Armstrong Circuit balancing Valves or Tour & Andersson (CBV) as noted. CBVs shall be CBV-G (straight) or CBV-A (angle).
 - .2 Valve body of ductile iron with grooved ends or with Armgrip non-rotating ductile iron flange adapters.
 - .3 Valves suitable for working pressures of 150 psi.
 - .4 Valve to have metering ports with EPT check valves on both sides of seat.
 - .5 Valves to be "Y" pattern modified equal percentage globe style, designed either for presetting with balancing schedule or for proportional balancing.
 - .6 Each valve shall perform three functions:
 - .1 precise flow measurement
 - .2 precision flow balancing
 - .3 positive shutoff with no-drip soft seat.
 - .7 Valves shall have five 63.5mm (2-1/2"); 76mm (3") or six 100mm (4"); 150mm (6") full 360 degree adjustment turns of handwheel with micrometer-type indicator and hidden memory feature to program valve for precise, tamper-proof balanced setting. Do not install handwheel and metering ports on bottom of valve to prevent sediment deposits. Position handwheel scale for clear reading without use of mirrors or other special tools.
 - .8 Install valves at least five pipe diameters downstream from any fitting and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream of CBV shall be free of any fitting.
 - .9 Furnish CBVs with pre-formed insulation to meet or exceed ASTM D 1784/Class 14253-C, MEA #7-87, ASTM-E-84 and ASTM-E-136 with flame spread rating of 25 or less and smoke development rating of 50 or less.
 - .10 Valves to be grooved/flanged.

2.3 EXPANSION JOINTS

- .1 On piping up to and including 64mm (2-1/2") diameter, FLEXONICS packless expansion compensators, having type 321 stainless steel bellows, suitable for traverse up to 44mm (1-3/4"), c/w guide sleeve and traverse stops. Expansion compensators up to and including 50mm (2") to have screwed ends or flanged ends; expansion compensators of 64mm (2-1/2") in size or larger to have flanged ends. Compensators to be external type 'H'.
- .2 On piping of 75mm (3") and above, Flexonics packless self-equalizing single expansion joints, with type 304 stainless steel bellows. Sizes 75mm (3") and above to be externally guided with flanged ends.
- .3 Guides to be Flexonics.
- .4 Expansion joints shall be selected on the following basis:
 - .1 Hot water heating - 100 deg.C temp. rise.

2.4 FLEXIBLE PIPE CONNECTIONS

- .1 On "hot" liquid systems provide Hydro Flex flexible braided stainless steel connectors manufactured of 300 series stainless steel convoluted metal bellows and braid with 1034 kPa (150 lb.) forged steel flanges (PCFF) or N.P.T. male ends (PCMX). Connectors to be 454mm (18") long unless noted otherwise on drawings or schedule.

2.5 AIR VENTS

- .1 Manual air vents: Dole #14 key-operated air vent rated at 1034 kPa (150 psig) with copper tube extensions or Dole #9 screwdriver operated air vent rated at 1034 kPa (150 psig).
- .2 Automatic air vents: Dole #75 automatic float air vent rated at 1034 kPa (150 psig).

2.6 STRAINERS

- .1 Strainers shall be Spirax Sarco type YS-250 or Toyo Fig. 380 for sizes up to and including 50mm (2") screwed ends.
- .2 On pipe sizes 64mm (2-1/2") and larger, use Spirax Sarco type CI-125 and F-125, Kitz Fig. 80 or Toyo Fig. 381A for systems operating below 689 kPa (100 psig) and use Spirax Sarco extra heavy type CI-250 and F-250 for systems operating at 689 kPa (100 psig) and above.
- .3 Screens shall be stainless steel with perforations as follows:

<u>Size</u>	<u>Water/Glycol</u>	<u>Steam</u>
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Up to 3"	20 MESH	20 MESH
4" to 6"	1/8"	3/64"
8" to 18" (CI-125, F-125)	1/8"	1/16"
8" to 18" (F-250)	1/8"	3/64"

2.7 THERMOMETERS

- .1 Ashcroft Series EI bi-metal dial thermometers, having stainless steel cases, rings, and stems, glass covers and adjustable pointers. Accuracy to be 1% of full span.
 - .1 Hot water heating systems - plus 10 deg.C to 150 deg.C.
- .2 Thermometers located up to 1.5m (60") above finished floor to have 75mm (3") diameter dials; and located above 1.5m (60") to have 125mm (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 installed. Stem type to be approved by Contract Administrator.
- .3 Brass separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Minimum length of stems to be 150mm (6").

2.8 PRESSURE GAUGES

- .1 Ashcroft type 1010 quality gauges having aluminum cases, bronze geared movements, bronze bourdon tube, friction glass cover, steel slip ring, precision type pointer. Accuracy to be 1% of full scale.
- .2 Use 113mm (4-1/2") dials. Where mounted above 3m (10') from floor level, use 150mm (6") dial. Gauges to be chosen with indicating needle at 12 o'clock position for normal operating pressure. Gauges shall have dual indication (i.e. kPa, psi) with kPa prominent figure.
- .3 Provide Ashcroft Fig. DH-11 brass needle valve on gauges on water and glycol systems.
- .4 Provide Ashcroft Fig. 1/4-1106B pulsation dampener on pump gauges.

2.9 WATER PRESSURE REDUCING VALVES

- .1 Chilled water and hot water heating systems: Fisher type 95-H pressure reducing valves. Refer to schedule. Provide backflow preventer and strainer.
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2.10 SAFETY RELIEF VALVES AND DRAINS

.1 Water Services

.1 On heat exchangers and expansion tanks use Conbraco 510 Series relief valves, c/w packed caps. Valves to be lever-operated, ASME Section VIII approved, rated at 10% overpressure.

.2 Install Consolidated Fig. 1665 drip pan elbows on all safety valve discharges. Drip pan elbow to have tapped drain connections in pan and elbow.

.3 Provide drains from all boiler relief valves.

.4 Refer to Safety Valve and Relief Valve Schedules.

2.11 FORCED DRAFT, HIGH EFFICIENCY CONDENSING BOILER PLANT

.1 Furnish an AERCO boiler plant consisting of two (2) natural gas fired model KC 1000 fire tube design, hydronic, condensing boilers, each having an input of 1000 mbh and a maximum gross output of 860 to 915 mbh dependent upon return water temperature.

.2 The boilers shall carry ULC/FM approval and be approved for operation in the Province of Manitoba.

.3 The boilers shall be a condensing fire tube design with a modulating power burner and positive pressure discharge. The heat exchanger/combustion chambers shall incorporate a helical firetube design that will be self supporting and baffle free. The pressure vessels/heat exchangers shall be ASME stamped for a working pressure of 150 psig and carry a Canadian Registration Number for the Province of Manitoba.

.4 Boiler exhaust manifolds shall be of corrosion resistant porcelain enameled cast iron, with a 6" dia flue connection. The exhaust manifold shall have a gravity drain and reservoir, for elimination of condensation. The exhaust shall be suitable for side wall venting and the boiler combustion air intakes, shall be provided with adaptor kits for connection to sealed combustion ductwork.

.5 The boilers shall be capable of handling return water temperatures down to 40 deg. F, without sustaining damage due to thermal shock or fireside condensation and carry a ten year warranty against failure due to thermal stress, condensate corrosion, mechanical defects or workmanship.

.6 The burners shall be forced draft, full modulation and operate on an adjustable inverse ratio in response to load demand. Maximum BTU input to BTU output efficiency shall be achieved at minimum firing input. Each burner shall be designed for a 14:1 turndown for a total plant turndown capability of 28:1. Boiler

plant efficiency shall increase upon a decrease in boiler firing rate. With both boilers controlled to fire in unison, and system supply water temperatures of 100 deg. F or lower, the expected plant fuel to water efficiency of the heating plant will be 95% to 93% through a firing range of 7-1/2% to 50%, of maximum input of each boiler.

- .7 The boiler control system shall be segregated into four components: "C-More" Control Panels, Power Boxes and Input/Output Connection Boxes, mounted and wired on each boiler and on BMS (Boiler Management System Panel) shipped separately for wiring by the control section.
 - .1 The C-More controls will include the following features:
 - .1 Six (6) surface mount circuit boards:
 - .1 LED temperature display
 - .2 VFD module for all message annunciation
 - .3 CPU, housing all control functions
 - .4 Low water cut off with test and manual reset functions
 - .5 Power supply board
 - .6 Ignition, stepper and flame safeguard control
 - .2 The combustion safeguard/flame monitoring system shall utilize spark ignition and a rectification type flame sensor.
 - .3 The controller shall annunciate boiler and sensor status and include 8 separate status and 34 separate fault, self-diagnostic messages.
 - .4 The C-More control will incorporate:
 - .1 PID set point, high limit
 - .2 Set point low limit
 - .3 Fail safe change over to internal signal, on loss of external signal.
 - .2 The AERCO Model 168 microprocessor based, Boiler Management System will control all operation and energy input of the boiler plant.
 - .1 The controller shall vary the input of both boilers throughout the full range, to maximize the condensing capability of the plant.
 - .2 The controller shall be PID type for accurate temperature control and frequency response with contact closure for automatic heat start and auxiliary equipment operation.
 - .3 The BMS will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature to ± 2 deg. F. The units shall operate on an Inverse Efficiency Curve, with known Part Load Value Efficiencies.
 - .4 The BMS will control the firing of the boilers in unison. Maximum plant efficiency shall be achieved at minimum firing input. The controller will automatically balance the operating time on each module by a first on-first off mode and provide for setback and remote alarms.
 - .5 The BMS panel will be shipped loose for wall mounting and connection to the system and the boilers, by the

installer. Connection to each boiler will be twisted pair low voltage wiring to internal terminal strips.

- .8 Each boiler module shall be furnished with an electric probe type low water cut off, dual over temperature protection including a manual reset and an ASME relief valve set at 50 psig. An external auxiliary low water cut off shall be furnished, shipped loose, for mounting in the system piping.
- .9 Each gas train shall be furnished in accordance with CGA requirements for a 5 psig natural gas supply pressure, including manual main lubricated gas shut off valve, gas pressure regulators, air/fuel control valve and electro-hydraulic double seated safety shut off valve.
- .10 Each boiler shall operate on a 220/1/60, 20 amp service.
- .11 Upon notification of completion of the installation, the boiler manufacturer's representative shall provide the services of a field technician to:
 - .1 Provide a "dry run" of the boiler plant control sequences.
 - .2 Fire the boiler and adjust control and fuel/air ratio settings to optimum operating conditions and record combustion performance and efficiencies over the operating range.
 - .3 Provide combustion analysis and commissioning reports for the purchaser and Contract Administrator.
 - .4 Furnish instruction and training to the City of Winnipeg's operating personnel.

2.12 EXPANSION TANKS

- .1 Replaceable Bladder Type
 - .1 Provide Expanflex Model AL Series tanks as manufactured by Hamlet & Garneau for working pressure of 862 kPa (125 psi) and 115 deg C (240 deg F) maximum.
 - .2 Tanks shall be constructed with steel shell in accordance with ASME Boiler and Pressure Vessel Code Section VIII, c/w replaceable heavy-duty (butyl bladder compatible with water and ethylene glycol)(or EPDM bladder compatible with propylene glycol).
 - .3 Vessel to be of vertical configuration with aerated skirt, and bottom connection through skirt.
 - .4 Bladder connection to be capable of handling the flow of the corresponding pipe size at 1.83 M/S (6ft/sec) with a maximum pressure drop of 3.45 kPa (0.5 psi).
 - .5 Piping from the system to the vessel to include a square-head cock and a boiler drain.
 - .6 In piping adjacent to each tank provide Conbraco 510 Series relief valve c/w packed caps. Relief valves to be ASME Section VIII approved and rated for 10% overpressure. Do not install any valves between relief valve connection and tank.
 - .7 Refer to drawings for tank sizes.
 - .8 Refer to Schedule.

2.13 FLUID PRESSURE SWITCHES

- .1 Pressure switch contacts to close on water flow.

2.14 WALL FIN

- .1 Engineered Air lengths stated are as measured over finned elements only and exclude stubs. Ratings are for finned elements only. Factory test at 1034 kPa (150 psig).
- .2 Ferrous Elements
 - .1 32mm (1-1/4" I.P.S.) tube with 40 steel fins per 305mm. 107mm x 107mm (4-1/4" x 4-1/4") fins, 0.8mm (.032") thick with flanged collars. Elements to have 63mm (2-1/2") stubs for screwed couplings with American Standard tapered threads. Elements to be cleaned and phosphatized, finished with baked grey enamel primer.
- .3 Cabinets
 - .1 All standard type cabinets furnished by manufacturer, c/w end caps, trim strips, and corner pieces to provide wall to wall and/or column cabinets unless noted otherwise. Cabinet to be 1.6mm (16 ga.) steel. Paint inside and out with grey primer. Provide valve access door on cabinets. Wall fin not thermostatically controlled to have dampers.
- .4 Provide lockable access panels/doors.
- .5 Ratings based on 93 deg.C supply water 11 deg.C temp. drop.

2.15 UNIT HEATERS

- .1 Casings shall be constructed of 18 gauge (1.2mm) cold rolled steel with electrostatically applied epoxy powder coat prime finish and shall have two integral 3/8" (10mm) threaded hanger connections. Provide four way adjustable louvred diffuser, factory mounted on each unit.
 - .2 Coils shall be 1/2" (13mm) copper tube with rippled aluminum fins. Headers include steel MPT pipe connections located at back of unit. Coils to be factory tested with air at 300 psig (2070 kPa).
 - .3 Fans shall be aluminum blade type, dynamically balanced and direct connected to motor shaft.
 - .4 Motors shall be 115v/1/60 and incorporate sleeve bearings and automatic re-set overload protection. H-1 through H-4 use 1500 RPM open shaded pole totally enclosed permanent split capacitor, type motors. Size H-5 through H-8 motors are 1050 RPM totally enclosed permanent split capacitor type. H-9 through H-11 motors are open permanent split capacitor type. All units complete with fan guards.
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- .5 Water ratings based on 93 deg.C supply water, 11 deg.C temp. drop.

2.16 INDOOR AIR HANDLING UNIT (As specified in Schedule)

- .1 Provide McQuay Vision air handling units as noted.
 - .1 Configuration: Fabricate with fan and coil section plus accessories, including:
 - .1 Heating coil section.
 - .2 Mixing box section.
 - .3 Combination filter/mixing box section.
 - .4 Access section.
 - .5 Cooling coil section.
 - .2 Casing
 - .1 Construction: Fabricate of channel posts and panels assembled with screws optional base rail galvanized steel finish. Assemble sections with bulb type gaskets and bolts.
 - .1 Outside Casing:
 - .1 G90 galvanized steel: frame channel 16 gauge nominal (1.5 mm), panels 18 gauge nominal (1.2mm).
 - .2 Optional Inside Casing:
 - .1 G90 galvanized steel: 20 gauge nominal (0.94mm).
 - .3 Optional Floor Plate:
 - .1 G90 galvanized steel: 20 gauge nominal (0.94mm).
 - .2 Insulation: 2 inch 50 mm thick, 1-1/2 lb. per cu. ft. 24 kg per cu m density, neoprene coated, glass fiber insulation.
 - .3 Finish: G90 galvanized steel.
 - .4 Access Doors; made of galvanized steel, flushmounted to cabinetry, with gasket, latch and handle assembly, optional inspection window.
 - .5 Lights: Provide in accessible sections.
 - .6 Drain Pans: Construct from galvanized steel with cross break and pitch to drain connection. Provide drain pans under cooling coil section interior of drain pan provided with antimicrobial coating.
 - .3 Fans
 - .1 Type: Forward curved, double width, double inlet, centrifugal. Fans dynamically balanced before and after installation in fan cabinet section. Maximum fan RPM below the first critical speed fan.
 - .2 Bearings: Self-aligning, grease lubricated, ball or roller bearings with extended copper lubrication lines to access side of unit. Grease fittings attached to fan base assembly near access door.
 - .3 Mounting: Locate fan and motor internally on steel base. Factory mount motor on slide base that can be slid outside of unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly mounted on (spring) vibration isolators inside cabinetry.
 - .4 Fan Accessories: Forward curved fan with optional inlet vanes will have heavy duty linkage connecting both vane
-

assemblies. The inlet vane actuating mechanism permanently lubricated and interconnected by a solid steel shaft through oil impregnated bronze bushing assemblies mounted in the fan housing.

.5 Air handling fan sound data shall meet with the following criteria:

<u>Unit Sound</u>	<u>63Hz</u>	<u>125Hz</u>	<u>250Hz</u>	<u>500Hz</u>	<u>1000Hz</u>	<u>2000Hz</u>	<u>4000Hz</u>	<u>8000Hz</u>
Radiated	67	66	63	58	54	44	41	36
Unit discharge	85	87	87	85	83	79	79	74
Unit return	83	85	84	81	78	74	72	73

.4 Bearings and Drives

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours, heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

.2 Shafts: Solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil.

.3 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated as recommended by manufacturer. Optional variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position. Standard drive service factor 1.1 (1/4 HP - 7-1/2 HP) times fan brake horsepower. Optional customer specified service factor. Optional customer specified service factor.

.4 Belt Guard: Enclosed on all four sides, wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

.5 Coils

.1 Casing: Provide access to coils from connection side of unit for service and cleaning. Enclose coil headers and return bends fully within unit casing. Coil connections, vents, and drains to extend beyond unit casing. Coils removable through side panels and/or top panels of unit without removal and disassembly of entire section.

.2 Drain Pans: Anti-microbial coated galvanized stainless steel drain pan located underneath and extending downstream of coil, and intermediate drain pans required for cooling coil banks more than one coil high.

.3 Eliminators: Three break construction of galvanized steel, mounted over drain pan.

.4 Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

.5 Fabrication:

.1 Tubes: 5/8 inch 16 mm OD seamless copper expanded into fins, brazed joints.

.2 Fins: Aluminum, optional copper plate type fins.

.3 Casing: Formed channel frame of galvanized steel.

.6 Water Coils: Fins have a minimum thickness of .0075" (.191 mm) with full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tube not visible between fins. Water coils provided with headers of seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil connections carbon steel with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent connections provided at the highest point to assure proper venting. Drain connections provided at the lowest point to insure complete drainage and prevent freeze-up.

.7 Refrigerant Coils: Coils designed for use with refrigerant R-22. Fins have a minimum thickness of .0075" (.191mm) with full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tube, not visible between fins. Refrigerant coils provided with round seamless 5/8" (16mm) O.D. copper tubes on 1-1/2" (38mm) centers, staggered in the direction of airflow. All joints brazed. Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage. Coils circuited to row control capacity reduction. Pressure type liquid distributors used. Coils tested with 315 pounds air pressure under warm water, and suitable for 250 psig working pressure. Coils are ARI certified and Underwriters Laboratories, Inc. listed. All coil circuited in a counterflow manner with uniform circuits.

.6 Filters

.1 Provide flat filter section with maximum filter velocity 2.64m/s (520 fpm), otherwise provide medium capacity filter section. Access on both sides. Provide filter types as specified elsewhere in this section.

.7 Dampers

.1 Mixing Boxes: Section with factory mounted low leak airfoil blade outside and return air dampers of galvanized steel in galvanized frame. Dampers are hollowcore airfoil blades, fully gasketed. Continuous vinyl seals between damper blades. Stainless steel end seals along end of dampers. Linkage and ABS plastic end caps provided.

.2 Damper Leakage: Leakage rate is less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

.8 Access

.1 Section to provide access between components 16" deep 406mm. Access doors of galvanized steel for flush mounting, with gasket, latch, and handle assembly.

- .9 Refer to Cl. Fan System - General.
 - .1 Refer to Air Handling Unit Schedule.

2.17 VERTICAL IN-LINE PUMPS

- .1 Pump to be close coupled or split coupled, as noted in pump schedule, and be vertical shaft, single stage, single suction, radially split casing in-line mounting centrifugal type. Pump to have cast iron casing, bronze fitted with alloy steel shaft, bronze removable shaft sleeves and bronze casing wear rings. Working pressure to be 862 kPa (125 psig). Impeller to be mounted on motor shaft extension.
- .2 Provide mechanical seal with carbon rotating face, Ni-resist stationary seat, EPDM secondary seal and stainless steel spring. Mechanical seal to have lubrication and be suitable for use with fluid being pumped.
- .3 Motor to be vertical, solid shaft, continuously rated, ball bearing, squirrel cage induction type with NEMA C flange and extended shaft.
- .4 For parallel operation inlet and outlet ports on the casing shall be at least one size larger than the single pump size.
- .5 For duty/standby operation inlet and outlet ports shall be sized as for a single pump.
- .6 Refer to Pump Schedule.

2.18 CHEMICAL TREATMENT

- .1 Chilled Water, Hot Water Heating and Glycol Systems Cleanout
 - .1 Provide 45 litres of GE Betz Ferroquest FQ7103 preoperational cleaner per 4,500 litres of water in system.
 - .2 Provide GE Betz Ferroquest FQ7102 as required.
 - .2 Chilled Water and Hot Water Heating Systems Treatment
 - .1 Provide GE Betz 6213 molybdate test kit.
 - .2 Provide Neptune Type DBF-2 pot feeder on each system.
 - .3 Provide GE Betz Corroshield MD4102 corrosion inhibitor to bring treatment residual into recommended range. Provide an additional 20 litres for the City of Winnipeg's use.
 - .3 Sidestream Filters
 - .1 Provide a sidestream filter on each hot water heating, chilled water, glycol heating and glycol heat recovery system.
 - .2 Provide a Filterite Model LM010-3/4" in-line filter and a 3/4" sight flow indicator on each system. Install as per standard detail.
 - .3 Provide one carton of thirty (30) 30-micron cotton filter cartridges.
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2.19 ELECTRONIC HUMIDIFIERS

- .1 Provide self-contained disposable cylinder electronic electrode steam generating humidifier.
 - .2 Rated steam output shall be net of unit kilowatt rating and after allowance for kilowatt lost in water drained from unit.
 - .3 Humidifier shall discharge pure steam with no mineral dust carryover.
 - .4 Steam distributor suitable for application with specified humidifier and shall be of length suitable for insertion in duct as shown on drawings.
 - .5 Steam distributor(s) shall incorporate condensate separator and return leg to remove condensate from distributor. Condensate shall be routed back to humidifier fill cup.
 - .6 Multiple cylinder humidifiers shall have multiple fill and drain solenoid valves, 3 position on/off/drain switch for each circuit, indicator lamps to indicate mode of operation, and internal control systems to allow completely independent operation of each cylinder, even though multiple circuits may be activated from a common humidistat.
 - .7 Cylinders shall be disposable type not requiring cleaning or maintenance.
 - .8 Units shall incorporate high water probe to prevent over-filling and water from entering steam supply outlet. Provide change cylinder alarm light to indicate when cylinder requires replacement.
 - .9 Humidifier cabinet, 16 gauge satin coat steel with enamel finish, with removable and lockable access door on electrical compartment and separate removable and lockable access door on plumbing compartment. Unit shall incorporate fill cup with 25mm (1") air gap on fill side to prevent back siphoning, and integral air gap on the drain side to comply with plumbing codes. Fill solenoid valve shall incorporate built-in strainer, pressure reducing and flow regulating orifice.
 - .10 Humidifier drain rate shall automatically adapt, both in frequency and duration, to variations in incoming water, based on continuous monitoring of contained water condition in cylinder.
 - .11 Provide self-diagnostic control circuitry capable of monitoring abnormal conditions, turning itself off to prevent unsafe operation, and providing coded visual indication that points to cause of fault. Such abnormal conditions to include current rising to high uncontrolled, current at zero with cylinder full, current rising too slowly to meet demand, signal to fill valve
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with no affect on current, and signal to fill valve with insufficient current increase.

- .12 Humidifier shall be controlled by on/off, RA duct mounted humidistat with high limit discharge air duct humidistat, adjustable, set at 95% R.H. and shall have built-in contactor to break power to electrodes when humidity is satisfied. Unit shall be protected by built-in overload fuses and automatic emergency drain trigger.
- .13 Humidifier shall incorporate safety interlock to shut unit off when door is open.
- .14 Section 15900 shall supply air R.H. duct sensor and high limit devices, etc., Provide an unpowered On/Off contact output for connection of humidifier. Provide terminal block to accept connection of unpowered On/Off contact input.
- .15 Humidifier and all accessories shall be ULC listed and CSA approved.
- .16 Section 15600 shall retain services of factory-trained manufacturer's representative to provide start-up services for all humidifiers. This start-up shall include:
 - .1 Check-out of control system.
 - .2 Analyse make-up water quality for humidifier.
 - .3 Make necessary adjustments to units so that they function properly.
 - .4 Issue report to Section 15600 noting that all units are functioning as per manufacturer's recommendation.
 - .5 Section 15600 shall issue copies of report to Contractor and Contract Administrator.
- .17 Refer to Humidifier Schedule.

2.20 LINEAR HOT WATER HEATING RADIANT PANEL

- .1 Scope of Work
 - .1 To provide a complete extruded linear panel system as per plans and specifications.
 - .2 Approved Equals
 - .1 Manufacturer: Twa Panel Systems
 - .2 Alternate manufacturers will not differ from Twa Panel Systems with regard to number of tube rows, water pressure drops, piping connections and such features as surface finish and cleanability.
 - .3 Substitutes to be submitted in accordance with B6.
 - .3 Quality Assurance
 - .1 The Contractor shall furnish all labour, materials, tools, equipment, appliances and services necessary to deliver and install all radiant panels as defined.
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- .2 Contractor shall submit complete shop drawings showing lay outs, fixing details and piping details of all areas where radiant panels are indicated. These drawings shall be coordinated with, and interference cleared with other trades.
- .4 Product - Linear Radiant Panels
- .1 Constructed of extruded aluminum planks.
 - .2 Width and number of tubes as per design specifications.
 - .3 Tube saddle shall be an integral part of the aluminum plank.
 - .4 Circulation tubing shall be 16 mm (5/8") O.D. round tubing mechanically fastened the plank. A non hardening heat transfer paste is required between the tubing and the aluminum saddle.
 - .5 Planks shall interlock using tongue and groove connection and be held together using aluminum cross channels with spring clips. Panels must be factory assembled. Panels requiring Site assembly are not acceptable.
 - .6 The length of the panels shall be based on lengths supplied by the Mechanical Contractor. The factory to allow for expansion before the final cut. No Site cutting allowed.
 - .7 Panel performance shall be that of Frenger linear extruded ceiling panel manufactured by Twa Panel Systems Inc. of Edmonton, Alberta. Capacities of installed panels shall be as called in the specifications and shown on the drawing.
 - .8 Panel shall consist of (4)- 6" sub panels fully assembled at the factory with continuous serpentine copper tubing for all panels up to 16' long. Manufactures not capable of providing continuous copper tubing for the entire width (24") of the panel shall factory solder "U" bends, pressure test each panel and submit pressure report test to Contract Administrator.
 - .9 Provide flanges around panel for drywall installation type.
 - .10 Refer to Specification Detail.
 - .11 Provide 300 x 600 sample at shop drawing time for the City of Winnipeg's approval.
 - .12 Provide recessed drapery track in patient rooms.
- .5 Refer to Schedule - Linear Radiant Panels
- .1 Manufacturer: Twa Panel Systems
 - .2 Model: Linear
 - .3 Performance: BTUH per lineal foot-Watts per lineal meter
 - .4 Width: Specify
 - .5 Length: Wall to wall or specify
 - .6 Output based on Mean Water Temperature of 87.8°C and Room Temperature of 22°C.
 - .7 The maximum water pressure drops shall be in accordance with the following: Flow of:
 - .1 0.1 gpm - pressure drop over 100 feet of tube = ½ ft
 - .2 1.0 gpm - pressure drop over 100 feet of tube = 2 ft
 - .3 2.0 gpm - pressure drop over 100 feet of tube = 7 ft
 - .4 2.5 gpm - pressure drop over 100 feet of tube = 10 ft
 - .5 3.0 gpm - pressure drop over 100 feet of tube = 14 ft
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PART 3 - EXECUTION

3.1 PIPE AND FITTINGS

- .1 Inside of all pipe, fittings, traps, valves and all other equipment to be smooth, clean and free from blisters, loose mill scale, sand and dirt when erected.
 - .2 Install screwed unions or flanges at all equipment connections, elements, traps, valves, etc.
 - .3 Pipe bending is not permitted.
 - .4 Pipe and fittings up to and including 50mm (2") diam. to be screw jointed with screwed fittings. Make screw joints iron to iron, with graphite and oil filler or joint compound. Dope male threads only. All fuel oil piping shall be welded.
 - .5 Pipe and fittings 63mm (2-1/2") diam. and above to be jointed by welding. Branch connections to be welded using butt welding fittings. Use slip-on welding flanges, welded to pipe on which they are fitting, at flange neck and back-welded on pipe end, at inside flange face. Valve companion flanges to be flat or raised face, matching valve flange. Use gaskets on flanged joints.
 - .6 Branch connections of sizes 13mm (1/2"), 19mm (3/4") and 25mm (1") for radiation may be formed on mains of 50mm (2") diam. and above using carbon steel Thred-O-Let welding fittings.
 - .7 Branch connections of sizes 31mm (1-1/4"), and larger to be formed using Weld-O-Lets. Reductions in mains to be after branches using butt weld reducing fittings. Site or shop fabricated welding fittings not permitted.
 - .8 Welding to conform to Provincial Department of Labour Regulations. Welders to be licensed.
 - .9 Use long radius elbows. For pipe reductions use eccentric reducing sockets.
 - .10 Keep pipe connections clear for tube removal, etc.
 - .11 Dielectric Couplings
 - .1 Provide where pipes of dissimilar metals are joined.
 - .2 Provide unions or flanges for pipe 50mm (2") and smaller and flanges on piping 63mm (2-1/2") and larger.
 - .3 Use Style 47 Dielectric Waterway as manufactured by Victaulic.
 - .12 Branch Connections
 - .1 Type 'K' copper soft temper pipe - Silver braze joints using Handy & Harman's silver brazing alloy and flux. Fittings to Emco smooth bore silver braze fittings.
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3.2 PIPING SYSTEMS

.1 Water and Glycol Piping Systems

.1 Grade up in flow direction or as noted so air may pass through connecting risers, etc. Minimum grading to be 1:480.

.2 General

.1 Install branch riser take-offs to grade up to riser.

.2 Run piping parallel to walls and as unobtrusive as possible when viewed from inside or outside building.

.3 Where pipe change in direction is shown to take up expansion, spring piping cold.

.4 Blow out radiation and coils with compressed air prior to piping connections.

.5 Use welded piping in concealed areas and as a result inaccessible, i.e. plastered ceilings, etc. Control valves, etc. to be accessible through access doors.

.6 Install drain cocks on each pump and at system low points. Pipe to nearest floor drain.

3.3 TESTING OF SYSTEMS

.1 Tests to be carried out in accordance with following time-pressure requirements and regulations and requirements of authorities have jurisdiction.

.2 Hot water heating - test at 862 kPa (125 psig), or to pressure 1-1/2 times operating pressure, which ever is greatest, for 12 hrs.

.3 Piping, concealed prior to completion of total service, to be tested in sections prior to concealment. Tests to be witnessed by Contract Administrator's representative. Two working days prior notice to be given Contract Administrator of such tests. Pressures to be as registered at system highest point. When sections are being tested additional pressure developed by static head of remainder of system above, to be added to specified test pressure.

.4 Tests to be with water, unless noted otherwise, prior to insulation being applied.

.5 System tests to be with equipment connected. Trap diaphragms to be removed and systems flushed prior test.

.6 Make good leaks, replace defective parts, flush out defective section, re-test and adjust until system functions correctly.

.7 Prior to the City of Winnipeg's takeover, systems to be balanced and ready for operation, with traps, strainers, drip legs, etc. cleaned.

3.4 VALVES

- .1 Provide three valve by-passes in the following locations and where shown on drawings. By-pass valves shall be as specified for balancing valves.
 - .1 Pressure reducing valves.
 - .2 Temp. control valves on heating coils where the inlet air temperatures are 5 deg. C and below.
 - .2 Provide isolating valves in the following locations and where shown on drawings.
 - .1 Suction and discharge of pumps.
 - .2 Before all temp. control valves.
 - .3 Inlet and outlet of all water, fed equipment.
 - .1 Inlet valve shall be ahead of control valve to single coils. Provide inlet and outlet valves on all coil sections in multiple coil bank.
 - .2 Where piping detail sheets note balancing valves on leaving side of radiation and coils, additional outlet isolating valves not required, unless specifically noted on detail sheet.
 - .3 All radiation elements which are not controlled by thermostat and automatic control valve, shall be provided with radiator valve.
 - .4 Provide balancing valves in following locations and where noted.
 - .1 Pump discharges.
 - .2 Outlet piping from all water, glycol coils, radiation, unit heaters and forceflow heaters.
 - .5
 - .1 Valves on all steam and water systems shall be gate type valves except for radiator valves and bypass valves which shall be globe type.
 - .6 Provide chain wheel operators c/w chain for all valves where the valve operator is higher than 6'-6" above the floor. Where necessary provide shaft extensions c/w brackets and bearing to locate chain wheel operator in accessible location.
 - .7 Valves installed in concealed locations, i.e. ceiling spaces, to be arranged for ease of access for servicing through access doors.
 - .8 Provide a union or flange dependent on size of piping between butterfly valves and equipment which they serve to permit isolation and removal of equipment.
 - .9 Butterfly valves shall be considered equal to gate valves for chilled water, condenser water, glycol and hot water heating installations.
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- .10 Ball valves shall be considered equal to gate valves for low pressure condensate, hot water heating, chilled water, condenser water and glycol installations.

3.5 EXPANSION JOINTS

- .1 Use guides on each side of expansion joints and compensators. Support from structural brackets.
- .2 When expansion joints are installed at ambient temps. higher than minimum system operating temp. they shall be precompressed prior to installation, to allow for eventual contraction of piping.

3.6 ANCHORS

- .1 Provide where noted on horizontal piping. Fit anchors on vertical piping to ensure that water or air is not trapped. Fabricate from channels and angles to suit location; brace to building structure.

3.7 AIR VENTS

- .1 On each water fed convector and forced flow unit, use key-operated air vent c/w copper tube extensions carried through ends of wall hung cabinets, or through fronts of recessed cabinets.
- .2 On wall fin in standard enclosures and baseboard, provide screwdriver-operated air vent. Use key-operated type c/w copper tube extensions on larger cabinet wall fin.
- .3 Install automatic float air vent at system high points, where air may be trapped in hot water heating, chilled water systems, and where noted, to suit operating pressures. Pipe discharges to nearest plumbing drain. Provide isolating valves ahead of auto air vents except at coils having service valves.
- .4 Provide manual air vents at high points of pumped condensate, boiler feedwater and glycol heating systems.

3.8 STRAINERS

- .1 Provide pipe strainers in following locations and where shown on drawings.
 - .1 Pressure reducing valves.
 - .2 Pump suction.
-

3.9 THERMOMETERS

- .1 Stems and wells to be immersed in liquid flow. Where a separable well is mounted in pipe 37mm (1-1/2") diam. or less, enlarge pipe to 50mm (2") diam. for well length plus 75mm (3").

3.10 PRESSURE GAUGES

- .1 Use pressure gauges on pressure reducing valve stations, suctions and discharges of pumps and where noted.
- .2 Gauges, subject to vibration, to have copper tube extensions to locate away from source of vibration.

3.11 WATER PRESSURE REDUCING VALVES

- .1 Fit union after pressure reducing valve.

3.12 EXPANSION TANKS

- .1 Install as per manufacturer's recommendations.
- .2 Standard Type
 - .1 Tanks to be supported from building structure.
 - .2 Provide airtrol tank fitting with globe shut-off valve, 19mm (3/4") drain piped to the nearest floor drain complete with globe shutoff valve. Fit 13mm (1/2") globe vent valve on tank top. Valve to be 1.8m (6'-0") above floor maximum.
- .3 Air-Charged Type
 - .1 Connect pressure equalizing line from tank bottom to system. Provide valved drain line to nearest drain.
 - .2 Run 25mm (1") compressed air line from valved connection at air compressor to expansion tank with globe valve, check valve, manual air relief and hose connection with valved check.

3.13 SAFETY RELIEF VALVES AND DRAINS

- .1 On hot water boilers and water heat exchangers pipe relief valve discharge to within 227mm (9") of adjacent funnel floor drain.
 - .2 On glycol boilers and heat exchangers pipe relief valve discharge to glycol fill tank.
 - .3 Discharge of all steam safety valves to be piped to outdoors. Install Consolidated Fig. 1665 drip pan elbows on all steam safety valve discharges. Pipe drip pan drains to nearest floor drain. Discharges to extend 2.1m (7 ft.) above finished roof and terminate with 90 deg. elbow and 600mm (2 ft.) length of pipe cut off at 30 deg. to pipe axis.
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3.14 LOCATION OF RADIATION

- .1 Locate radiation including force-flo units, unit heaters, wall fin and convectors, etc. in relation to architectural room features.

3.15 WALL FIN

- .1 Mount wall fin at height recommended by manufacturer, minimum height to underside of fins to be 88mm (3-1/2") from finished floor, unless shown otherwise on drawings or schedules. Support elements on manufacturer's brackets at fin ends, 900mm (3'0") maximum centres. Grade wall fin.
- .2 Wall fin, not thermostatically controlled, to have hand valves and dampers.

3.16 PROTECTION OF FINNED ELEMENTS

- .1 Protect all finned coils against damage during construction period. Comb out fins on completion. Replace damaged finned elements.

3.17 BOILER

- .1 Install in strict accordance with manufacturers recommendations and requirements of authorities having jurisdiction.
 - .2 Electric wiring to boiler control panels shall be provided by Div. 16. Control wiring from boiler control panel to boiler controls and necessary transformers for boiler controls shall be provided by Section 15600. Boiler low water cut-off shall be wired into combustion controls.
 - .3 Electric wiring to boiler control panels shall be provided by Div. 16. Electric control wiring from control panel to all boiler controls and from boiler feed pumps to boiler water level controls and motorized valves and all necessary transformers for boiler controls shall be provided under this section. Boiler low water cut-off controls on each boiler shall be wired into combustion controls.
 - .4 Start-Up Services
 - .1 Boiler manufacturer shall include services of factory-trained representative for period of at least two (2) working days to provide following services:
 - .1 Open all inspection doors for inspection of refractory. The City of Winnipeg's representative and Section 15600 shall be present.
 - .2 Supervise initial start-up and assist in necessary adjustments to place the equipment in operation.
-

.2 In addition to start-up time, include additional two (2) days to train the City of Winnipeg's designated personnel to safely and properly operate and maintain the equipment.

.3 Submit report to Contract Administrator with copy to the City of Winnipeg stating above actions have been completed.

.5 Pipe blowdown to be 19mm (3/4") diam. minimum piped to drain, c/w 6mm (1/4") Hancock Fig. 4455 Flocontrol valve.

.6 Contractor to provide fire-rated insulated base, if floor is not concrete, to conform to N.B.C. and D.F.C. requirements.

3.18 CHEMICAL TREATMENT

.1 General

.1 Provide services of GE Betz Water Treatment Specialist to supply chemicals, accessories and to conduct water treatment analysis; supervise installation of equipment and initial start-up of treatment procedures. If, from analysis, other treatment is required, provide same but submit proposed treatment to Contract Administrator for approval prior to start-up of any system.

.2 Provide training in use of test equipment, establish treatment ranges, and provide log sheets with training in their use.

.3 Make regular call-backs to check on procedures being followed and report each call in writing to Contractor Administrator, Sect. 15600 and the City of Winnipeg during first year's operation. Call-backs to be in accordance with following:

.1 Hot water heating systems - at the beginning, mid-point and end of the heating season.

.2 Chilled water and condenser water systems - at the beginning, mid-point and end of the cooling season.

.3 Steam boilers - every three months.

.4 Guarantee all mechanical equipment provided to be free of defects for one year from date of start-up.

.5 Provide operating manual indicating all phases of water conditioning program. Include detailed schematic drawings showing all special fittings, timers, controllers, etc. for each system. Four hard cover binders to be submitted to Contract Administrator for approval.

.6 Witness cleaning of all strainers.

.7 If system is used for temporary heat, clean it as outlined below prior to use for temporary heat and then clean again before takeover by the City of Winnipeg. During temporary heat period chemically treat system under Supplier supervision and maintain logs on chemical balances. Chemicals required during temporary heat period are to be in addition to quantities listed below.

.2 Hot Water Heating Systems Cleanout

.1 Systems to be cleaned out, including new and existing piping. Pump on each system may be used to circulate cleaning solution. Balancing valves on pump discharges to be regulated to

ensure against operating pumps out of their normal operating range.

.2 Cleaner to be introduced and circulated from 48 to 72 hours and removed from system by Contractor by dumping system.

.3 GE Betz to monitor system pH and add Ferroquest FQ7102 neutralizer as required, to bring pH into the 6.5-7.0 range.

.4 Flush each system until conductivity of water in system is back to conductivity of make-up water. If gland packed or mechanical seal pumps of permanent system are used during cleaning period, replace packing and mechanical seals with new material.

.5 All strainers to be cleaned by Sect. 15600.

.6 System to be refilled and required amount of chemical treatment added to provide immediate protection against corrosion.

.7 Conduct conductivity tests before, during, and after cleaning each system, and report procedures followed and conductivity readings to Contract Administrator in writing.

.8 System not to be used until cleaning procedure has been carried out and supervised by Supplier.

.3 Hot Water Heating Systems Treatment

.1 Introduce corrosion inhibitor through by-pass pot feeders installed across circulating pumps of each system under supervision of and according to drawings submitted by Supplier.

.4 Sampling Connections

.1 Provide 19mm (3/4") valved sampling connections where instructed by Supplier representative in the following systems:

- .1 Boilers
- .2 Boiler feedwater
- .3 Hot water heating
- .4 Soft water

3.19 CO-ORDINATE WITH H.V.A.C. BALANCE AND TESTING AGENCY

.1 Refer to Section 15990 H.V.A.C. Balance and Testing.

.2 Air balancing Work shall not begin until system has been completed and in full working order. Section 15600 shall put all heating, ventilation, and air conditioning systems and equipment into full operation, as season would demand, and shall continue operation of same during each working day of testing and balancing. Co-ordinate Work with Section 15990.

.3 As part of this Contract, Section 15600 shall make any changes in pulleys and belts, and add manual dampers for correct balance as recommended by Section 15990, at no additional cost to the City of Winnipeg.

.4 Section 15600 responsible for initial alignment and tension of all fan pulleys and belts of equipment supplied by Section 15600.

3.20 PACKAGED AIR HANDLING UNITS

- .1 Start-up of unit shall be executed by manufacturer's personnel. A complete manufacturer's check list of field start-up tests must be submitted with operations and maintenance instructions, and shall be signed by start-up technician and mechanical trade, field supervisor as certified satisfactory for operation.
- .2 Complete AHU factory installation relating to mechanical and or electrical materials, piping, pipe insulation, wiring etc. shall conform to standards set out in Division 15 and Division 16 specification.
- .3 AHU's shall be CSA labelled and shall conform to Canadian Electrical Code and all Manitoba (Ontario) Codes.

3.21 STEAM HUMIDIFIERS

- .1 Mount humidifier in duct so is centred in duct, provide 6mm (1/4") pipe supports.
- .2 Mount humidifier so it is centred in duct with additional piping and support at duct or plenum sides. Provide steam trap ahead of control valve unless valve is located directly at the steam main.
- .3 Install in strict accordance with manufacturer's recommendations.

3.22 RADIANT HEATING PANELS

- .1 The Mechanical Contractor shall cooperate with other trades working in the ceiling area to achieve a neat and well coordinated installation.
 - .2 All support moulding shall be the responsibility of Division 9 unless specialized application is required. All wall mouldings shall be mitred with cross tees installed flush. Perimeter moulding to be extruded aluminum - minimum 25 gauge. Ensure ceiling openings and wall mouldings are installed as per radiant panel shop drawings.
 - .3 Twa Panel Systems supplied fluted inter-connectors must to connect panels installed in series. Soft copper or pigtail type connectors will not be acceptable.
 - .4 Connection to supply, return piping with 16 mm (5/8") O.D. soft copper.
 - .5 All panels to be covered by min 25 mm (1") foil backed insulation after connection and testing of panels is complete. Insulation provided and installed by Div. 15.
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- .6 All system piping shall be thoroughly cleaned and flushed before connecting to radiant panels.
- .7 All radiant panels to be pneumatically tested as per Contract Administrator's specifications.
- .8 Minimum of one hanger wire for safety and seismic restraint per crossbrace. Minimum of 2 panel.
- .9 All radiant panels shall be installed by personnel wearing clean white gloves.
- .10 Site measure for exact lengths and co-ordinate with reflected ceiling layout.

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

1.2 WORK INCLUDED

- .1 Labour, materials, plant, tools, equipment and services necessary and reasonably incidental to completion of air conditioning and/or ventilation work.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
- .2 Section 15180 Insulation
- .3 Section 15400 Plumbing
- .4 Section 15600 Liquid Heat Transfer
- .5 Section 15900 Controls/Instrumentation
- .6 Section 15990 Testing, Adjusting and Balancing
- .7 Section 16010 Electrical General Provisions

PART 2 - PRODUCTS

2.1 DUCT OPENINGS

- .1 Pack area between ducts and openings with fireproof self-supporting insulation. Seal with 25mm (1") mastic topping.
- .2 Use 1.2mm (18 ga.) galv. iron sleeves where ductwork passes through mechanical room and kitchen floors. Sleeves to extend 150mm (6") above floor. Use watertight mastic between sleeve and floor material.

2.2 DUCT AND EQUIPMENT SUPPORTS, HANGERS AND INSERTS

- .1 Support horizontal ducts on maximum 2.4m (8'0") centres by non perforated galv. steel, rivetted strap for ductwork 900mm (36") (either dimension) or less, and minimum 25mm x 25mm x 3mm (1" x 1" x 1/8") galv. angle iron passing under ducts 925mm (37") or over (either dimension) with 9.4mm (3/8") diam. threaded rods suspending angles from structure.
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- .2 Support vertical ducts at every floor with angle iron collars sized to provide proper bearing.
- .3 Use universal concrete type inserts of black malleable iron, for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.
- .4 Where inserts must be placed in existing concrete use Hilti H.K.D. steel anchors as recommended by manufacturer, or if heavy weights must be supported, drill hole through slab and provide 50mm x 50mm (2" x 2") washer and nut above rough slab before floor finish is poured.
- .5 To Steel Beams: Where pipe size is 50mm (2") or less, Grinnell Fig. 87 Malleable Iron C-Clamp and Retaining Clip, or equal. Where pipe size is over 50mm (2"), use Grinnell Fig. 229 Malleable Beam Clamp or Fig. 228 Forged Steel Beam Clamp.
- .6 To Wooden Ceilings and Beams: Grinnell Fig. 153 Pipe Hanger Flange or Fig. 156 or equal.
- .7 Support hangers in corrugated steel deck by 50mm (2") wide piece of 3mm (1/8") thick steel plate across top of steel deck, secured to hanger rod by washer and nut; prior to pouring of concrete topping.

2.3 LOW PRESSURE DUCTWORK

- .1 Low Pressure Rectangular Ductwork Schedule

<u>Max. Side</u>	<u>Bracing</u>
.1 Up to 600mm(24")	None
.1 Gauge: .60mm (24 USSG)	
.2 635mm to 750mm (25" to 30")	25mm(1")x 25mm(1") x 3.2mm(1/8") angle, 1.2mm(4'0") from joint.
.1 Gauge: .60mm (24 USSG)	
.3 785mm to 1000mm (31" to 40")	25mm(1")x 25mm(1") x 3.2mm(1/8") angle, 1.2mm (4'0") from joint.
.1 Gauge: .80mm (22 USSG)	
.4 1040mm to 1.5m (41" to 60")	37.5mm(1-1/2") x 37.5(1-1/2") x 3.2mm(1/8") angle, 1.2m(4'0") from joint.
.1 Gauge: .80mm (22 USSG)	
.5 1.525m X 2.25m (61" x 90")	37.5mm(1-1/2") x 37.5mm(1-1/2") x 3.2m(1/8") diagonal angles or 37.5m(1-1/2") x 37.5m(1-1/2") angles

- 600mm (2'0") from joint.
- .1 Gauge: 1.0mm (20 USSG)
 - .6 2.31m (91") and up Similar to above.
 - .1 Gauge: 1.3mm(18 USSG)
 - .2 Round Ductwork Schedule

	<u>Duct Diameter</u>	<u>Gauge</u>
.1	Up to 508mm (20")	0.5mm (26 USSG)
.2	533mm to 1.02m (21" to 40")	0.6mm (24 USSG)
.3	1.04mm to 1.52m (41" to 60")	0.8mm (22 USSG)
 - .3 Ductwork to be galvanized steel unless noted otherwise.
 - .4 Outdoor ductwork to be two gauges heavier than directed above.
 - .5 Turning vanes (Ducturns)
 - .1 Use duct elbows which have throat radius of 1-1/2" times the diameter.
 - .2 Where use of above specified item is precluded by space limitations, use duct elbows fabricated square throats and backs and fitted with Rovane turning vanes.
 - .3 Standard of Acceptance: S.E. Rozell & Sons Limited, Kitchener, Ontario.
 - .6 Provide E.H. Price AE-1 c/w #3 operator at all supply registers.

2.4 FLEXIBLE DUCTWORK

- .1 Connections to diffuser supply air boots and duct connections:
 - .1 Thermoflex M-KE vinyl covered spring with fibreglass insulated metallized jacket. Flexible ductwork shall conform to NFPA and UL-181 fire penetration test.
 - .2 Attach to duct with galv. wire hose clamps and Duro-Dyne S-2 duct sealer.
 - .3 Provide lengths as noted on drawings. However, use maximum of 900mm (8'-0") length to each boot connection.

2.5 FLEXIBLE DUCTWORK CONNECTORS

- .1 Thermoflex Thermaflair formed connectors for attaching flexible ductwork to the rectangular supply ducts serving supply air boots.

2.6 SPLITTER DAMPERS

- .1 Duro-Dyne type SRP. Dampers to be streamlined double thickness sheet metal, properly stiffened. Damper hardware as recommended by Duro-Dyne.

2.7 MANUAL VOLUME DAMPERS

- .1 1.2mm (16 ga.) galv. steel stiffened, blades of louvre type. Maximum of 300mm (12") wide and 1.8m (72") long, with one centre and two edge crimps. Damper hardware to be Duro-Dyne KS-145, KS-385 or KS-12 as recommended by manufacturer.

2.8 MOTORIZED DAMPERS

- .1 Supplied by Section 15900 for installation by Section 15800, with exception of those supplied with factory assembled:
 - .1 air-conditioning units
 - .2 heating and ventilating units
 - .3 factory fabricated preheat coils and by-pass units
 - .4 fan vortex dampers

2.9 FIRE DAMPERS

- .1 Install U.L.C. labelled fusible link folding blade fire dampers as manufactured by Air Balance of Canada Limited in fire separations where shown, and where otherwise required by authorities having jurisdiction. Fire dampers shall conform to the most recent issue of N.B.C. Fire dampers and fusible links shall be tested and approved by ULC or other Testing Agency recognized by the authorities having jurisdiction. Fusible links shall be readily removable by hand for testing without use of auxiliary equipment such as pliers.
 - .2 Depending on the rating of fire separation, based on architectural drawing and specifications, the rating, construction and testing of fire dampers shall meet the following:
 - .1 N.B.C.
 - .2 ULC S 112
 - .3 NFPA 252
 - .4 ULC or ULI 10(b)
 - .5 Authorities Having Jurisdiction
 - .3 Use type 'B' fire dampers, i.e. blades out of air stream, in all ducts passing through fire separations. Use combination fire damper-balancing damper, with blades in air stream, on sidewall supply or return or floor mounted supply registers, up to maximum size of 0.372m (576 sq.in.). For all sidewall return grilles or sidewall return registers above 0.372m (576 sq.in.) in size, use a type 'A' fire damper, i.e. blades in the air stream.
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2.10 CEILING FIRE STOPS

- .1 Install fusible link ceiling fire stops as manufactured by Air Balance of Canada Limited on all diffusers, registers, and grilles located in every membrane ceiling forming a part of an assembly required to have a fire-resistance rating. Refer to Architectural room finish schedules for rated ceilings. Ceiling fire stops shall conform to N.B.C. and local authorities.
- .2 Units mounted behind supply or exhaust units to be type 'B'.
Units mounted behind gravity return/relief units to be type 'A'.

2.11 MOTORIZED FIRE/SMOKE DAMPERS

- .1 Provide ULC labelled fire/smoke dampers as manufactured by Controlled Air Limited where shown on drawings (marked FSD), and where otherwise required by authorities having jurisdiction. Fire/smoke dampers shall be tested and approved by ULC or other Testing Agency recognized by authorities having jurisdiction.
 - .2 Depending on rating of fire separation, based on architectural drawing and specifications, the rating, construction and testing shall meet the following:
 - .1 N.B.C.
 - .2 ULC S 112
 - .3 N.F.P.A.
 - .4 Authorities having jurisdiction
 - .3 Motorized fire/smoke dampers shall be type A, blades within air stream, with pneumatic electrical operator configuration, c/w factory fabricated collar.
 - .4 Manufacturer to supply and install, at factory, approved operators. All operators shall be product of single manufacturer. Factory test all dampers for proper operation. Operators to be externally mounted. Make allowance for field adjustments. Refer to specification detail.
 - .5 All fire/smoke dampers to be factory set for normally open or normally closed operation during non-emergency periods as described in clause 'Fire Alarm System', Division 16. Refer to drawings.
 - .6 All fire/smoke dampers shall be c/w approved limit switch of plunger or wobble stick type, Form C, N.O-N.C., contacts rated at 120V for remote damper status indication.
-

2.12 DUCT ACCESS DOORS

- .1 Install airtight, 25mm (1") internal glassfiber insulated access doors in ductwork as noted and at all humidifier dispersion tubes, motorized dampers; at inlet and outlet of vaneaxial and axial fans; at inlet of heating coils; at fire dampers and locations noted on drawings.
- .2 Access doors at fire dampers, fire/smoke dampers and smoke detectors shall be minimum 300mm (12") x 300mm (12") or larger to fully access and replace fusible link. Enlarge duct as required.

2.13 PITOT TUBE TEST OPENING ENCLOSURES

- .1 Lawson-Taylor 1.2mm (18 ga.), cadmium-plated deep drawn flange type with quic-lok cap retained with a ball chain, c/w gaskets. At insulated ductwork use a quic-lok extension c/w neoprene tipped prolite insulating plug.
- .2 Other manufacturer may be considered, but must be approved by Contract Administrator's representative prior to installation.
- .3 Refer to Part 3 of this Section for enclosure sizing and location requirements.

2.14 LOUVRES AND WALL OPENINGS

- .1 Provide where shown, Airolite Type K609HP extruded aluminum louvres. Blades and frames of 1.8mm (12 ga.) (.081) 6063-T5 extruded aluminum alloy, spot welded to flange legs of side channels. Provide flange extension to butt to back of wall. Assemble all louvre parts by welding. Spot weld all flanges to frame members on maximum 150mm (6") centres. Mullions, as required, to have cover plates attached to louvre section with No. 10 trusshead aluminum screws on 300mm (12") maximum spacing.
- .2 Units c/w 12mm (1/2") square mesh 1.6mm (16 ga.) aluminum birdscreening with standard folded frame on louvres and outside openings not having louvres.

2.15 ROOF AIR INTAKES AND RELIEF HOODS

- .1 1.6mm (16 ga.) galv. iron hoods as per detail sheet. Provide 12mm (1/2") mesh galv. steel birdscreen.
-

2.16 FILTERS

.1 General:

- .1 Fan manufacturer to provide filter in filter sections provided with equipment.
- .2 Filter supplier to provide all other filters.
- .3 Provide one spare set of filter media for each filter bank.
- .4 Section 15800 shall fabricate filter sections not provided with equipment. Provide access panels c/w cam-lock fasteners, on each side of filter section. Access doors shall also have gaskets that butt against the filter frames to eliminate bypassing of air filters. Filter banks exposed to the outdoors shall have stainless steel piano hinges.
- .5 Refer to Filter Schedule.

.2

- .1 Unless noted otherwise, all fan systems to have AAF PerfectPleat Ultra extended surface pleated panel filters of 45mm (1-3/4") thick fibrous media pads coated with Intersept (antimicrobial). Media shall have 30% atmospheric dust spot efficiency (MERV-6) based on ASHRAE 52.2-1999 Test Method.

2.17 FAN SYSTEMS - GENERAL

.1 Fan Connections

- .1 Duro-Dyne Metal-Fab of neoprene coated fibreglass, airtight, water tight and flameproof, 75mm (3") wide with 75mm (3") galv. metal connections.

.2 V-Belt Fan Drives

- .1 Provide multi-matched set of belts for all fans with motors of 1.12 kW (1-1/2 hp) and larger.
- .2 Provide vari-speed adjustable drive on units with motors of 7.46 kW (10 hp) and less. Drive to allow speed variation of plus or minus 15% of fan speed at specified capacity. Should this variation not be attainable, manufacturer to provide extra fixed pulley and if necessary, matched belts to provide this speed range, if requested by Contract Administrator.
- .3 Provide fixed pitch on units with motors of 7.46 kW (10 hp) and greater. Manufacturer shall include for one change in drive; i.e. allow for additional pulley and matched belts for each air handling unit.
- .4 Fans mounted outside of building to have belt drives capable of operating satisfactorily at -37 deg.C ambient.
- .5
 - .1 Vari-pitch type with multi-belt matched set of belts with factor of 1.3 against motor nameplate rating.
 - .2 Drive shall allow speed variation of +/- 15% of fan speed at specified capacity.

.3 Fan Bearings

- .1 Fan bearings shall be selected to have minimum B10 life of 15,000 hours or minimum average life of 75,000 hours.
-

.2 All grease lubricated bearings that are not directly accessible shall be fitted with extended grease leads terminating at some convenient accessible location on the fan casing.

.4 Fan Vibration Isolators

.1 Spring vibration isolators designed and selected to operate at no greater than 2/3 solid deflection and be stable for lateral displacements. Spring mounts c/w levelling device and rubber sound pads. For loads less than 227 kg (500 lbs.) and deflection less than 31mm (1.2"), use Vibro Acoustics CM cast type mount. For loads and deflections greater than this, Vibro-Acoustics type FS open type mounts shall be used.

.2 Unless noted otherwise, mount floor mounted air handling units upon CM spring mounts to give 25mm (1") static deflection.

.3 Hang all suspended fans with SH-1 spring hangers to provide 25mm (1") static deflection.

.5 Fans to have prime coat finish of red oxide except dome exhausters. Wheels and shafts to be statically and dynamically balanced.

.6 Scheduled operating fan speeds and outlet velocities noted in specification herein and/or in fan schedules shall be maximum acceptable.

.7 Guards

.1 Protect V-belt drives by guards that encompass all sides of the drive. Any expanded mesh or ventilation openings in the guard are to be "finger proof" to meet OSHA requirements.

.2 Mount guards to the fan by bolted clips. They shall be completely removable.

.3 Each guard shall be c/w two 25mm diameter holes opposite both fan and motor shaft for purpose of allowing tachometer readings. Each hole will be covered with gravity-actuated swing cap.

.4 Front face of drive guard shall be hinged and latched for convenient access to interior.

.8 Coil manufacturer shall provide removable insulated covers over ends of cooling coils for access to headers and tube ends.

.9 Refer to Fan Schedule for fan sizes, capacities, etc.

2.18 BELT DRIVE CENTRIFUGAL INLINE FAN

.1 Greenheck in-line belt drive fan.

.1 Galvanized steel housing.

.2 Backward inclined aluminum wheel.

.3 Two bolted access panels.

.4 Integral duct connection flanges.

.5 Ball bearing motors.

.6 Adjustable motor pulley and plate.

- .7 Fan shaft mounted in regreaseable ball bearing pillow blocks.
 - .8 Static free belts.
 - .9 Corrosion resistant fasteners.
- .2 Return fan sound power data shall meet with the following criteria:

Inlet / Radiated Sound Power by Octave Band							
<u>63</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>4000</u>	<u>8000</u>
84/87	84/85	89/85	85/79	78/70	76/61	71/53	68/52
<u>LwA</u>	<u>DbA</u>	<u>Sones</u>					
85/79	74/68	23/16.4					

2.16 IN-LINE EXHAUST FANS

- .1 Greenheck in-line exhaust fans c/w removable fan-motor assembly, direct drive, acoustic lined plenum, inlet and outlet duct connections. Fan speed specified maximum acceptable.
- .2 Provide matching wall vents, goosenecks or roof jacks all c/w backdraft damper as required.
- .3 Section 15800 to be responsible for ensuring units have CSA approval for the particular application, prior to shop drawing submission.
- .4 Refer to Fan Schedule.

2.17 CEILING MOUNTED EXHAUST FANS

- .1 Ceiling exhaust fans c/w removable fan-motor assembly, direct drive, backdraft damper. Specified fan speed maximum acceptable.
- .2 Provide matching wall vents, goosenecks or roof jacks all c/w backdraft dampers as required.
- .3 Where units in rated ceiling, provide special inlet grille c/w fire damper and access door in inlet duct plenum to remove fan unit for servicing.
- .4 Section 15800 responsible for ensuring that units have CSA approval for the particular application, prior to shop drawing submittal.
- .5 Refer to Fan Schedule.

2.18 RANGE HOOD

- .1 Provide removable fan-motor assembly, direct drive, aluminum mesh charcoal filter, backdraft damper. Specified fan speed maximum acceptable.
- .2 Unit to have fully variable speed fan control.
- .3 Provide matching wall vents, goosenecks or roof jacks all c/w backdraft damper as required.
- .4 Refer to Fan Schedule.
- .5 Unit to have light under hood.

2.19 ELECTRIC DUCT HEATERS (c/w BINARY STEP CONTROLLER)

- .1 Supply where indicated CSA approved electric duct heaters as manufactured by Thermolec Manufacturing Ltd.
 - .2 Coils shall be iron-free, 80% nickel, 20% chrome and shall be insulated by floating ceramic bushing from the steel frame which shall be galvanized or aluminized. Coil terminal pins shall be insulated by means of non-rotating ceramic bushing.
 - .3 Duct heaters shall be equipped with both automatic and manual reset disc type thermal cut-outs and power terminal block.
 - .4 Thermal Safety Cut-outs shall be shielded from accidental impact and be serviceable through a side mounted terminal box. Each individual cut-out shall de-energize the entire heater in case of overheating.
 - .5 Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts. Frame shall be type FC flanged or type SC side duct slip-in to facilitate ease of installation and servicing.
 - .6 Duct heaters shall be complete with integral S.C.R. and driver. The SCR shall be c/w active transient energy protection feature to protect semiconductor components from transient line high voltage spikes.
 - .7 Optional accessories to include: 24 VAC, D-45 step controller, TransAX protection feature, duct temperature sensor, air proving pressure differential switch, inlet debris screen, 24 V internal control transformer and contactors. Control panel shall be c/w full line break disconnect switch.
 - .8 Watt density not to exceed 242 kW/sq.m. (22.5 kW per sq.ft.).
 - .9 Standard of Acceptance: Corridor make-up air unit heating coil EHC-1: Thermolec duct size 600 x 600, @ 50 kW, control; S.C.R.,
-

600 V/3ph, safeties including auto cut-out, transformer c/w fusible link, air flow sensor, door interlock disconnect.

2.20 ELECTRIC DUCT REHEAT COILS

- .1 Thermolec Model SC electric duct heaters where noted, open coil element supported refractory porcelain insulators. 1.2mm (18 ga.) galv. steel frame flanged manual reset high limit controllers. Insertion-type coil to slide out duct side. Airtight sheet metal channel around coil. Fit with CSA approved protection inlet screen.
- .2 Equip with both automatic recycling and manual reset type high temperature limit thermostats. Heaters to be CSA approved. Minimum air velocities to conform to manufacturers minimum requirements. Include packaged controls to accept 0-10Vdc signal from the building automation system.
- .3 Watt density not to exceed 242 kw/sq.m (22.5 KW per sq. ft.).
- .4 Refer to Electric Re-heat Coil Schedule.

2.21 AIR COOLED CONDENSING UNITS (12.5 to 20 tons)

- .1 Carrier air cooled condensing units as noted.
 - .1 System Description
 - .1 Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground or rooftop installation. Unit shall consist of a semi-hermetic reciprocating compressor, an air-cooled coil, propeller-type condenser fans, and a control box. Unit shall discharge supply air upward as shown on contract drawings. Unit shall be used in a refrigeration circuit to match a packaged fan coil unit.
 - .2 Equipment
 - .1 General:
 - .1 Factory assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge (R-22), and special features required prior to field start-up.
 - .2 Unit Cabinet:
 - .1 Unit cabinet shall be constructed of G-90 galvanized steel, bonderized and coated with a prepainted, baked enamel finish.
 - .3 Fans:
 - .1 Condenser fans shall be direct-drive propeller type, discharging air vertically upward.
 - .2 Condenser fan motor no. 1 shall be ball bearing type compatible with accessory low-ambient control.
 - .3 Shaft shall have inherent corrosion resistance.
 - .4 Fan blades shall be statically and dynamically balanced.

- .5 Condenser fan openings shall be equipped with PVC-coated steel wire safety guards.
- .4 Compressor:
 - .1 Compressor shall be serviceable, reciprocating, semi-hermetic type.
 - .2 Compressor shall be equipped with an automatically reversible oil pump, operating oil charge, suction and discharge shutoff valves, and an insert type, factory-sized crankcase heater to control oil dilution.
 - .3 Compressor shall be mounted on spring vibration isolators with an isolation efficiency of no less than 95%.
 - .4 Compressor speed shall not exceed 1750 rpm.
 - .5 Compressor shall unload using suction cutoff unloading (electrical solenoid unloading shall be available as an accessory).
- .5 Condenser Coil:
 - .1 Condenser coil shall be air cooled, circuited for integral subcooler.
 - .2 Coil shall be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed. Copper fins shall be available as an option.
- .6 Refrigeration Components:
 - .1 Refrigeration circuit components shall include hot gas muffler, high-side pressure relief device, liquid line shutoff valve, suction and discharge shutoff valves, holding charge of refrigerant R-22, and compressor oil.
- .7 Controls and safeties:
 - .1 Minimum control functions shall include:
 - .1 Power and control terminal blocks.
 - .2 Five-minute Time Guard protection to prevent compressor short-cycling.
 - .3 Capacity control on the compressor shall be by suction cutoff unloader in response to compressor suction pressure. Electric solenoid unloading shall be available as an accessory.
 - .4 Head pressure control by fan cycling. One condenser fan shall be cycled by discharge pressure to maintain proper head pressure.
 - .2 Minimum safety devices shall include:
 - .1 Automatic reset (after resetting first at thermostat)
 - .1 High discharge-pressure cutout.
 - .2 Low suction pressure cutout.
 - .3 Condenser fan motors to be protected against overload condition by internal overloads.
 - .2 Manual reset at the unit
 - .1 Electrical overload protection through the use of definite-purpose contactor and calibrated, ambient compensated, magnetic

trip circuit breakers. Circuit breakers shall open all 3 phases in the event of an overload in any one of the phases or a single phase condition.

2.22 REFRIGERANT PIPING AND ACCESSORIES

- .1 All refrigerant piping to be type 'L' copper with long radius elbows. All joints to be brazed with Silfos. Continuously bleed oil-free nitrogen through piping when brazing to prevent oxidation of internal pipe surface. All piping to be installed in accordance with good refrigerant piping practice with minimum number of fittings to minimize friction loss. Pipe sizes as specified in schedule on detail sheet. Provide separate piping for split refrigerant circuits.
 - .2 Provide flexible vibration eliminators on liquid and suction pipe connections to condensing unit.
 - .3 Install refrigerant controls supplied by condensing unit manufacturer. Install thermo-expansion valve on each DX coil liquid line with external equalizer connection. Valve c/w external remote bulb, set to provide 5.5 deg C superheat. Install solenoid pilot control with filter drier in external equalizer line for on-off control of refrigerant flow. Install Henry angle drier immediately upstream of thermo-expansion valve. Provide Henry sight glass between drier and valve only on DX coils located above air cooled condensers.
 - .4 Provide initial charge of refrigerant R22 and oil, as well as any additional amounts required during system warranty.
 - .5 Provide manual valves as required to isolate individual system components to minimize refrigerant loss during replacement of individual components. Valves welded/brazed with Silfos to copper piping. No flare or compression fittings. No ball valves. Valves up to 5/8" - packless line by Streamline; 7/8" and larger - packed line by Globemaster, Streamline or Henry.
 - .6 Provide refrigeration equipment manufacturer - approved wiring diagram illustrating all electrical wiring for refrigeration system.
 - .7 Refrigeration Subcontractor shall include for system check-out during extreme cold weather in first year of operation (below -28 deg. C) outdoor ambient) to ensure proper operation. Reports for operation shall be issued to Division 15, and Contract Administrator. Refrigeration Subcontractor shall insist that the City of Winnipeg's representative be present during check-out to verify that system operates properly and that refrigerant and oil levels are satisfactory.
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2.23 DIFFUSERS, REGISTERS AND GRILLES

- .1 Steel diffusers to have baked enamel finish, unless noted otherwise herein. Aluminum grilles and registers to be of welded construction and to have etched finish with clear lacquer overcoat unless noted otherwise herein.
- .2 Grilles and registers to be of one-piece construction with hidden mullions.
- .3 Refer to diffuser, register and grille schedule.

2.24 ACOUSTIC DUCT INSULATION

- .1 J-M Linacoustic flexible duct insulation with flame-attenuated glass fibers bonded with thermosetting resin. Black plastic-coated mat finish. Provide where noted on drawings and/or as specified herein.
- .2 Insulation to be fungi and bacteria resistant so as not to breed or promote growth. (ASTM G21, ASTM G22).
- .3 Provide protective 1.6mm galvanized iron walkway on floor of ducts and/or plenums requiring servicing.
- .4 Round Low Pressure Ducts
 - .1 Where indicated on drawings use 25mm (1") J-M Linacoustic.
- .5 Rectangular Low Pressure Ducts
 - .1 25mm (1") Thickness
 - .1 Ducts indicated as being acoustically lined on the drawings, unless noted otherwise.
 - .2 50mm (2") Thickness
 - .1 Ductwork indicated as being acoustic lined with 50mm (2") acoustic lining on drawings and specification details.
 - .2 Combustion air ductwork.
 - .3 Relief air duct from F-1 to louvre.
 - .4 Outside air intake duct from roof to AHU-1.
 - .5 Exhaust ducts from roof to main floor ceiling apply to F-4, F-5, F-6, F-7, F-8.

2.25 CHIMNEY AND BREECHING

- .1 Forced Draft Chimney and Breeching
 - .1 Boiler breeching and stacking components, supports and terminations shall be factory prefabricated, tested and listed by ULC, S636 for use with condensing boilers. The breeching and stack system, shall comply with all safety and building codes where applicable.
 - .2 Breeching assemblies and stack/s shall be double wall air-insulated system, having inner walls AL 29-4C stainless steel and the outer casing of 430 stainless steel.
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.3 Breeching and stack system section joints shall be sealed with a tapered end closure system with tabs, sealant and locking containment bands each band locked from a single point for a pressure tight assembly. Assemblies using metal screws through inner and/or outer walls will not be accepted.

.4 The breeching and stack system shall maintain air tight integrity at pressures up to 15" w.c. Breeching and stack systems shall be designed to adjust to thermal expansion caused by the heating and cooling of normal equipment operation.

.5 The manufacturer of the system must furnish complete CAD system drawings of the assembly to be furnished.

.6 Material required for breeching and stacks is Cleaver-Brooks SaF-T Vent CI Plus having double wall construction with 1" air insulation, suitable for use with ANSI Category I,II,III and IV, gas burning appliances.

.7 Support entire chimney height from base. Lateral support brackets over height of chimney as required.

2.26 SOUND ATTENUATORS

.1 Sound attenuators shall be of VAW manufacturer.

.2 Provide as shown and as per schedule.

.3 Tubular as required with outer casing of 0.701mm (24 ga.) galvanized steel sheet metal stiffened as required for duty, with perforated inner tube liner or open mesh standard to manufacturer, having inert vermin moisture-proof filler material of glass fibres or mineral wool of density required to meet specified acoustic performance, the whole fully air-tight when subjected to 2500 Pa (10" w.g.) internal pressure.

.4 Rectangular as required with same standard of construction except that outer casing thickness shall be 0.853mm (22 ga.) minimum for all sizes.

.5 Silencers to have mylar film between inner lining and glass fibres to ensure against erosion.

2.27 CIT BACKUP ROOM COOLING SYSTEM (NOMINAL 5 TON PRECISION A/C UNIT) - AC-1, AC-2, AC-3

.1 General

.1 Summary

.1 These specifications describe requirements for a cooling system. The system shall be designed to maintain temperature within the room. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements of the site.

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- .2 Design Requirements
 - .1 The cooling system shall be a Liebert Challenger 3000 factory assembled unit model no. BU067A-BAEI. Standard 60 Hz units shall be UL listed and CSA (NRTL-C) certified. It shall be specifically designed for service from the front of the unit. The system shall be designed for draw-through air arrangement to insure even air distribution to the entire face area of the coil.
 - .2 Each system shall be capable of handling 2800 CFM (1321 L/s) at 0.30 inches of water (75 Pa) external static pressure with up discharge airflow with front return pattern. It shall have a total cooling capacity of 64700 BTU/HR (19 kW), sensible cooling capacity of 53,800 BTU/HR (15.8 kW), based on the entering air condition of 80°F (26.6°C) dry bulb, and 60 °F (15.5°C) wet bulb and 50% relative humidity. These units are to be supplied with 600 Volt, 3 phase, 60 Hz power supply. The main fan motor shall be 1.50 HP (1.11 kW).
 - .3 Submittals
 - .1 Submittals shall include: Single-Line Diagrams; Dimensional, Electrical, and Capacity data; Piping and Electrical Connection Drawings.
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- .2 Product
 - .1 All Systems
 - .1 Cabinet and Frame Construction
 - .1 The frame shall be constructed of MIG welded tubular and formed steel. All frame components shall be finished in a black, powder coat finish to protect against corrosion. The exterior panels shall be 18 gauge steel and shall be powder coated with white color paint. The panels shall be insulated with a minimum 1 in. (25.4mm), 1-1/2 lbs. (0.68 kg) density fiber insulation. Front and side panels shall have captive, 1/4 turn fasteners.
 - .2 The cabinet shall be designed so that all components are serviceable and removable from the front of the unit.
 - .2 Fan and Motor Section
 - .1 The fan shall be the centrifugal type, double width, double inlet. The shaft shall be heavy duty steel with self-aligning ball bearings with minimum life span of 100,000 hours.
 - .2 The fan motor shall be 1750 RPM and mounted on an adjustable base. The drive package shall be sized for 200% of the fan motor horsepower, and equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators. The fan shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.
 - .3 Filter
 - .1 The filter shall be 2 inches (51 mm) thick and rated not less than 20 % efficiency based on ASHRAE 52.1.
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- .4 Advanced Microprocessor Control
 - .1 The Advanced control processor shall be microprocessor based with a front monitor LCD display panel and control keys for user inputs. The controls shall be menu driven with on-screen prompts for easy user operation. The system shall allow user review and programming of temperature and humidity setpoints, alarm parameters, and setup selections including choice of control type. A password shall be required to make system changes. For all user selections, the range of acceptable input (temperature, humidity, or time delay) shall be displayed on the monitor screen. The system shall provide monitoring of room conditions, operational status in % of each function, component run times, date and time, and four analog inputs from sensors provided by others.
 - .2 Control
 - .1 The control system shall allow programming of the following room conditions:
 - .1 Temperature Setpoint 65 to 85°F (18-29°C)
 - .2 Temperature Sensitivity +1 to +9.9°F (0.6 to 5.6°C) in 0.1° increments
 - .3 Humidity Setpoint 20 to 80% RH
 - .4 Humidity Sensitivity +1 to +30% RH
 - .2 All setpoints shall be adjustable from the individual unit front monitor panel. The microprocessor can be set within these ranges, however, the unit may not be able to control to extreme combinations of temperature and humidity.
 - .3 Temperature Sensor shall be capable of being calibrated using the front monitor panel controls to coordinate with other temperature and humidity sensors in the room.
 - .3 Predictive Humidity Control
 - .1 The microprocessor shall calculate the moisture content in the room and prevent unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature.
 - .4 Compressor Short Cycle Control
 - .1 The control system shall include a program to pre-vent compressor short cycling.
 - .5 System Auto Restart
 - .1 For startup after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the unit or from the central site monitoring system.
 - .6 Sequential Load Activation
 - .1 During startup, or after power failure, the microprocessor shall sequence operational load activation to minimize inrush current. Systems
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allowing multiple loads to start simultaneously are unacceptable.

.7 Front Monitor Display Panel

.1 The microprocessor shall provide a front monitor LCD backlit display panel with 4 rows of 20 characters with adjustable contrast. This display (along with five front mounted control keys) shall be the only operator interface required to obtain all available system information such as room conditions, operational status, alarms, control and alarm setpoints, and all user selections including alarm delays, sensor calibration, DIP switch selections, and diagnostics. All indicators shall be in language form. No symbols or codes shall be acceptable.

.8 Alarms

.1 The microprocessor shall activate an audible and visual alarm in event of any of the following conditions:

- .1 High Temperature
- .2 Low Temperature
- .3 High Humidity
- .4 Low Humidity
- .5 Short Cycle
- .6 Compressor Overload (Optional)
- .7 Main Fan Overload (Optional)
- .8 Humidifier Problem
- .9 High Head Pressure
- .10 Change Filter
- .11 Loss of Air Flow
- .12 Low Suction Pressure
- .13 Loss of Power
- .14 Custom Alarm (#1 to #4)

.2 Custom alarms are four customer accessible alarm inputs to be indicated on the front panel. Custom alarms can be identified with prepared (pro-programmed) alarm labels for the following frequently used inputs:

- .1 Water Under Floor
- .2 Smoke Detected
- .3 Standby GC Pump On
- .4 Loss of Water Flow
- .5 Standby Unit On

.3 User customized text can be entered for two of the four custom alarms. Each alarm (unit and custom) can be separately enabled or disabled, selected to activate the common alarm, and programmed for a time delay of 0 to 255 seconds.

.9 Audible Alarm

.1 The audible alarm shall annunciate any alarm that is enabled by the operator.

.10 Common Alarm

.1 A programmable common alarm shall be provided to interface user selected alarms with a

- remote alarm monitoring device such as a DDC system.
- .11 Remote Monitoring
 - .1 All alarms shall be communicated to the Liebert monitoring system with the following information: date and time of occurrence, unit number, and present temperature.
 - .12 Analog Inputs
 - .1 The system shall include four customer accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5 VDC or 0 to 10 VDC if desired. The gains for each analog input shall be programmable from the front panel. The analog inputs shall be able to be monitored from the front panel.
 - .13 Diagnostics
 - .1 The control system and electronic circuitry shall be provided with self diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front monitor panel. Control outputs shall be able to be turned on or off from the front monitor panel without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.
 - .14 Data Collection
 - .1 The control system shall maintain accumulative operating hours of compressor, reheat, humidifier, fan motor, and Econ-O-Coil. The ten most recent alarms shall also be retained.
 - .15 Communications
 - .1 The microprocessor shall be compatible with all Liebert remote monitoring and control devices.
 - .5 Infrared Humidifier
 - .1 The humidifier shall be of the infrared type consisting of high intensity quartz lamps mounted above and out of the water supply. The evaporator pan shall be stainless steel and arranged to be serviceable without disconnecting water supply lines, drain lines or electrical connections. The complete humidifier section shall be pre-piped ready for final connection. The infrared humidification system shall use bypass air to prevent overhumidification of the controlled space. The auto flush system shall automatically flush deposits from the humidifier pan. The system shall be field adjustable to change the cycle time to suit local water conditions. The humidifier shall have a capacity of 11 lbs/hr (5 kg/h).
 - .6 Electric Reheat
 - .1 The low watt density, 304/304, stainless steel, finned-tubular electric reheat coils shall be capable of maintaining room dry bulb conditions when the system
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is calling for dehumidification. The reheat section shall include UL approved safety switches to protect the system from overheating. The capacity of the reheat coils shall be 56,200 BTU/HR (16.5 kW), controlled in 2 stages.

- .7 Plenum
 - .1 The unit shall be supplied with a 3 way air discharge plenum complete with air discharge grills. The plenum shall be 18 in. (457mm) high. Insulated and powder painted the same color as the room unit.
- .8 Floor Stand
 - .1 The floor stand shall be constructed of a heliarc welded tubular steel frame. The floor stand shall be coated using an autodeposition process to protect against corrosion. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be: 9 in. (23cm) high.
- .9 Disconnect Switch, Non Locking Type
 - .1 The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible with the door closed.
- .10 Remote Sensors
 - .1 The unit shall be supplied with remote temperature and humidity sensors. The sensors shall be connected to the unit by a 60 ft. (18m) shielded cable.
- .11 Leak Detection
 - .1 The unit shall be provided with a single remote point leak detection sensor, Liquitect 300 Series.
- .12 Direct Expansion Self Contained Systems
 - .1 Direct Expansion Coil
 - .1 The evaporator coil shall have 6.67 sq.ft. (0.62 sq. m) face area, 4 rows deep. It shall be configured as V frame and be constructed of copper tubes and aluminum fins and have a maximum face velocity of 405 ft. per minute (2.1 m/s) at 2800 CFM (1321 L/s). The coil shall be provided with a stainless steel drain pan.
 - .2 Refrigeration System
 - .1 The refrigeration system shall consist of a high efficiency scroll compressor, hot gas bypass, pressure safety switches, externally equalized expansion valve, filter drier, refrigerant sight glass and moisture indicator.
- .13 Warranty and Service
 - .1 Manufacturer's warranty shall be for a period of one year from date of equipment start, but not more than 18 months from shipment. The warranty shall cover defects in material and workmanship and include labour to replace or repair the defective part.
 - .2 Manufacturer must have local representation and must have factory trained local serviceperson capable of servicing this type of equipment.

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- .3 CIT Backup Room Air Cooled Condenser (for Nominal 5 ton Precision A/C Unit) - ACCU-1, ACCU-2, ACCU-3
 - .1 Pump Down Control
 - .1 A liquid line solenoid valve shall be provided for pump down control.
 - .2 Crankcase Heater
 - .1 A crankcase heater shall be provided for additional system protection from refrigerant migration during off cycles.
 - .3 Propeller Fan Condenser
 - .1 The Liebert manufactured air cooled condenser shall be the low profile, slow speed, direct drive, propeller-fan type, model no. DCSL083-B. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil with an integral electric control panel. The system shall be designed for 95 °F (35 °C) ambient. The air cooled condenser shall have a 600 Volt, 3 phase, 60 Hz power supply. The main fan motor shall be 0.75 HP (0.55 kW).
 - .2 Propeller fan blades shall be constructed of aluminum with a maximum diameter of 30 inches and secured to the fan shaft by a heavy duty hub with set screw. Fan guards shall be heavy gauge, close meshed, steel wire with corrosion resistant finish. Fan shall be factory balanced and tested before shipment.
 - .3 Fan motor shall be provided with rain slingers, permanently lubricated bearings, and individual builtin overload protection. Motors shall be rigidly mounted on die-formed galvanized steel supports.
 - .4 Condenser housing shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Structural support members, including coil support frame, motor, and drive support, shall be galvanized steel for strength and corrosion resistance. Aluminum legs are provided with rigging holes for hoisting the unit into position.
 - .4 Lee Temp Head Pressure Control
 - .1 The winter control system for the air cooled condenser shall be "Lee Temp." The Lee Temp system shall allow startup and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C). The Lee-Temp package shall include: insulated receiver, pressure relief valve for each circuit, head pressure three way control valve, and rotalock valve for isolating the refrigerant charge. The Lee Temp receiver shall be factory insulated and mounted ready for the field connection to the air cooled condenser. The Lee Temp heater shall be 150 Watt and require a separate power supply of 115 Volt, single phase, 60 Hz.
 - .5 Unit Disconnect Switch
 - .1 A locking disconnect factory installed and wired in enclosed condenser control section.
 - .6 Warranty and Service
 - .1 Manufacturer's warranty shall be for a period of one year from date of equipment start, but not more than 18 months from shipment. The warranty shall cover defects in
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material and workmanship and include labour to replace or repair the defective part.

.2 Manufacturer must have local representation and must have factory trained local serviceperson capable of servicing this type of equipment.

.4 Execution - CIT Backup Room Cooling System

.1 Installation of Environmental Control Units

.1 General

.1 Install environmental control units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

.2 Electrical Wiring

.1 Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical Subcontractor.

.3 Piping Connections

.1 Install and connect devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's piping connection diagram submittal to the piping Subcontractor.

.4 Supply and Drain Water Piping

.1 Connect drains to air conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

.2 Field Quality Control

.1 Start up environmental control units in accordance with manufacturer's start up instructions. Test controls and demonstrate compliance with requirements.

2.28 DUCTLESS FAN COIL UNIT

- .1 The air conditioning systems shall be a Mitsubishi Electric Series PK split type system. The system to consist of a slim silhouette, compact wall mounted packaged evaporator section Model PK-36FK3 and matching Slim Line air cooled outdoor unit Model PU-36EK. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label. In Canada, the unit shall also bear a Canadian Standards Association (CSA) inspection, acceptance or certification label. All wiring to be in accordance with the National Electric Code (N.E.C.), or in Canada, comply with prevailing Provincial and Local codes and ordinances. The units shall be rated in accordance with ARI Standard 210 and bear the ARI label. A full charge of R-22 for refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal and Provincial Standards.

- .2 The units shall have a manufacturer's warranty for a period of one (1) year from the date of installation. The compressor shall have a warranty of six (6) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of Mitsubishi Electric Sales Canada Inc. This warranty does not include labor. Manufacturer shall have ten years experience in the Canadian markets.
 - .3 The system shall provide a total minimum cooling capacity of 34,200 BTU/H with a SEER of 10.2 or an EER of 9.9 at ARI standard conditions. The system net minimum total cooling capacity shall be 34,200 BTU/H and the net minimum sensible cooling capacity shall be 24,300 BTU/H with a circulating air rate of 890 cfm at 67 degrees FWB entering the indoor coil and 95 degrees FDB air entering the outdoor coil. The total power consumption shall not exceed 3.47 kW at these conditions.
 - .4 The indoor unit shall be completely factory assembled and wired. The casing shall have a white finish. The evaporator fan shall be an assembly with line flow fans direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. An adjustable guide vane shall be provided with the ability to change the air flow from horizontal to vertical. A motorized air sweep flow louver shall provide an automatic change in air flow by directing the air from side to side for uniform air distribution. Return air shall be filtered by means of an easily removable washable filter. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan with drain shall be provided under the coil. The unit electrical power shall be 115 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 103 volts to 127 volts.
 - .5 The control system shall consist of two (2) microprocessors interconnected by a single non polar two wire cable as supplied. Wiring shall run from indoor unit to controller direct. NO SPLICES. When running longer lengths or more than one set of remote controller wires together, a double insulated, two wire cable equivalent to that provided e.g. Belden 9407 cable, is mandatory or use shielded two wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the remote controller; provide emergency operations, and control the outdoor unit. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature; a 24-hour on/off timer so that automatic operation can be set on the timer at one-hour intervals from one to twenty-four hours; have self-diagnostic function display;
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check mode for memory of most recent problem; control operation of the air sweep louvers; and provide on-off and system/mode function switching. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room. The remote controller shall have the capability of controlling up to a maximum of 50 systems at a maximum control cable distance of 502mm (1650 feet). The control voltage between the remote controller and the indoor unit shall be 12 volts, D.C. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, D.C. Both 12VDC shall be generated from the indoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include twenty function self diagnostics including total hours of compressor run time.

- .6 The outdoor unit shall be completely factory assembled, piped, and wired. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel. The unit shall be furnished with one (1) direct drive, propeller type fan arranged for horizontal discharge. The motors shall have inherent protection be of the permanently lubricated type, and resiliently mounted for quiet operation. Each fan shall be provided with a raised guard to prevent contact with moving parts. The compressor shall be of the high-performance, rotary type with crankcase heater, accumulator and internal thermal overloads. The compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall be equipped with high pressure switch and have the capability to operate with a maximum height difference of 40.04m and overall refrigerant tubing length of 40.04m between indoor and outdoor sections without the need for line size changes, traps or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with an integral metal guard. The unit shall be controlled by the microprocessor located in the matching indoor unit. A built-in, low-ambient controller will allow cooling to 23 degrees F outdoor temperature. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The unit shall be equipped with a condenser discharge windscreen.
- .7 Program Timer - Part # PAC-SK65PT - to provide daily on/off switching, daily set-back temperature differentials. The timer shall have a LCD clock, today set switch, weekly timer switch, degree set-back switch and daily timer switch. The timer shall mount next to the remote control and be connected by plug-in wire harness.
- .8 Extra low ambient option - to allow the system to operate to -40°F (-40°C) cooling mode.

PART 3 - EXECUTION

3.1 DUCT OPENINGS

- .1 Locate only openings in walls, floors, partitions, beams, etc. required for ducts, equipment, etc. Contractor to form all openings for same, except as noted below.

3.2 WALL RELIEF AIR OPENING

- .1 Locate openings in walls above ceilings to allow passage of return and relief air.

3.3 DUCT AND EQUIPMENT SUPPORTS, HANGERS AND INSERTS

- .1 Design, Installation
 - .1 Supports to secure ducts and equipment, prevent vibration and provide for expansion and contraction. Design supports of strength and rigidity in a manner which will not stress the building construction. Use inserts for suspending hangers. Do not use vertical expansion shields without Contract Administrator's approval.
- .2 Concrete Inserts
 - .1 Do not weaken concrete or penetrate waterproofing membrane. Use reinforcing rods through inserts for pipe sizes over 50mm (2"), or equivalent weight. Where concrete slab is finished ceiling, inserts to be flush with surface.
- .3 Protect insulation at contact with hangers and support with approved metal shields.

3.4 CO-ORDINATION WITH H.V.A.C. BALANCE AND TESTING AGENCY

- .1 Refer to Section 15990 H.V.A.C. Balance and Testing. Co-ordinate work with Section 15990.
 - .2 As a part of this contract, Section 15800 shall make any changes in pulleys and belts, and add manual dampers for correct balance as recommended by 15990, at no additional cost to the City of Winnipeg.
 - .3 Section 15800 responsible for initial alignment and tension of all fan pulleys and belts, of equipment supplied by Section 15800.
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3.5 LOW PRESSURE DUCTWORK

- .1 Where duct width exceeds 450mm (18") in largest dimension, stiffen by cross breaking sheets diagonally. Beaded ducts as per SMACNA Catalogue Fig. 1.13 acceptable alternative.
 - .2 Duct sizes are inside dimensions. If ducts are acoustically lined, outside duct size to be increased as required.
 - .3 Provide ductturns in all elbows of ducts 1200mm (48") wide and greater, in segments of 600mm (24") maximum.
 - .4 Single thickness partitions between ducts not accepted.
 - .5
 - .1 All ductwork shall have seams and joints sealed watertight with Duro-Dyne S-2 duct sealer and FT-2 fibreglass duct tape. Prior to installation ductwork to be clean, dry and free of grease. Apply duct sealer with stiff brush or trowel. Wrap wet seam or joint with duct tape and apply further coat of duct sealer. Duct sealer and glassfiber to extend 25mm (1") on each side of joint or seam. On outside ductwork construct duct so that top of duct slopes 12mm (1/2") per 300mm (12") minimum to ensure that water does not collect on top.
 - .2 Ductwork exposed in finished rooms do not require duct tape application, but seams and joints shall be sealed with S-2 duct sealer. Sealer must be capable of accepting finish painting.
 - .3 Ductwork on roof shall have seams and joints sealed by application of TREMCO MONO black acrylic sealant applied with application gun and levelled with putty knife. Material shall be used in accordance with manufacturer's printed recommendations.
 - .6 Provide openings for thermostats and controllers by Section 15900.
 - .7 Where ductwork conflicts with mechanical and electrical piping and it is not possible to divert ductwork or piping to stay within allowable space limitations, provide duct easements. Easements not required on pipes 100mm (4") and smaller outside dimension, unless this exceeds 20% duct area. Irregular or flat shaped piping requires duct easement. Hangers and stays in ductwork to be parallel to air flow. If easement exceeds 20% of duct area, duct to be split into two ducts with original duct area being maintained. Easements to be approved by Contract Administrator before installation.
 - .8 At points within air system where air streams at different temperatures meet, install baffling for a good mix. Baffling to be by Section 15800 in locations recommended by Section 15900, approved by Contract Administrator, and at no additional cost to the City of Winnipeg.
 - .9 If ductwork is not adequately braced and/or supported to provide good installation, additional bracing and/or supports to be
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provided at no extra cost to the City of Winnipeg. Contract Administrator to interpret.

- .10 Assemble round duct sections using beaded couplings attached with sheet metal screws.
- .11 Every intake and exhaust duct up through the roof shall be installed with a 2" (50mm) deep water-tight drip pocket at base of duct complete with drain, unless noted otherwise. Refer to specification details. This shall not apply to kitchen exhaust systems. Refer to plans for drain requirements.

3.6 FLEXIBLE DUCTWORK CONNECTORS

- .1 Mount on ducts with mastic seal and sheet metal screws. Formed conical connections approved by Contract Administrator, to be considered equal.

3.7 DIFFUSER CONNECTIONS

- .1 Flex duct connection: align vertically flex connections with diffuser neck with no more than 1/8 duct diameter of deviation to achieve manufacturer's sound level ratings. Otherwise, provide equalizing grid in diffuser's neck.
- .2 Hard duct connection: provide min. 3 duct diameters section of straight vertical duct upstream of diffuser to achieve manufacturer's sound level ratings. Otherwise, provide equalizing grid in diffuser's neck.

3.8 MANUAL VOLUME DAMPERS

- .1 Install, in manner acceptable to manufacturer, where noted on drawings.

3.9 MOTORIZED DAMPERS

- .1 Units in acoustically lined ducts are to be sized to suit clear dimensions of acoustic insulation and not of size to suit sheet metal duct. Where units are located in acoustic lined ducting, install heavy gauge metal channel and fasten to metal duct to receive damper frame. Space between channel and duct to be filled with flexible insulation.
 - .2 On plenums and ducts with external insulation, Section 15900 to provide channel mounting frame of same thickness as insulation. Pack channel frame with loose fibreglass insulation.
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3.10 FIRE DAMPERS

- .1 Fire dampers shall be installed in the plane of the fire separation so as to stay in place should the duct be dislodged during a fire. Install fire dampers only in positions for which they have been tested. Refer to specification details.
- .2 Installation shall conform to N.B.C. 1995 and local authorities.

3.11 MOTORIZED FIRE/SMOKE DAMPERS

- .1 Firmly attach fire/smoke dampers to walls. Install fire/smoke dampers in strict accordance with manufacturer's recommendations and only in positions for which they have been tested.
- .2 Size operators to ensure proper damper operation against static pressures likely to be encountered in application specified.
- .3 Co-operate with Section 15990 and provide assistance for testing and verification of all fire/smoke dampers. Refer to Section 15990 and Section 15991 for further requirements.

3.12 MANUAL DAMPER REGULATORS

- .1 Install in strict accordance with manufacturers published recommendations.

3.13 DUCT ACCESS DOORS

- .1 Locate properly for inspection and servicing. Doors and frame to be rigid, close-fitting, with rubber gaskets, galvanized hinges with brass pins and at least two galvanized cam locks. Rivet frame and hardware to ducts.
- .2 Where impossible to swing access doors, install removable door with four cam locks.
- .3 Access doors for humidifier application shall be liquid tight, and installed on side of duct (not bottom).

3.14 LOUVRES AND WALL OPENINGS

- .1 Flash and make all openings around the louvres and wall openings weathertight. Slope ductwork down to louvre. Drill drain holes in bottom blade of louvre. Seal ductwork with Duro-Dyne S-2 until watertight.
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3.15 ROOF AIR INTAKE AND RELIEF HOODS

- .1 Install units as per detail sheet. Sizes shown as roof openings on drawings. Insulation held on with metal clips.

3.16 FILTERS

- .1 During construction period, no air system to be started unless air filters function as specified. At time of building acceptance by the City of Winnipeg, all filter banks to be in perfectly clean operating condition. There shall be no air bypass around or in filter banks.
- .2 Install all filters as per mfg. published installation data.

3.17 FAN SYSTEMS - GENERAL

- .1 Use flexible connections at inlets and outlets where ductwork and plenums connect to fans and air-handling equipment.
- .2 Fan Vibration Isolation
 - .1 Install as per Isolation manufacturer's published data.
- .3 All equipment shall be installed in strict accordance with manufacturer's published data.
- .4 Protection of Fan Equipment Before Installation
 - .1 Grease shafts, sheaves, etc. to prevent corrosion. Fan bearings to be greased or oiled at time of building takeover.
- .5 Centrifugal fans located outdoors to have drain holes in casing.
- .6 Co-ordinate installation of smoke detectors with Division 16 - Electrical.

3.18 PRECISION A/C UNIT

- .1 General
 - .1 Install precision air conditioning units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
 - .2 Electrical Wiring
 - .1 Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical Subcontractor.
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- .3 Piping Connections
 - .1 Install and connect devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping Subcontractor.
- .4 Field Quality Control
 - .1 Start up mainframe coolant units in accordance with manufacturer's start up instructions. Test controls and demonstrate compliance with requirements.
 - .2 These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.
 - .3 The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

3.19 AIR COOLED CONDENSING UNITS

- .1 Install unit as per manufacturer's published data. Provide clearance at access doors.
- .2 Provide auxiliary liquid receiver c/w shut-off relief valves if condensing unit is not adequate for storage of refrigerant during pump down periods. Receiver capacity to be total system refrigerant value plus 20% allowance for expansion. Obtain approval from Contract Administrator for receiver location and piping sizes and design.
- .3 Refrigeration manufacturer to include in quotation for services of his factory-trained technician to review installation of units, refrigerant piping and system control wiring and to submit a report to Contractor and Contract Administrator which states that condensing units have been installed, piped and wired satisfactorily.

3.20 REFRIGERANT PIPING AND ACCESSORIES

- .1 Retain services of experienced Refrigerant Subcontractor to provide complete refrigeration installation. Subcontractor shall be member of CRACCA. Subcontractor shall submit refrigerant piping layout c/w sizing calculations to Contract Administrator for review prior to Work commencing.
 - .2 Bleed nitrogen through piping when welding to prevent oxidation of internal pipe surface. All piping to be installed in accordance with good refrigerant piping practice with minimum number of fittings to minimize friction loss. Provide separate piping or split refrigerant circuits.
 - .3 Pressure test refrigerant piping with nitrogen 2068 kPa (300 psig) for four hours.
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- .4 Suction piping to be installed to ensure oil return to compressor. Grade lines toward compressor and provide oil traps. Where specified on drawings, provide double suction risers with oil traps and inverted loop connections for all vertical lines in system.
 - .5 Provide additional amounts of oil and refrigerant required during system warranty.
 - .6 Provide horizontal and vertical piping support in accordance with accepted standards.
 - .7 Provide detailed wiring diagram showing all power and control wiring related to refrigeration cycle, including refrigerant solenoid pilot control, interlocks between condensing units and supply fan, temperature control inter locks and all other control wiring for complete refrigeration system operation to approval of refrigeration equipment manufacturer and Contract Administrator. Supply all control transformers and all necessary auxiliary controls to provide complete operational system to approval of equipment manufacturer and Contract Administrator. Section 15900 shall provide single or multiple stage start/stop control contacts and interconnecting wiring only.
 - .8 Provide startup services of refrigeration system with the City of Winnipeg's representative present. Instruct the City of Winnipeg on proper operation of the system and equipment. Providing that equipment functions satisfactorily, Refrigeration Subcontractor shall confirm in writing date of this startup to Mechanical Sub-contractor, Contractor, the City of Winnipeg and Contract Administrator. This letter will form part of warranty period documents.
 - .9 Provide 12 month warranty on entire refrigeration system including equipment, piping and accessories, such that any further adjustments or alterations during warranty period required to achieve specified refrigeration system performance to be at no additional cost to the City of Winnipeg. Warranty to commence after date of satisfactory start-up and upon receipt of refig. manufacturer's report of the overall system. Actual date to be determined by the Contract Administrator.
 - .10 Include for normal Fall shutdown services as recommended by refig. manufacturer. Include in quotation for startup during second cooling season. Issue reports for each operation to the City of Winnipeg and Contract Administrator. Refrigeration Subcontractor shall ensure that the City of Winnipeg's representative is present during second cooling season start-up to verify that refrigerant and oil levels are satisfactory. Provide the City of Winnipeg with 48 hour prior notice. The City of Winnipeg shall pay for necessary refrigerant, oil and parts required providing system warranty period has terminated.
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3.21 ELECTRIC DUCT HEATERS

- .1 Provide airtight sheet metal channel around coil.
- .2 Minimum air velocities to conform to manufacturer's minimum requirements.
- .3 Coils mounted horizontal for vertical discharge shall have across-the-face lineal thermal cut-out. Each coil section shall be removable without disassembly of entire unit.
- .4 Units to be installed in ductwork in strict accordance with manufacturer's recommendations. If acoustic lining is noted being adjacent to duct heaters, cut back duct lining for distance of 150mm (6") before and 300mm (12") after coil.

3.22 DIFFUSERS, REGISTERS AND GRILLES

- .1 Provide sponge gasket behind each outlet or inlet and adequate fastenings to prevent streaking between outlet and duct, wall or ceiling.
- .2 Shop drawings to be accompanied by itemized list indicating unit locations by room number and unit size. Itemized list noted above shall be certified by direct representative.
- .3 Submit typical unit c/w all accessories, specified finishes, for all diffusers, grilles and registers, if requested by Contract Administrator. Materials installed on job to be fully equal to samples submitted for approval.
- .4 Exact dimensions of walls, etc. are as per architectural drawings. Install diffusers so they fit properly in ceiling suspension system. Co-ordinate with all related Subcontractors.
- .5 Should there be any confliction in location of grilles, registers and diffusers with lights, etc. matter to be referred to Contract Administrator for directive. If requested by Contract Administrator, re-locate grilles, diffusers and registers and ductwork attached, within 1.2m (48") of locations noted on drawings, without extra cost to the City of Winnipeg. Refer to drawings for additional requirements.
- .6 Section 15800 to paint, with flat black finish, ductwork exposed to view through inlet or outlet grilles, registers and louvres.

3.23 ACOUSTIC DUCT INSULATION

- .1 Duct sizes are free area inside duct dimensions. Where lining is required, actual duct dimensions to be increased to allow for thickness of internal insulation.
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- .2 Round Low Pressure Ducts
 - .1 Insulation adhered with No. 3M-29 or BF81.71. Breaks and joints to be painted out with BF-60-30N fire retardent mastic. Exposed edges to be coated with adhesive.
- .3 Rectangular Low Pressure Ducts
 - .1 Impale on welded studs spaced 400mm (16") o.c. Paint breaks and joints with BF-60-30N fire retardent mastic. Coat exposed edges with adhesive. Projecting fasteners and ends cut off vertically flush.
- .4 Provide 1.6mm U.S.S. prime quality galvanized. iron covering over floor insulation to allow servicing of equipment; e.g. where ductwork houses motorized dampers, controls, filters and like.

3.24 TESTING OF DUCTWORK

- .1 Visually and audibly check for air leaks that can be heard or felt under normal operating conditions. Repair all leaks in ductwork.

3.25 TESTING OF FIRE DAMPERS AND CEILING FIRE STOPS MOTORIZED SMOKE DAMPERS

- .1 Refer to Section 15990 H.V.A.C. Balance and Testing.
- .2 Section 15800 shall repair all units that have been identified as being faulty by Section 15990.

3.26 CHIMNEY AND BREECHING

- .1 Provide venting systems for all fired equipment.
 - .2 Breeching shall slope up to chimney and shall offer no restriction to flow. Provide long sweep elbows. On forced draft breeching provide cleanout at boiler.
 - .3 The vent connector rise from each piece of equipment shall be the maximum possible to enhance flue gas venting.
 - .4 Support chimneys and breeching from structure.
 - .5 Connections to equipment shall be installed as recommended by the equipment manufacturer. Locate chimney minimum of 907mm (3'-0") above highest point of roof including any project and/or rooftop mounted equipment within 3m (10'-0") horizontal from chimney, unless higher chimney is noted on drawings.
 - .6 Provide guy wire support as noted or as recommended by manufacturer.
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- .7 Venting system diameter shown on drawings represents a minimum size only. Mechanical contractor shall provide adequately sized venting systems, including all vent connections, breeching, vents, chimneys, rain caps and other associated components, for all fuel fired equipment. Sizing of venting systems shall be determined to suit fuel fired equipment and vent system provided, and shall meet requirements of vented equipment manufacturer and vent system manufacturer. In case of a variance in requirements between the two manufacturers, the larger size shall be used. Manufacturer's sizing calculations shall be submitted to the Contract Administrator for review. Performance deficiencies related to inadequate vent sizing shall be corrected at no additional cost to the City of Winnipeg.

3.27 SOUND ATTENUATORS

- .1 Provide data with full ratings to include:
.1 Dynamic insertion loss.
.2 Noise regeneration data both at 0m/s, 10.2m/s and 20.4m/s face velocities by certifying laboratory which is standard used by supplier for his published catalogue data.
- .2 Manufacturer's representative shall visit Site during installation and shall submit inspection report in writing to Contract Administrator.
- .3 After start-up, final corrections and balancing of systems, manufacturer shall take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and in other critical locations.
- .4 One-third octave band and narrow band vibration measurements, and tests utilizing artificial sound sources are required in areas shown having critical requirements.
- .5 Submit complete report to Contract Administrator of test results including sound curves.
- .6 Silencer selection showing model number, air pressure drop and attenuation in appropriate octave band shall be equal or more than as per silencer schedule.
- .7 Static pressure loss of silencer shall have been measured in accordance with AMCA Bulletin 210.
- .8 Insertion loss data shall be as measured by 'Duct to Reverberation Room' method recommended by S1W42 sub-committee of American Standards Association (USASI) with airflow generated noise measured in accordance with ASHRAE 36B-63 test method. Only tests made at an independent testing laboratory will be considered, and test data must include acoustical performance and generated noise levels at various airflow velocities.
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.9 Necessary duct transitions shall be field fabricated.

PART 1 - GENERAL

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2 Wherever words "shall be capable of" appear in specifications, interpret as meaning that; where feature or performance referred to is being applied, that feature or performance shall be provided. Where feature or performance is not applied now, but will be applied in future (i.e. Card Access Control), system shall be provided with all necessary central hardware and software required to support that feature or performance, with only addition of field hardware being required at that future time.

1.2 WORK INCLUDED

- .1 Labour, material, plant, tools, equipment and services necessary and reasonably incidental to completion of temp. control/instrumentation systems as noted herein and/or on the drawings.
- .2 Provide complete system of Johnson automatic controls for systems indicated.
- .3 Control equipment to be product of one manufacturer unless otherwise specified.
- .4 Prewired or prepiped controls on package equipment specified, is not included in this Section.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
 - .2 Section 15400 Plumbing
 - .3 Section 15600 Liquid Heat Transfer
 - .4 Section 15800 Air Distribution
 - .5 Section 15990 Testing, Adjusting and Balancing
 - .6 Section 16010 Electrical
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1.4 WORK BY OTHER SECTIONS

- .1 Section 15400 and Section 15600 to distribute and mount all pipe connected equipment including valves, immersion controllers, thermometers, humidifiers, orifice flanges, flow switches etc. in their respective locations, as supervised by Section 15900.
- .2 Section 15800 to distribute and mount all motorized dampers, air measuring stations, etc. in their respective locations, as supervised by Section 15900.
- .3 Section 15800 shall provide additional galv. iron baffles as required at all mixed air plenums to ensure good air mix so controllers can function properly. Section 15900 shall assist Section 15800 in establishing locations of such baffles.
- .4 Section 15400 to pipe drains from control air compressors.
- .5
 - .1 Division 16 - Electrical to supply and install all conduit, wire and connections from the distribution panels to line side of magnetic starters and thermal overload switches, and from load side of starters and switches to motors.
 - .2 Division 16 - Electrical to supply and install conduit, wire and connection for line voltage control devices on single phase equipment such as:
 - .1 Electric thermostats, pressure electric switches, aquastats for unit heaters.
 - .2 Float switches, pressure switches, alternators for sump pumps, sewage pumps, etc. and other mechanical wiring required but not specified in this section of the specifications.
 - .3 All safety controls must be wired in series with both "HAND" and "AUTO" starter switch positions to ensure against damage to equipment and/or system.
 - .4 Normal and/or emergency power source wiring to Section 15900 systems panels and other devices or groups of devices requiring 120 volt normal and/or emergency power source.
 - .5 All control wiring for boilers in accordance with wiring diagrams supplied by boiler manufacturer.

1.5 ELECTRICAL WIRING PERFORMED BY SECTION 15900

- .1 Supply and installation of all conduit, wire, electric relays, connections and other devices required for control circuit wiring for systems as specified in Section 15900, whether line or low voltage, shall be responsibility of Section 15900, except as noted above.
 - .2 Section 15900 shall either use own electricians, retain and pay for services of successful Division 16, or use an Electrical Subcontractor acceptable to Contract Administrator to supply and
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install all conduit and wiring for systems as specified in this Section.

- .3 Factory trained servicemen in employ of manufacturer, shall make final wiring connections on all components, mount and electrically connect all controls.
- .4 Electrical wiring shall be installed in conformance with CSA, ULC, Manitoba Building Code, National Building Code of Canada 1990 and standards set in Division 16 of this specification.
- .5 Ensure that adequate conduit is installed during initial phases of construction, to accommodate total systems requirements.
- .6 Wire all safety controls in series with both 'Hand' and 'Auto' starter positions to ensure that systems are properly protected.
- .7 Section 15900 shall provide all other conduit and wiring required for Section 15900 systems operation, including tie-ins from Section 15900 supplied relays to motor starting circuits.
- .8 If approved by system manufacturer, cable up to 30 Volts may be installed in extra-low voltage communication cable tray.
- .9 Refer to Section 16150 for conduit and cable identification requirements.
- .10 Section 15900 shall provide all control circuit wiring required for DX refrigerant systems. Co-ordinate wiring with Refrigerant Subcontractor wiring diagrams.
- .11 Section 15900 shall provide detailed wiring diagrams for remote supervisory panels supplied with rooftop equipment, connections between Section 15900 supplied equipment and DX cooling equipment, and SCR contactor connectors for electric heating coil and re-heat coil controls.

1.6 PROTECTION OF SOFTWARE RIGHTS

- .1 Prior to the delivery of software, the City of Winnipeg shall enter into software license agreement with provisions such as limiting use of software to equipment provided under these specifications, limiting copying, preserving confidentiality and prohibiting transfer to third party.

PART 2 - PRODUCTS

2.1 IDENTIFICATION OF EQUIPMENT - GENERAL

- .1 Use engraved black and white laminated plastic, 25mm x 62mm (1" x (2-1/2")), at all thermostats, thermometers, panels, etc., supplied so as to clearly indicate service of particular device. Does not apply to room thermostats. Manual switches, unless they come with standard nameplates, and thermostats, thermometers, switches, etc., installed on local panels to be similarly labelled. All controllers, relays, etc. mounted inside local panels may have tape labels.
- .2 Excluding room thermostats, convector valves, ceiling reheat and radiant panel valves and damper assemblies, provide lamacoid identification plates fastened with rivets or self-tapping screws at all equipment supplied by Section 15900 so as to clearly indicate service of particular device. All manual switches, unless they come with standard nameplates, shall be similarly labelled.
- .3 Equipment installed on surfaces of local panels shall be similarly labelled. Equipment mounted inside local panels, must have permanent plate labels with self-tapping screws. Tape labels are not acceptable.
- .4 Identification plates, by Section 15900, to be white background with minimum 5mm high black letters, unless specified otherwise. Electrical systems identification to be as per Section 16150.
- .5 Information on lamacoid identification plates to be consistent with 'as-built' control drawings.
- .6 Prior to lamacoid fabrication, submit copies of control drawings and complete list of proposed wording for each lamacoid, for approval by Contract Administrator and the City of Winnipeg. Include copy of approved lamacoid list in each Maintenance/Operating Manual.

2.2 VALVE ACCESS IDENTIFICATION

- .1 Points of access to radiant panel and reheat coil control valves shall be identified with black lamacoid with 10mm high white lettering mechanically fastened either onto ceiling T-bar grid or onto access door.
- .2 Lamacoids shall state:
 - .1 "RAD. HTG. PANEL"
 - .2 "HTG. COIL HC- (STATE NO.)"

2.3 INSTRUMENT CABINETS

- .1 Provide at each system or groups of systems, cabinet type metal control panel with all instruments mounted inside locking cover. All panels shall have same key. Temperature indication and control point adjustments and gauges labelled as to function with lamacoid nametags fixed to panel face with self-tapping screws. All electrical equipment mounted in cabinet to be pre-wired to labelled terminal strips.

2.4 AUTOMATIC CONTROL VALVES

- .1 Bodies shall be cast brass up to and including 50mm (2") I.P.S. and cast iron 64mm (2-1/2") I.P.S. and over.
 - .2 All automatic control valves to be fully proportioning Honeywell Model VP525A with modulating plug or V-port inner guides, unless otherwise specified. Valves to be quiet in operation and failsafe in either N.O. or N.C. position in event of air failure. Valves to be capable of operating in sequence when required by sequence of operation. All control valves shall be sized by control manufacturer and shall be guaranteed to meet heating and cooling loads as specified. All control valves to be suitable for system pressure involved. Valve operators shall be of molded rubber diaphragm type. Body pressure rating and connection type (screwed, flared, or flanged) shall conform to pipe schedule elsewhere in this specification.
 - .3 Water and glycol control valves shall be single seated type with equal percentage flow characteristics. Valve discs shall be composition type. Valves on glycol system shall be suitable for use in glycol solution specified in Section 15600.
 - .4 Provide 3-way mixing valves, piped as noted on drawings and/or spec. detail sheets.
 - .5 Butterfly valves used as control valves, shall be high performance type with heavy-duty shaft bearings and adjustable heavy-duty packing.
 - .6 Maximum valve pressure drop:
 - .1 Water: 20.7 kPa (3 psig)
 - .7 Size properly by manufacturer in accordance with published data to match load requirements of corresponding equipment to which they are applied.
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2.5 CONTROL DAMPERS

- .1 Provide all control dampers of type and sizes indicated. All outside, exhaust and relief control dampers to be opposed blade low leakage moduflo dampers. Frames to be heavy ga. galv. steel formed for extra strength with mounting holes for flange and enclosed duct mounting. Dampers available in 50mm (2") size increments from 203mm (8") horizontal and vertical to 1219mm (48"). Requirements over 1219mm (48") to be standard modules with interconnecting hardware. 1.6mm (16 ga.) damper blades, galv. steel, roll formed for high velocity performance. Blades of 203mm (8") width maximum; blade seals and spring loaded stainless side seals. Dampers and seals suitable for temperature ranges of -40 deg.C to 100 deg.C. Leakage shall not exceed 1% with approach velocity of 7.62M/s (1500fpm) when damper is closed against 100mm (4") W.G.

2.6 VALVE & DAMPER OPERATORS

- .1 Electric:
 - .1 Electric proportional or two position type as required, with adjustable forward and return stops, aluminum housing and spring return.
 - .2 Operators mounted outside shall be c/w internal heater.
 - .3 Valve operators shall be of type to withstand temps. likely to be encountered in application.
- .2 Size operators to guarantee component operation under maximum load. No damper operator shall be required to drive more than 2.5 sq.m. (27 sq.ft) of damper.
- .3 Refer also to Cl. "Motorized Fire/Smoke Dampers" in Section 15800 for further requirements.

2.7 ELECTRONIC HUMIDIFIERS

- .1 Humidifiers shall be supplied by Section 15600.
 - .2 Supply, mount and connect all controls for humidifier (duct sensors), provide unpowered on/off contact output for connection to humidifier and ensure that all interlocks and interconnection to devices supplied by Section 15600 are properly connected to provide fully operational humidification control system as specified in this Section.
 - .3 Refer to Section 15600 for further requirements.
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2.8 LOW TEMPERATURE CUTOUTS

- .1 Provide on coils or where noted, low temperature cutouts with 6096mm (20 ft.) temperature sensitive elements wound across downstream face of coil.
- .2 All air systems introducing O.A. shall have air side low temperature cut-out switch. If system does not have steam or water coil ahead of supply fan, safety control can be located on leaving side of fan.
- .3 Cut-outs must have manual reset unless noted otherwise.
- .4
 - .1 In heating season, below 5 deg C O.A. as sensed by O.A. thermostat on water coil systems provide:
 - .1 Aquastat set at 21 deg.C in supply water to coil to alarm on low temperature and shut off fan.
 - .2 Provide pilot light indications on local panel.
 - .3 Current sensing relay on circulation pump to shut down fan and activate alarm.

2.9 ROOM THERMOSTAT

- .1 Proportional or snap action contact type to suit application. Provide with setpoint indicator thermometer and adjustable stops. Direct or reverse acting to suit system. Setpoint range adjustable from 16 deg C to 32 deg C.
- .2 Provide blank covers with concealed adjustment and thermometers inside cover. Private offices to have exposed thermometer and adjustment.
- .3 Provide heavy duty plastic guard on thermostats in public areas such as entranceways, washrooms, corridors, gymnasiums and other unsupervised areas.

2.10 REMOTE ELEMENT THERMOSTAT

- .1 Die cast aluminum body with die cast zinc cover. Body finish of iridite and cover sprayed silver. Suitable for surface mounting. 3mm (10 ft.) F.P.T. air connections with integral 0 - 207 kPa output gauge. Provide 2.4m (8 ft.) averaging element for air flow sensing with 1.2m (4 ft.) copper capillary. Element range to be -34 deg.C to 149 deg.C Instrument ambient temp. limits to be -29 deg.C to 65.5 deg.C. Dials to have dual ranges - one side -18 deg.C to +51 deg.C and 43.3 deg.C to 106.6 deg.C and be spaced 1 deg.C apart.
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2.11 ALARM MODULE SEQUENCE

- .1 Where reference is made to alarm annunciation in any operation sequences, provide equipment to accomplish following sequence for each point annunciated.
 - .1 Alarm condition - audible ON, corresponding visual point flashing.
 - .2 Acknowledge - audible OFF, visual ON steady.
 - .3 Normal - audible OFF, visual OFF.
 - .4 Test - audible ON, visual ON steady - all lights.
- .2 Each subsequent alarm condition shall cause repeated sequence as detailed above whether or not previous alarm condition has been acknowledged.

2.12 SENSING WELLS

- .1 Where required for sensing fluid temperatures, install thermowells. Do not use existing thermometer wells or strap-on surface thermo-couples.
- .2 Thermowells shall be suitably sized for sensing element to be used and shall be of bronze construction c/w pipe fittings suitable for installation in piping material as specified.

2.13 IDENTIFICATION OF DATA GATHERING & D.D.C.PANELS

- .1 Provide lamacoid nameplates to identify following:
 - .1 Data Gathering Panel Title.
 - .2 Supply feeder panelboard number, circuit number, and panelboard location.
 - .2 Fasten nameplates with rivets or self-tapping screws to exterior of Data Gathering Panel door.
 - .3 Refer to subsection "Identification of Equipment - General", and comply with all requirements related to lamacoid nameplates.
 - .4 For each panel or terminal cabinet, indicate designation, system, load and area served. Provide directories to identify all termination points. For each termination point, identify equipment connected, equipment location and termination wire colour code or identification code number. Insert copy of directory in clear plastic pouch attached inside panel or terminal cabinet door, and insert copy into each Maintenance/Operating Manual. All wires or cable shall be colour coded and/or identified with identification code using wire markers. Information on data cards or directories shall be either typewritten or neatly printed with permanent ink.
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2.14 FIELD DATA PANEL

- .1 Factory wire and test. Encoding and decoding equipment shall be of printed circuit board construction.
- .2 Provide each panel with space for average of 25% spare point capacity for future use. This may be averaged over a mechanical room (i.e. 15% binary, 10% analog).
- .3 Design panel such that in case of localized trouble, panel can be isolated from system for testing and repairs without effecting normal operation of total system.
- .4 Locations of field data panels shall be approved by Contract Administrator prior to installation.
- .5 Panels shall be capable of handling multiple systems with ability to have at least two different and not necessarily sequential systems assigned to one panel.
- .6 Each panel to operate set points in accordance with points list.
- .7 On power failure at panel, each panel shall run through power failure routine so that no data will be lost either remotely or centrally. After power failure, each affected start/stop fan or motor to remain OFF until either operator at Central Console manually turns motor ON; or until automatic power fail restart programme starts. Power failure at one building shall not interrupt operation of remainder of system.
- .8 Panels shall be individually fused for input power and separately fused for all control voltages.
- .9 Panels shall be capable of electrically supervising all wiring required for security system points. Wiring shall be supervised for short circuits, open circuits and ground fault conditions, and shall transmit to CPU type of condition and location of circuit affected.
- .10 Standard of Acceptance:
 - .1 Standard Panel - Honeywell S1500
 - .2 Security Panel - Honeywell FS-20
 - .3 Building Services Panel - Honeywell EXCEL.

2.15 SENSORS

- .1 General:
 - .1 All temperature, R.H., pressure, etc. sensors shall be corrosively resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.
 - .2 All sensors shall be installed in strict accordance with mfg. recommendations.
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- .3 All motor (fans, pumps, etc.) operating status shall be obtained by using binary differential pressure sensors or current sensing relays as described herein. Auxiliary contacts in magnetic starters shall not be used to obtain motor status.
- .4 All temperature, R.H., pressure, etc. sensors shall be electronic type. Pneumatic sensors shall not be acceptable.
- .2 Temperature Sensors:
- .1 Temp. sensors shall be precision elements with sensing to readout accurately of ± 0.5 deg.C over entire range of element.
- .2 Temp. element range shall be -40 deg.C to 60 deg.C or 40 deg. C to 120 deg.C as required by particular temperature being sensed.
- .3 Duct mounted sensors shall be point type for use in return air systems and shall be averaging type for all other duct locations. Averaged sensors shall be of sufficient length to accurately determine correct average temperature.
- .4 Room sensors shall be wall mounted with vented cover, back box and tamper proof screws.
- .5 O.A. sensors shall be c/w weatherproof enclosure and sun shield.
- .3 Relative Humidity Sensors:
- .1 R.H. elements shall be precision type with sensing to readout accuracy of $\pm 1\%$ R.H. over entire range of element.
- .2 R.H. elements shall be 5% R.H. to 90% R.H.
- .3 Duct mounted sensors shall have stainless steel sheath construction c/w integral shroud. Sensor shall be located in approximate centre of duct.
- .4 Room R.H. sensors shall be wall mounted with vented cover, back box, and tamper proof screws.
- .5 R.H. Sensors located outdoors shall be c/w non-corroding outdoor shield and sun shield.
- .4 Analog Differential Pressure:
- .1 Internal materials to be suitable for continuous contact with the process material measured including compressed air, water, glycol, or steam as applicable.
- .2 Output variation of less than 0.2% full scale for supply voltage variations of $\pm 10\%$.
- .3 Combined non-linearity repeatability and hysteresis effects not to exceed $\pm 0.5\%$ of full scale output over entire range.
- .4 Over-pressure input protection to a minimum of twice rated input.
- .5 Differential pressure ranges shall be ± 0.25 , ± 0.50 , or ± 1.0 as required to suit flow conditions.
- .6 Provide isolation valves between sensor and fluid line.
- .7 Steam flow shall be sensed using orifice plates. Provide differential pressure transducer and all necessary devices to ensure proper operation with C.C.M.S.
- .8 Standard of Acceptance: Static Pressure - SETRA Steam - Honeywell 411.
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- .5 Flow Sensors:
 - .1 Flow metering shall be to accuracy required for billing purposes. Sensors shall be accurate to +/- 1% over full range of sensor.
 - .2 Sensor range to suit flow.
 - .3 Sense steam and chilled water using orifice plates. Provide all necessary devices to ensure proper operation.

- .6 Relays:
 - .1 DPDT relay with coils rated for 120V AC or 24V DC as required.
 - .2 Contacts rated at 5 Amps at 120V AC.
 - .3 Relays to be plug in type with termination base.

- .7 Current Sensing Relays:
 - .1 Relays shall be capable of sensing over 0.1 to 5 Amp range, with adjustable trip point and 10 Amp rated SPDT contact output.
 - .2 Relay shall have adjustable hysteresis from 10% to 75% of sensing range.
 - .3 Latching capability shall be available.
 - .4 Relay shall be of plug-in configuration complete with termination base.
 - .5 Single and multiple phase current metering transformers shall be provided in ranges to suit application.
 - .6 Current sensing relays shall be used for sensing fan and pump operating status, unless specifically indicated otherwise.
 - .7 Install relays in NEMA tamperproof enclosure. Install current transformer downstream from motor disconnect or starter.
 - .8 Standard of Acceptance: Electromatic SM-115.

2.16 DIRECT DIGITAL CONTROL (DDC) SYSTEM

- .1 Control performed by field programmable, digital controller, microprocessor based, which shall include features for performance of DDC, energy management, system diagnostics, and performance analysis. System performance information, status, and parameter adjustment shall be accessible to operator through local control and display panel mounted as integral part of DDC controller.

 - .2 DDC controller shall perform its control and energy management functions as standalone unit.

 - .3 Control algorithms shall be available and included in DDC controller to permit, Proportional, Integral, and Derivative control modes in any combination, to meet application requirements. Other control modes such as incremental, floating, and two-position shall also be available to meet job requirements.

 - .4 All control shall be performed in digital manner using digital signal from microprocessor based controller converted through transducers for modulation of pneumatic actuators.
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- .5 DDC controller shall be capable of performing all energy management functions necessary to reduce energy consumption. Programs shall include, but not be limited to:
 - .1 supply air reset using space load demand
 - .2 economizer control
 - .3 optimal start using an adaptive algorithm to prevent need for parameters manual adjustment
 - .4 night setback space temp. control
 - .5 morning quick warmup
 - .6 unique programmed start/stop for air handling systems
 - .7 client tailored program.

 - .6 Provide DDC controller with six character digital display, programmed to display analog variables, binary conditions, off-normal scans, and other analog or binary information required for analysis and adjustment of controlled system. Display panel shall be visible through window in cabinet and shall contain visible indication lights to indicate automatic operation, manual or override operation, test and associated trouble light, alarm indication, controller communicating with CAS (where specified) and auxiliary light associated with special purpose auxiliary function keys. Associated keyboard shall contain numerical keys to call up desired point and type of value to be displayed and have several special dedicated keys for such functions as "Auto-Manual", test and function, and value enter as aid to operator. Programs shall be password protected for different levels of operator access. Once entered this password will automatically time out to insure that access does not remain open.

 - .7 DDC controller shall contain necessary mathematics, logic, utility functions, standard energy calculations and control functions in ROM (Read Only Memory) to be available in any combination or field programming the unit. Store final field programs in battery-backed up RAM (Random Access Memory).

 - .8 DDC controller expandable by adding additional field interface units that operate through processor of master unit. Processor in master unit shall be able to manage remote field interface units thereby expanding its control loop and energy management point capacity.

 - .9 To maintain long term analog accuracy in controller sensing circuits, DDC controller shall sense voltage being supplied to resistance sensing elements and through firmware compensate for power supply changes due to long term drift due to ambient temperature changes at power supply.

 - .10 Supply DDC controller with minimum of 30 hours battery backup for RAM with automatic charger.

 - .11 DDC controller to contain operator initiated self-test program to provide verification of proper operation of unit including all
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indication lights, numerical displays, and program memory, both EPROM and RAM, through non-destructive test.

- .12 All alarm (e.g. fan failure to respond) and deviation alarm (e.g. off-normal temperature) conditions shall cause immediate indication to operator through red alarm light. Operator shall be able to scan and uniquely identify all active alarm conditions by manipulation of local control and display panel.
- .13 DDC controller capable of maintaining history file of selected system variables and computed values recorded during various modes of operation. Displayed contents of these files on operator request through simple manipulation of local control and display panel. DDC controller capable of 16 separate files for historical storage with user specifying number and rate of sampling as well as method of retrieval either locally or through CAS (where specified). Each panel capable of totalizing any of its inputs including equipment run time, flow, or other analog values.
- .14 Enclose DDC controller in metal cabinet constructed such that it can be mounted and electrical terminations made during construction phase of project. Electronics shall be added during commission stage of project. For ease of repair, construction shall be of type that allows replacement of any card containing electronics without use of tools, and without disturbing installed field wiring. Provide cabinet with key lock. All cabinets in this installation shall utilize one master key. All wiring and system communications shall be electrically terminated within cabinet.
- .15 Provide at each DDC controller, permanently mounted on panel face, an operator interface as described in this clause.

2.17 DIRECT DIGITAL CONTROL SYSTEM - HARDWARE

- .1 Stand-alone control panels shall be capable of operating properly under the following environmental conditions:
 - .1 Temperature range: 32 deg.F - 100 deg.F
 - .2 Relative humidity: 10% - 95% range (non-condensing)
 - .2 Stand-alone control panels shall be stand-alone intelligent controllers, with volatile program memory, as described herein. Panel shall be comprised of micro-processor capable of supporting all necessary software to meet these specifications.
 - .3 Provide each panel, with 10% minimum spare point capacity (each of AI, AO, DI and DO), requiring only connection of input or outputs. All other hardware and software shall be resident in panel.
 - .4 Install all control panels and controllers in secure enclosures with key lock.
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- .5 Provide necessary quantity of stand-alone control panels that are required to fully meet the requirements of this specification.
 - .6 Each stand-alone control panel shall be capable of performing all specified control functions in a completely independent manner. Additionally, control panels shall be networked for single point programming and for sharing of point information and control instructions between panels. EMCS shall be capable to have each control panel operate with dedicated local display and for collection of control panels to share single operator terminal.
 - .7 Each stand-alone control panel shall include its own controller power supply, input/output module, termination modules and battery. The battery shall be self-charging and be capable of supporting all memory within the control panel if commercial power to the unit is interrupted or lost for a minimum of 8 hours. Battery condition shall be automatically monitored by EMCS with charging and other catastrophic failures reported as both real-time and historically summarized alarm (format reporting as described in Section No. 2.3 BAS - Processing Firmware Software).
 - .8 All system processing gear shall be fully protected from electrical noise and surges so as not to permit interruption of normal operating functions.
 - .9 Stand-alone control panel be ULC listed against fire and shock hazard as single system appliance unit.
 - .10 Each stand-alone control panel shall be capable of direct interface to a variety of industry standard sensors and input devices. It shall be possible for each stand-alone control panel to monitor the following types of inputs as a minimum:
 - .1 Analog inputs
 - .1 4-20 mA
 - .2 0-10 V DC
 - .3 3-15 psi
 - .4 Note: Analog/Digital Resolution of 13 Bit Minimum
 - .5 Thermistors shall not be acceptable.
 - .2 Digital inputs
 - .1 dry contact closure (motor starters, size no.s 1 to 4) pulse accumulator
 - .2 All units shall contain the necessary equipment for direct interface with sensors and actuators connected to it.
 - .3 Note: Analog/Digital Resolution of 13 Bit Minimum.
 - .11 Each stand-alone control panel shall provide ability to support its own operator terminal. Control strategies shall be the City of Winnipeg definable at each panel, and for all control panels in system from any one operator terminal.
 - .12 All temperature control functions shall be executed within stand-alone control panel. Loop control shall be executed via
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- direct digital control algorithms. User shall be able to customize control strategies and sequences of control, and shall be able to define appropriate control loop algorithms and choose optimum loop parameters for the loop control. Control loops shall support any of following control modes as a minimum:
- .1 2 position (on, off, slow, fast, etc.)
 - .2 Proportional (P)
 - .3 Proportional plus integral (PI)
 - .4 Proportional, integral, plus derivative (PID)
- .13 It shall be possible to fully create, modify or remove control algorithms within a specific stand-alone control panel while it is operating and performing other control functions. Input for these changes shall be made directly into stand-alone control panel or via the network from any other control panel. Each control loop shall be fully user definable in terms of:
- .1 Sensors/actuators that are part of the control strategy
 - .2 Control mode
 - .3 Gain
 - .4 Control action
 - .5 Sampling time
- .14 System shall permit generation of job specific control strategies that can be achieved in any of the following ways:
- .1 Continuously
 - .2 At particular time of day
 - .3 On pre-defined rate
 - .4 When specific measured or controlled variable reads selected value or state.
 - .5 When a piece of equipment has run for certain period of time.
- .15 Upon loss of commercial power to any stand-alone control panel, the other parts within the network shall not be affected. All control strategies and energy management routines defined for stand-alone control panel shall be retained during power failure. Upon resumption of commercial power, control panel shall resume full operation without operator intervention. The panel shall also automatically reset its clock such that proper operation of time sequences is possible without need for manual reset of clock.
- .16 Should a loss of power exceed memory backup, the building operator shall be able to manually restore all system programs with floppy disc from any unit on network.
- .17 Connect DDC system to building emergency power system to permit normal program operation during standard power brownouts and blackouts. EMSC shall log date, time and duration period of all electrical brownouts and blackouts.
- .18 Each stand-alone control panel shall contain self-diagnostics that continuously monitor the proper operation of unit. Malfunction of unit will be reported in real time and will inform
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operator of nature of malfunction. It shall be possible to annunciate malfunctions as well as other control panel alarms at operator selected central operator station(s).

- .19 In event of loss of communication with, or failure of panel, this equipment shall leave controlled HVAC equipment in 'fail-safe' (as defined by Contract Administrator) mode.
- .20 All cables and conductors which serve as communication links, whether in underground conduits or overhead runs, shall have lightning arrestor networks installed at each.
- .21 All interface devices shall be asynchronous, compatible with other interface devices in system, and shall meet MOC and HVAC industry standards.
- .22 Shall include vendor supplied Bell 103 compatible Hayes Smart Modem, 1200 Baud auto dial/answer to be Site located c/w all necessary interface cabling. Set up configuration shall support communication with remotely located IBM PC/XT microcomputer, operating "Hayes Smartcom II" software. Vendor equipment shall satisfy current MOC and FCC standards for data communication equipment operating on voice-grade dial-up telephone lines.
- .23 Provide the City of Winnipeg with all equipment (mass-storage disc drive, floppy(s), etc.) required to load stand-alone panels in event of memory loss. Provide three sets of floppy discs.
- .24 Provide voice-grade, dial-up telephone line c/w female RT-11 telephone jack with no handset but with unique telephone number. Co-ordinate with MTS to provide line for this purpose. All associated installation costs shall be paid by the City of Winnipeg.

2.18 DIRECT DIGITAL CONTROL SYSTEM - SOFTWARE

- .1 Provide all software necessary to maintain control of and monitor all points physically connected to stand-alone panels.
 - .2 Supply each stand-alone panel with following software:
 - .1 Real time operating system resident in ROM.
 - .2 Operator/system communication software.
 - .3 Point data-base
 - .4 Report software.
 - .5 Alarm and monitoring software.
 - .6 User programming software.
 - .7 Energy management control software.
 - .8 Direct digital control software.
 - .3 Control language shall be realtime control language oriented to HVAC systems. Structure control language along conventional control loop logic to ensure ease of customer programming by
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building operator. All control loops shall be fully addressable from operator station(s).

- .4 It shall be possible for operator to modify system functions independently and to independently perform functions listed below:
 - .1 Read value of measured variable
 - .2 Start or stop equipment
 - .3 Monitor status of equipment being controlled
 - .4 Read the setpoint of controlled loop
 - .5 Determine control strategies that have been defined for specified piece of equipment.
 - .6 Generate displays of control strategies.
 - .7 Add/delete control loops to system.
 - .8 Add/delete real and virtual points to system.
 - .9 Create, modify or delete control strategies.
 - .10 Assign sensors and/or actuators to a control strategy.
 - .11 Tune control loops through adjustment of control loop parameters.
 - .12 Software enable or disable control strategies.
 - .13 Select points to be alarmable and define alarm state(s).
 - .5 In addition, the City of Winnipeg shall be able to create customized control strategies. Arithmetic functions shall permit simple relationships between variables (i.e. +, -, -, x) as well as more complex relationships (i.e. square root, exponential).
 - .6 All points in all stand-alone control units shall be capable of performing following energy management routines as a minimum:
 - .1 Time of day scheduling
 - .2 Start/stop optimization
 - .3 Outdoor air reset
 - .4 night setback
 - .5 Economizer changeover
 - .6 Peak demand limiting
 - .7 Duty cycling
 - .8 Supply air reset
 - .9 Economizer
 - .10 Event initiated/excepted programming.
 - .7 Provide instructive menu-driven prompting software to aid operator in inputting and editing.
 - .8 All energy management and operator/system control software shall be ROM resident, unless approved in accordance with B6.
 - .9 Shall permit operator selection and designation of EMS control routines to any I/O point, and in any operator selected sequence of point priority.
 - .10 All I/O real and virtual points shall be operator programmable to permit inter-point control by exception.
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- .11 Shall have minimum of 3 discrete levels of secured user access, as follows:
 - .1 1st - read only
 - .2 2nd - user programming of control and alarm parameters only
 - .3 3rd - system design, programming of control logic

 - .12 Shall annunciate alarms (both real-time, and 48 hour summary log) noting: Point number, point description, date and time of occurrence.

 - .13 Shall provide following operator initiated summary reports:
 - .1 Current Status, including:
 - .1 Point number
 - .2 Point description
 - .3 Current date
 - .4 Current time
 - .5 Point programmed status (i.e. on/off)
 - .6 Point actual status (i.e. where real input signal is provided)
 - .2 48 Hour alarm Summary, including:
 - .1 Point number
 - .2 Point description
 - .3 Occurrence date
 - .4 Occurrence/measurement time
 - .3 24 Hour Event Summary, including:
 - .1 Point number
 - .2 Point description
 - .3 Date(s), (sliding window)
 - .4 Occurrence/measurement time
 - .5 Point data (peak value, cumulative total, etc. as relevant to the I/O function)
 - .4 30 Day Event Summary, including:
 - .1 Point number
 - .2 Point description
 - .3 Date(s), (sliding window)
 - .4 Occurrence/measurement time
 - .5 Point data (peak value, cumulative total, etc. as relevant to the I/O function)

 - .14 Shall have ability to have control algorithms created, entered, modified, down-loaded, or erased by either local or remote (i.e. through RS232C telecommunications data port) operator station without interrupting real control of other control functions. Supply an auto-selection device to automatically select which port shall communicate with master control panel, either remote dial-up or local interface (i.e. on first-come first-service basis).

 - .15 Shall perform time-interval, failure-event, and operator initiated self diagnostic assessments of all: Discrete components, circuit boards, internal connections, firmware/software and real-world input signals. Unit shall provide both real-time (selectable to operator interface, printer, or connected dial-up telephone modem) and data-logged
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failure annunciation/reports, detailing cause and data/time failure.

- .16 Shall permit operator initiated software downloading/uploading to and from both a local or remote (via telephone modem interface) mass storage device.
- .17 EMCS shall automatically disconnect dormant (i.e. inactive I/O greater than 5 minutes) local and remote operator stations, thereby opening the opportunity for communications with other operators.
- .18 EMCS shall be menu driven to permit operator to designate either local or any MGS Data-Gathering Device type operator station as DDC dial-out target in case of alarm. The alarm shall be reported in real-time and logged historically, showing all information described in this specification including targetted telephone number. These functions shall be accomplished without any change of software by operator.

2.19 DDC SOFTWARE APPLICATION - GENERAL

- .1 Implement following control strategies and techniques within DDC software developed for all systems controlled by DDC controllers. Control set-points shall be as described in individual system sequences of operation specified in this section. Where local indication manual adjustments are specified, they shall be obtained and/or adjusted utilizing operator's terminal specified in clause 'Direct Digital Control System'.
 - .2 Mixed air temperature control - O.A., return air and relief air dampers shall modulate to maintain mixed air temperature. Mixed air temperature control shall interact with minimum O.A. control and system shall interact with minimum O.A. control and system shall revert to min. O.A. on signal from dry bulb, enthalpy or other economizer control as specified in individual sequences of operation in this section.
 - .3 Minimum O.A. control (constant volume systems) - calculate per cent of O.A. actually provided by utilizing O.A., return air and mixed air temperatures. Override mixed air control sequence if necessary to ensure min. O.A. is maintained. If S.A. temperature falls more than 2 deg.C (4 deg.F) below setpoint min. O.A. shall be reduced to provide largest min. O.A. possible while S.A. temperature is maintained.
 - .4
 - .1 Minimum O.A. control (variable volume systems) - calculate actual quantity (L/s) of O.A. provided by utilizing O.A., return air and mixed air temperatures and system total flow (sensed by supply air flow station). Override mixed air control sequence if necessary to ensure minimum O.A. quantity is maintained. If S.A. temperature falls more than 2 deg.C (4 deg.F) below setpoint
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minimum O.A. quantity shall be reduced to provide largest O.A. quantity possible while discharge air temperature is maintained.

.2 When space static pressure is used (in lieu of flow station) space static pressure control shall override mixed air control if necessary to maintain positive space static pressure. Actual percent of O.A. shall be calculated using O.A., return and mixed air temps. If S.A. temp. falls more than 2 deg.C (4 deg.F) below set point minimum O.A. quantity shall be reduced to provide largest O.A. quantity possible while maintaining discharge air temperature.

- .5 Ramp functions - where control loops are subject to rapid load changes (i.e. supply fan volume control on system start-up, O.A. damper control on system start-up, mixed air and discharge air temperature control when systems are manually switched to 100% O.A. mode of operation, etc.). Ramp functions shall be implemented to prevent system overshoot, cycling and nuisance tripping of low limit protection devices.
- .6 Reset Schedules - Where control loops have reset schedules associated with them, (i.e. hot water supply temperature reset based on O.A. temperature) high and low temperature alarm indication shall also be on sliding schedule. e.g. If alarm limits are set at +/- 2 deg.C from setpoint, alarm will be generated only if the sensed temperature is above or below present set point by 2 deg.C (i.e. if present, set point is 85 deg.C then alarm limits are 83 deg.C and 87 deg.C). Indication available to operator shall include, low end point of reset schedule, high end point of reset schedule, present setpoint, present high and low alarm limits and sensed temperatures.

2.20 FAN SYSTEM CONTROLS - GENERAL

- .1 Following control sequences shall apply to all supply fan systems whether specifically noted in sequence of operation or not.
 - .2 Where fan systems have outdoor and return air dampers modulated to maintain mixed air, discharge air, or room temperature, provide adjustable (0 - 1 min.) restriction feature to retard opening of O.A. damper on system start up and enable heating source controls to come into control and prevent nuisance tripping of low limit protection controls.
 - .3 Provide interlocks to ensure system controls energize and associated return and/or exhaust fans run when supply fan runs.
 - .4 Provide interlocks to ensure auxiliary equipment such as humidifiers, humidifier valves, outdoor air dampers, relief air dampers, etc. are shut off and/or closed when supply fan is off.
 - .5 Where steam, hot water or glycol heating coils are utilized, the mixed air controller shall modulate media flow through coil when
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supply fan is off in order to prevent overheating condition within system plenum and/or ductwork.

- .6 Where hot water heating coils have coil circulation pumps and 3-way valves associated with them, provide interlocks to ensure that circ. pump shall run when O.A. temp. is below 13 deg.C (55 deg.F).
- .7 Provide all fan systems that introduce O.A. with low limit control in discharge air to shut down supply fan and activate local alarm when discharge air temperature drops below 3 deg.C(37 deg.F). Locate low limit in manner that shall protect heating and cooling coils, and at same time not be subject to nuisance tripping.
- .8 Provide all fan systems that introduce O.A. with adjustable O.A. damper minimum position controls. Where O.A. dampers are larger than 1 sq. m (10 Sq. ft.), dampers shall be split into two sections horizontally. Each section shall be driven by separate operator and lower section shall close when O.A. temp. falls below 0 deg.C (32 deg.F). Minimum O.A. controls shall override this requirement and modulate lower section open to maintain minimum O.A. quantity specified.
- .9 Where relief air dampers are not directly ducted to supply/return fans, provide backdraft temp. controller to prevent backdraft condition from occurring.
- .10 Provide differential pressure switches across each filter bank to energize "filter dirty" pilot light and sound local alarm.
- .11 Where direct expansion cooling systems are utilized this section shall provide all necessary devices to ensure proper interface. Refer also to Section 15800.
- .12 Where fan systems have electric heating coil, low limit control shall be located at end of the longest duct run. Low limit shall be automatic reset type connected to latching relay, that shall shut off unit and sound local alarm, and fan shall be unable to restart until alarm reset button is pushed. Reset button and alarm horn shall be mounted on face of system control panel.

2.21 SUPPLY SYSTEM AIR CONTROL

- .1 System shall operate on day/night basis as dictated by 7-day time clock.
 - .2 When supply fan runs, return fan shall run and controls shall energize.
 - .3 Mixed air control shall modulate O.A., return and relief air dampers in sequence to maintain mixed air temp.
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- .4 Discharge air control shall modulate heating valve and cooling valve, cycle DX cooling in sequence to maintain discharge air temperature.
- .5 Provide mixed air low limit to override control of O.A. damper and prevent mixed air temp. from dropping below 13 deg.C.
- .6 Economizer control shall revert O.A. damper to minimum position when O.A. temp. rises above 15.5 deg.C O.A. temp. exceeds return air temp., O.A. enthalpy exceeds return air enthalpy.
- .7 Provide adjustable minimum O.A. damper position controls.
- .8 Provide low limit control in discharge air to shut down supply fan and sound local alarm when discharge air temp. drops below 3 deg.C.

2.22 SUPPLY AIR SYSTEM CONTROL

- .1 System shall be under control of DDC controller with input and output connections as follows:
 - .1 Analog Inputs
 - .1 O.A. temp.
 - .2 O.A. R.H.
 - .3 Return air temp.
 - .4 Return air R.H.
 - .5 M.A. temp.
 - .6 Discharge air temp.
 - .7 Discharge air R.H.
 - .8 Discharge air static pressure
 - .2 Analog Outputs
 - .1 Mixing dampers
 - .2 Relief air damper
 - .3 Heating coil valve
 - .3 Binary Inputs
 - .1 Filter status (pre and/or final)
 - .2 Heating coil circ. pump status
 - .3 Supply fan status
 - .4 Return fan status
 - .5 Discharge air low limit status.
 - .4 Binary Outputs
 - .1 Heating coil circ. pump start/stop
 - .2 Supply fan start/stop
 - .3 Return fan start/stop

2.23 AHU-1/F-1 SEQUENCE OF OPERATION

- .1 Schedule
 - .1 Shall be arranged as stipulated by the City of Winnipeg.
 - .2 Unoccupied: AHU-1/F-1 off, OA and relief air dampers closed.
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.3 Occupied: AHU-1/F-1 on continuously, OA damper in minimum position unless overridden by SAT control. Minimum OA flow rate for occupancy shall be 471 L/S (1000 cfm).

.2 SAT Control

.1 AHU-1 SAT shall be reset up if all spaces having temperature feedback to AHU-1 are calling for heating. The top range limit of temperature reset shall be 18C (65F).

.2 AHU-1 SAT shall be reset down if all spaces having temperature feedback to AHU-1 are calling for cooling. The bottom range limit of temperature reset shall be 11C (52F).

.3 If not all spaces having temperature feedback are calling for heating or cooling, the SAT shall be continuously maintained at 13C (55F).

.4 The SAT shall be achieved by modulating OA, RA and relief air dampers, by modulating heating coil valve and by energizing and staging/modulating of the direct expansion (DX) cooling system.

.3 This Section shall provide the relief air damper c/w actuator. The OA damper and the RA damper come with the unit. This section shall provide actuators.

.4 This section shall provide all controls/wiring to integrate the condensing unit with the AHU-1.

.5 Provide magnehelic gauge for AHU-1 filter.

.6 Refer to "Smoke Control Sequence" Clause for impact on AHU-1 temperature control.

2.24 SPACE TEMPERATURE CONTROL SEQUENCE

.1 Communications Centre 110 (East Call Centre Room) and Communications Centre 122 (West Call Centre Room)

.1 The space temperature controller shall have feedback to AHU-1 SAT control.

.2 On first stage of heating demand the radiant ceiling panel control valve shall open.

.3 On second stage of heating demand the duct re-heat coil shall be energized.

.4 Back-up Heating: electric baseboard heaters provided and fed from emergency power by Div. 16. Emergency heating setpoint shall be 3C (5.5F) lower than the room temperature setpoint. Controls setting by this Section.

.5 Wall-mount A/C units shall operate under their own controls, which shall have cooling setpoint 2C (4F) higher than the space temperature setpoint. The units will be fed from emergency power supply by Div. 16. Power and control wiring to AC and CU units by Div. 16. Controls setting by this Section.

- .2 Server Office 109:
 - .1 The space will not have temperature feedback to AHU-1.
 - .2 Heating: On first stage of heating demand the radiant ceiling panel valve shall open.
 - .3 Backup heating: Back-up Heating: electric baseboard heaters provided and fed from emergency power by Div. 16. Emergency heating setpoint shall be 3C (5.5F) lower than the room temperature setpoint. Controls setting by this Section.
 - .4 Backup Cooling: Wall-mount A/C units shall operate under their own controls, which shall have cooling setpoint 2C (4F) higher than the space temperature setpoint. The units will be fed from emergency power supply by Div. 16. Power and control wiring to AC and CU units by Div. 16. Controls setting by this Section.

 - .3 Supervisors Office 108, Quiet Room 106 and 129, Duty Inspector Office 127:
 - .1 The space will not have temperature feedback to AHU-1.
 - .2 Heating/Reheating: electric baseboard heater provided by Div. 16 will be energized. Power and control wiring by Div. 16.

 - .4 Staff Room/Lunch Room 105
 - .1 The space temperature controller shall have temperature feedback to AHU-1.
 - .2 On first stage of heating demand the wallfin heater control valve shall open.
 - .3 On second stage of heating demand the duct re-heat coil shall be energized.

 - .5 UPS Room 104
 - .1 The space will not have temperature feedback to AHU-1.
 - .2 Heating: On first stage of heating demand the wallfin heater control valve shall open.
 - .3 Cooling/Back-up Cooling: Wall-mount A/C units shall operate under their own controls, which shall have cooling setpoint 2C (4F) higher than the space temperature setpoint. The units will be fed from emergency power supply by Div. 16. Power and control wiring to AC and CU units by Div. 16. Controls setting by this Section.

 - .6 Security Office 103
 - .1 The space will not have temperature feedback to AHU-1.
 - .2 On first stage of heating demand the wallfin heater control valve shall open.
 - .3 On second stage of heating demand the duct re-heat coil shall be energized.

 - .7 C.I.T. Backup Room 132
 - .1 The space will not have temperature feedback to AHU-1.
 - .2 Heating: On first stage of heating call the ceiling radiant panel control valve shall open.
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- .3 Cooling/Back-up Cooling: Stand-alone precision A/C units (two duty, one standby) shall operate under their packaged controllers. Units provided by Div. 15, fed by Div. 16 from emergency power supply. Controls setting by this Section. Control wiring between AC unit and CU by Div. 16.
- .8 Training Room 131
- .1 The space temperature controller shall have feedback to AHU-1 SAT control.
- .2 On first stage of heating demand the radiant ceiling panel control valve shall open.
- .3 On second stage of heating demand the duct re-heat coil shall be energized.
- .9 Tape Storage Room 130
- .1 The space will not have temperature feedback to AHU-1.
- .10 Wiring Closet 125
- .1 The space will not have temperature feedback to AHU-1.
- .2 On first stage of heating demand the radiant ceiling panel control valve shall open.
- .3 Wall-mount A/C units shall operate under their own controls, which shall have cooling setpoint 2C (4F) higher than the space temperature setpoint. The units will be fed from emergency power supply by Div. 16. Power and control wiring to AC and CU units by Div. 16. Controls setting by this Section.
- .11 SPCO Office
- .1 The space will not have temperature feedback to AHU-1.
- .2 On first stage of heating demand the radiant ceiling panel control valve shall open.
- .3 Heating/Reheating: electric baseboard heater provided by Div. 16 will be energized. Power and control wiring by Div. 16.
- .4 Provide integrated temperature control for the electric heat and the hydronic heat.
- .12 Men's Locker Room 121/Women's Locker Room 112
- .1 The space will not have temperature feedback to AHU-1.
- .2 On first stage of heating demand the radiant ceiling panel control valve shall open.
- .3 On second stage of heating demand the duct re-heat coil shall be energized.
- .13 Electrical Room 115
- .1 On heating demand the wallfin radiation control valve shall open.
- .2 On cooling demand the F-8 system shall energize, and mixed air dampers and relief air dampers shall modulate to maintain room temperature. There shall be 13C (55F) low limit on SAT. A freezestat shall disable the system and close OA/relief air dampers.
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2.25 CRAWLSPACE TEMPERATURE CONTROL SEQUENCE

- .1 Hot water flow through each hydronic unit heater in the crawlspace shall be continuous.
- .2 Upon drop in space temperature the unit heater fan shall be energized.

2.26 SMOKE CONTROL SEQUENCE

- .1 Smoke Control Compartments: smoke control is based on grouping the protected rooms into 4 compartments:
 - .1 North-East (NE) compartment including:
 - .1 Communications Centre 110
 - .2 Supervisor Office 108
 - .3 Server Office 109
 - .2 South-East (SE) compartment including:
 - .1 Quiet Room 106
 - .2 Staff/Lunch Room
 - .3 UPS Room 104
 - .4 Security Office 103
 - .3 South-West (SW) compartment including:
 - .1 C.I.T. Backup Room 132
 - .2 Training Room 131
 - .3 Tape Storage Room 104
 - .4 Quiet Room
 - .4 North-West (NW) compartment including:
 - .1 Wiring Closet 125
 - .2 SPCO Office 124
 - .3 Duty Inspector 127
 - .4 Corridor 123
 - .5 Communication Centre 122
 - .2 If fire/smoke is detected in any of the compartments, all fire and smoke dampers (FSD) on supply air ducts and return air ducts along the compartment perimeter shall close, and the respective smoke exhaust fan shall energize. Coordinate with Division 16.
 - .3 The smoke exhaust fans are arranged as follows:
 - .1 NE Compartment: F-4
 - .2 SE Compartment: F-5
 - .3 SW Compartment: F-6
 - .4 NW Compartment: F-7
 - .5 All the above fans are fed from emergency power supply by Division 16.
 - .4 AHU-1 and F-1 shall operate continuously, their blowers fed from emergency power supply.
 - .5 AHU-1 temperature control in smoke evacuation mode shall be limited to monitoring minimum OA flow under fire/smoke condition. Heating and cooling in critical areas will be provided by their
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respective back-up heating/cooling systems, also fed from emergency power supply system by Division 16.

2.27 CRAWLSPACE EXHAUST CONTROL F-9

- .1 The crawlspace exhaust will operate on a continuous basis with the outdoor temperatures above 13°C.
- .2 With the outdoor temperature below 13°C, the exhaust fan will operate on a demand from a dehumidistat located in the space. There are 3 dehumidistats.
- .3 With the exhaust fan operating, the normally closed outside and exhaust air dampers will open fully.

2.28 BOILER ROOM VENTILATION SYSTEM

- .1 Room thermostat shall cycle unit heater fan, ventilation fan and modulate O.A. and return air dampers in sequence to maintain room temp.
- .2 Discharge air low limit control shall prevent discharge air temp. from dropping below 13 deg.C.
- .3 Provide heavy duty thermostat guard.
- .4 Provide strap-on thermostat heating media return line to prevent unit heater fan operation when return media temp. drops below 30 deg.C.

2.29 TRANSFORMER ROOM VENTILATION

- .1 Space thermostat shall cycle supply fan and modulate MA dampers and relief air dampers to maintain temp.
- .2 Discharge air low limit control shall prevent discharge air temperature from dropping below 13 deg. C.
- .3 Provide heavy duty thermostat guard.

2.30 STAR-ZONE CONTROL SYSTEM

- .1 This Section shall modify control wiring/thermostats to suit all zone dampers that are relocated on the 2nd Floor.
-

2.31 RADIATION CONTROL

- .1 Room thermostat shall modulate N.O. rad. valve to maintain room temp.
- .2 All radiation (wall fin, convectors, etc.) shall have control valve unless specifically noted as "Hand Valve Control" on drawings.

2.32 LEAD/LAG PUMP CONTROL

- .1 Provide lead/lag pump sequencing control through local DDC panel.
- .2 On failure of lead pump, as sensed by differential control panel shall automatically start lag pump, and energize alarm.
- .3 Provide manual software 'switch' for lead/lag pump selection to allow manual alteration of lead and lag pumps.
- .4 Provide lead/lag pump control for pumps as noted (P-3/P-4).
- .5 Provide automatic alteration of lead and lag pumps based on run time totalization program.

2.33 UNIT HEATER CONTROL

- .1 Room thermostat shall cycle fan to maintain room temp.
- .2 Provide heavy duty thermostat guard.

2.34 FORCE FLOW CONTROL

- .1 Room thermostat shall modulate N.O. heating valve fully open then cycle unit fan to maintain room temp.
- .2 Provide strap-on thermostat located on heating media return line to prevent fan operation when heating media return temp. drops below 30 deg.C (86 deg.F).
- .3 This is applicable to the existing steam FF unit at the main entrance which is retrofitted to hot water by Section 15600.

2.35 SPLIT SYSTEM AIR CONDITIONING AUXILIARY CONTROLS

- .1 Section 15900 shall:
 - .1 Provide on-off switch pre-wired to terminals in air handling unit main control panel. This switch is to be "off" for 24 hours after main power is turned "on" in spring to allow warming of oil in crank case.
-

- .2 Provide interlock to prevent simultaneous heating and cooling when cooling system is energized.
- .3 Provide interlock to prevent cooling system operation when fan system is shut off.

2.36 SHOP DRAWINGS

- .1 Include following with submission:
 - .1 Conventional control drawings showing pneumatics, electrics, bill or materials, etc.
 - .2 List of alarm set point parameters, DCP Point Data Definition (CDPC), Define Controller Points (XLPT), and Define Controller Alarm Points (XALM).
 - .3 Sketch of all graphics.
 - .4 Flow chart of RACL programs.
 - .5 Updated C.C.M.S. transmission loop drawings.
 - .6 Fabrication details and proposed wording for all lamacoid identification.
- .2 Prior to commissioning, submit as-built information and drawings for each of above items, for use by the City of Winnipeg during commissioning.

2.37 REDUNDANT SERVICES AND EQUIPMENT

- .1 Remove existing controls, control air tubing, equipment etc. which are not necessary for revised systems. The City of Winnipeg shall have opportunity to retain used materials.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Control components and interconnecting tubing systems to be installed by trained control mechanics, regularly employed by Section 15900.

3.2 EXISTING BUILDING SYSTEM

- .1 Visit jobsite in accordance with B3 to review section of existing systems relating to the new installation.
 - .2 Co-ordinate new installation with existing system. Make revisions to existing systems as noted on drawings and/or in specifications.
-

3.3 OPERATING INSTRUCTIONS AND AS-BUILT INFORMATION

- .1 Provide operating instructions as specified elsewhere. Include schematic drawings of all control systems including control sequence write-up.
- .2 Provide six hard cover copies of complete information pertaining to temperature control\instrumentation system for the City of Winnipeg's permanent record. This to include following:
 - .1 As-built schematic control diagrams with complete control sequence write-up.
 - .2 Operator's manual including maintenance instructions.
 - .3 Engineering data and data product sheets.
 - .4 Parts list of all components including repair instructions.
 - .5 Suggested spare parts list.
- .3 In addition, each mechanical room shall have respective control diagrams, control sequence and equipment model numbers mounted permanently on heat laminated plastic encased prints with grommet hangers. Mount adjacent to equipment or as recommended by the City of Winnipeg.
- .4 During system commissioning and at such time acceptable performance of Temperature Control System has been established, provide on-site operator instruction to the City of Winnipeg's operating personnel. Operator instruction during normal working hours will be performed by competent Section 15900 representatives familiar with systems specified. At time mutually agreed upon as stated above, provide instruction to the City of Winnipeg's designated personnel on operation of all temperature control equipment and systems and describe its intended use with respect to programmed functions to the overall operational program equipment functions.
- .5 Provide in DDC operator's manual, details of all functions, operator interaction with the system, complete with examples. Manual shall be written by professional technical writers. Provide operator's pocket guides for quick reference on day-to-day routine operations.

3.4 SERVICE AND WARRANTY

- .1 Upon completion of installation, all thermostats, control valves & all other equipment shall be adjusted as required to place system in complete operating condition subject to Contract Administrator's approval. Make all adjustments in collaboration with field Contract Administrator responsible for balancing air and water system.
 - .2 If within one year from date of completion as interpreted by Contract Administrator, any of equipment herein described is proven to be defective in workmanship or materials, it shall be replaced or repaired free of charge to the City of Winnipeg.
-

- .3 After installation completion, provide any service incidental to proper performance of control system under guarantees outlined above for guarantee period. Normal maintenance of system or adjustment of components is not to be considered part of guarantee.
- .4 Provide two additional service inspections, one prior to change of system; i.e. heating to cooling (Spring) or cooling to heating (Fall). Provide the City of Winnipeg with three days prior notice before inspection is to take place so the City of Winnipeg can arrange to have his representative present during full inspection. Following each inspection an itemized report shall be forwarded to the City of Winnipeg. Inspections shall include calibration of controllers and sequencing and lubrication of all dampers, damper operators and valves, trip testing of high and low limit protection devices.

3.5 INSTRUMENT MOUNTING

- .1 Mount transmitters and sensing elements on pipework at location where temperature is to be sensed. Care shall be taken to prevent breaking of insulation barrier and where practicable instruments shall be stood off on sheet metal brackets to allow installation of insulation behind instrument.

3.6 LOW TEMPERATURE CUTOUTS

- .1 Wire into "HAND" and "AUTO" positions of fan starter switch circuits, or if there is none, wire into local fan circuit such that, when any 305mm (12") section of element senses temperature below +2 deg. C, supply fan to de-energize and O.A. dampers to close.

3.7 ROOM THERMOSTATS

- .1 Room thermostats and sensors shall be located where shown on drawings. Mount thermostats and sensors approximately 1400mm (56") above finished floor.
- .2 Calibrate all thermostats and confirm to the City of Winnipeg that this Work has been done.

3.8 CONTROL DAMPERS

- .1 Linkage hardware to be readily accessible for maintenance after installation.
 - .2 Where dampers are required to be assembled from multiple sections, each section shall be driven by an independent
-

operator, with no single operator driving a damper section having a surface area greater than 2.5 sq.m.

3.9 SENSING WELLS

- .1 Wells shall be installed in piping at elbows where piping is smaller than length of well to effect proper flow across entire area of the well. Well shall not restrict flow area to less than 70% of line-sized-pipe normal flow area.
- .2 Pipe wells as required shall be furnished to Section 15400 and Section 15600 for installation at appropriate sensing points in pipework.
- .3 Void between inside of well and outside of sensing bulb shall be filled with heat transmission grease.

1.1 GENERAL

- .1 All drawings and all sections of the specifications shall apply to and form an integral part of this section.
- .2 Testing, Adjusting and Balancing (TAB) Agency shall be an experienced, independent contractor specializing in the testing, adjusting and balancing of HVAC systems.
- .3 TAB Agency shall be a member of the Associated Air Balance Council (AABC) and Work shall carry standard AABC Certificate of Guarantee.
- .4 Include extended service for 90 days after completion of final balancing work, during which time Contract Administrator at his discretion may request re-check or re-setting of any systems and/or equipment listed in test report

1.2 SCOPE OF WORK

- .1 Provide complete testing, adjustment and final balancing of all new & modified building air systems shown on the drawings.
- .2 Provide complete testing, adjustment and final balancing of liquid based building HVAC hot water heating system.
- .3 Provide inspection, verification and testing of all fire dampers, fire/smoke dampers, smoke control dampers and ceiling fire stops after installation. Coordinate the Work with Sections 15800 and 15900.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- .1 Section 15010 Mechanical General Provisions
 - .2 Section 15600 Liquid Heat Transfer
 - .3 Section 15800 Air Distribution
 - .4 Section 15900 Controls/Instrumentation
-

PART 2 - PRODUCTS

2.1 BALANCING REPORTS

- .1 Provide two copies of detailed draft balancing report to Contract Administrator for review after completion of all adjustments.
- .2 Final balancing report shall incorporate all changes resulting from Contract Administrator's comments and any adjustments undertaken since the draft report was issued.
- .3 Provide sufficient number of copies of final balancing report to Mechanical Subcontractor for inclusion in Operating & Maintenance Manuals.

2.2 FIRE PROTECTION EQUIPMENT VERIFICATION REPORTS

- .1 Provide detailed verification report to include all fire protection devices noted herein. Report shall list each device and verification of its operation and installation per the requirements specified herein.
- .2 Provide two copies of completed draft verification report to Contract Administrator for review.
- .3 Incorporate comments or changes requested by Contract Administrator and provide sufficient number of copies of final report to Mechanical Subcontractor for inclusion in Operating & Maintenance Manuals

PART 3 - EXECUTION

3.1 GENERAL

- .1 All instruments used shall be accurately calibrated and maintained in good working order. If requested, tests shall be conducted in the presence of Contract Administrator and/or his representative.
 - .2 Schedule all Work to comply with completion date.
 - .3 Work shall not begin until system has been completed and in full working order. Division 15 shall put all heating, ventilating, and air-conditioning systems and equipment into full operation, as season would demand, and shall continue operation of same during each working day of testing, adjusting and balancing.
-

3.2 AIR BALANCING

- .1 Coordinate with Sections 15600 and 15800 to ensure installation of all manual adjusting dampers and pitot tube enclosures are as indicated, as specified and as required to allow proper adjustment of air systems.
- .2 Sections 15600 and 15800 to provide initial alignment and tension of all fan pulleys and belts supplied by them.
- .3 Testing Procedure:
 - .1 Test, adjust and record all fan speeds, motor amperes.
 - .2 Make pitot tube traverse to main supply and obtain cfm at fan.
 - .3 Test and record static pressure for each system at fan suction and discharge.
 - .4 Adjust all supply and return air ducts to proper design cfm.
 - .5 Test and adjust each diffuser, grille, and register to within 5% of design requirements. Balance as per manufacturer's recommendations.
 - .6 All outlets shall be adjusted to provide proper throw and distribution, in accordance with architectural requirements.
 - .7 Fan operating conditions tested shall confirm air delivery within 5% of manufacturer's fan curves.
 - .8 Systems shall be balanced so that fans operate at lowest possible static pressure.
 - .9 Inlet vanes or variable speed drives shall not be used to reduce fan capacity to achieve balance condition. Balance on fan drive only with VAV or VSD at 100% capacity.
 - .10 Prepare single line diagrams of duct systems indicating terminal outlets identified by number. List on data sheets all such outlets denoted by the same numbers, including the outlet sizes, 'K' factor, location, cubic feet per minute and jet velocity. Provide this data for all supply, return and exhaust air systems.
- .4 As part of Work of this contract, Sections 15600 and 15800 shall make any changes in the pulleys and belts, and any additional manual dampers for correct balance as recommended by Section 15990, at no additional cost to the City of Winnipeg. Section 15990 shall provide final alignment and tension adjustment of fan pulleys and belts.

3.3 WATER BALANCING

- .1 Completely balance pumps and piping systems by adjustments of plug cocks, globe valves or other control devices, to obtain the flow quantities. During balancing set controls for full-flow through coils. Set automatic throttling valves in the full-open position. Close bypass port on automatic 3-way valves.
-

- .2 Balance fluid flow through coils, converters, cabinet heaters, heat exchangers, unit heaters, etc., in accordance with design.
 - .3 For flow measuring devices, record pipe size, manufacturer and size of device, and direct reading of the differential pressure, and calculated final flow.
 - .4 Balance flow through equipment and coils by means of flow measuring devices and pressure drop. Obtain curves from equipment manufacturers indicating relationship between flow and pressure drop through coils and equipment. Take readings on calibrated test gauges.
 - .5 Upon completion of fluid balance, reconcile total heat transfer through all heating and cooling coils by recording entering and leaving water temperatures and entering and leaving air dry bulb and wet bulb temperatures.
 - .6 Upon completion of balancing, adjust differential bypasses and 3-way valve bypasses for same pressure drop on full bypass as on full flow.
 - .7 Section 15600 shall supply and install water metering systems and devices. Refer to Section 15600.
 - .8 Equipment Data
 - .1 Provide following data on equipment:
 - .1 Heat Exchangers
 - .1 Equipment information
 - .2 Water flow rate
 - .3 Fluid temperatures entering and leaving
 - .2 Water & Glycol Coils
 - .1 Equipment information
 - .2 Air and fluid flow rates
 - .3 Air and fluid temperatures entering and leaving
 - .3 Pumps
 - .1 Equipment information
 - .2 Fluid flow and head:
 - .1 at operating capacity
 - .2 at no flow
 - .3 at full flow.
 - .3 Motor bhp and Amperage at above ratings and motor speed.
 - .4 Marked up pump curves on all pumps.
 - .2 Equipment lists shall also include all information noted in schedules.
 - .9 After entire installation has been completed, make required adjustments to balance valves, air vents, automatic controls, pumps until performance requirements are met. Make these adjustments with equipment operating. During such periods of adjustment prior to date of acceptance of mechanical systems, operate equipment. After date of acceptance of mechanical
-

systems, the City of Winnipeg's maintenance personnel will operate equipment.

- .10 During the first year of operation Section 15990 shall repeat these adjustments for each of immediately following three seasons of the year.
- .11 Division 15 Subcontractors to install red valve tags onto all balancing valves, as specified under Section 15050, subsection "Identification of Valves". Section 15990 to add following information onto each balancing valve tag; valve final setting position, date of final adjustment, TAB Agency name and name of individual who made final adjustment.

3.4 SYSTEM CHECK

- .1 Provide spot checks of systems if called upon by Contract Administrator. If capacities, fan speeds, ratings, etc. do not agree with submitted balance report, rebalance system or systems in question, until satisfactory results are received.

3.5 TESTING/VERIFICATION OF FIRE PROTECTION EQUIPMENT

- .1 Section 15990 shall test and verify operation all new and/or relocated fire dampers, combination fire/smoke dampers, ceiling fire stops and smoke control dampers on this project. Co-ordinate work with Sections 15800 and 15900.
 - .2 Testing shall be performed after air balancing has been completed.
 - .3 Test shall include following:
 - .1 Visual inspection of each device:
 - .1 Confirm appropriately rated device installed and CSA/ULC label affixed and visible through duct/ceiling access door.
 - .2 Confirm appropriate duct and/or ceiling access door provided to permit servicing of device. Confirm duct access door openable without interference from adjacent ceiling, pipes, ducts, etc.
 - .3 Confirm device has been installed in accordance with requirements of the specifications, manufacturer's instructions and codes.
 - .4 Confirm proper installation, clearances, use of proper angle framing, use of proper fasteners, use of fire rated material in wall opening, location of breakaway joints etc.
 - .5 Confirm that device has not been painted.
 - .2 Operational inspection of each device to include:
 - .1 Manual release of fusible link allowing device to close. Confirm tight fit closure without binding.
 - .2 Confirm that appropriate fusible link is installed.
 - .3 Re-open device and reset fusible link connection.
-

- .3 Following requirements are in addition to the above noted testing requirements and shall apply to all motorized smoke and fire/smoke dampers, including all motorized dampers associated with smoke control systems:
- .1 Associated fan system shall be operating as per normal conditions.
 - .2 Power to operator shall be applied/removed, as required, to cause damper to open. Ensure full opening operation without binding or overdriving of operator.
 - .3 Power to operator shall be removed/restored, as opening operation without binding or overdriving of operator.
 - .4 Ensure damper closes/opens against associated fan operating static pressure.
 - .5 Ensure proper adjustment of all damper drive linkages for fully open and fully closed positions and operation through full range without binding.
 - .6 Ensure proper device configuration e.g. power-to-open or power-to-close as specified.
- .4 Co-ordinate Work with Sections 15800 and 15900. Instruct Sections 15800 and 15900 as appropriate to repair or replace, as required, all devices or components of devices identified as being faulty, and to correct any installation deficiencies noted.
- .5 After necessary repairs have been completed, Section 15990 shall reinspect/retest each device as indicated above.
- .6 Provide verification report on completion of work. Report shall indicate general location (e.g. room number or description) and specific location (e.g. north wall above ceiling) of access door to device. Report shall include itemized verification of following, as appropriate, for each device:
- .1 Device is fully accessible.
 - .2 Device has been properly installed
 - .3 Device has been successfully tested.
 - .4 Device has been reset.
 - .5 Name of tester.
 - .6 Date device tested successfully.

Air Handling Units

AIR HANDLING UNIT NO.	AHU-1			
SERVICE	First Floor- North			
MODEL	CAH012GDAC			
SUPPLY FAN	Forward Curve			
AIRFLOW RATE (l/s) (cfm)	3160		6700	
EXTERNAL STATIC REQUIRED (Pa) (in.)	250		1.00	
MOTOR (BkW/kW) (Bhp/Hp)	3.64	5.60	4.88	7.50
SPEED (rpm)	1081			
FILTER SECTION	DISPOSABLE, PLEATED MERV 6			
FILTER NUMBER & SIZE (mm) (in.)	(2) 610 X 610 X 51 (24 X 24 X 2)			
	(1) 610 X 305 X 51 (24 X 12 X 2)			
	(2) 305 X 610 X 51 (12 X 24 X 2)			
HOTWATER COIL MODEL	5WB0801C			
HEATING COIL SIZE (qty.)(h x l) (mm) (in.)	1	838 x 1270	1	33 x 50
ENTERING WATER TEMP. (°C) (°F)	82.22		180	
LEAVING WATER TEMP. (°C) (°F)	70.50		158.9	
ENTERING AIR TEMP. (°C) (°F)	12.00		54	
LEAVING AIR TEMP. (°C) (°F)	18.33		65.0	
CAPACITY (kW) (Btu/h)	43		147,000	
FLOW RATE (l/m) (gpm)	55.0		14.5	
MAX. WATER PRESSURE DROP (kPa) (ft.)	3.9		1.3	
MAX. FACE VELOCITY (m/s) (fpm)	2.73		538	
DX TOTAL COOLING (kW)(TONS)	52.40		14.90	
SENSIBLE COOLING (kW)(TONS)	47.46		13.50	
AMBIENT TEMPERATURE (°C)(°F)	35.00		95.0	
ENTERING AIR TEMP. db/wb (°C) (°F)	25.50	17.80	76.0	63.0
LEAVING AIR TEMP. db/wb (°C) (°F)	12.80	12.20	55.0	53.7
SUCTION TEMPERATURE (°C) (°F)	7.22		45.0	
OUTSIDE AIR (l/s) (cfm)	505		1070	
UNIT WEIGHT (kg) (lbs)	920		2037	
UNIT ACCESSORIES				
	Condensate Drain Trap, Discharge Air Temperature			
	Sensor, DDC Compatible.			

Air Handling Unit Schedule

SMS ENGINEERING

Project: Alternate Communication Centre
700 Assiniboine Park Drive

File: 05-015-01 Designer: MA
Date: Feb-06 Sheet: MS-1

Pump Schedule

NO.	SERVICE	LOCATION	MODEL / SIZE	CAP. (gpm) (l/s)	HEAD (ft) (m)	MTR. (HP) (kW)	SPD. (rpm)	REMARKS
P-1	Excess Pressure Pump	Boiler Room.	Albany CEP-93-3	2 0.13	173 52.74	0.333 0.25	1750	Fire Protection
P-2	Air Compressor	PA Unit	Factory Unit	22.4 1.41	100 30.49	0.5 0.37	1750	Pre-Action
P-3	Hot Water Heating Circulation	Boiler Room	Bell&Gosset Series 80 3x3x9.5	193 12.16	40 12.20	7.5 5.59	1750	Duty/Stand-by
P-4	Hot water heating circulation	Boiler Room	Bell&Gosset Series 80 3x3x9.5	193 12.16	40 12.20	7.5 5.59	1750	Duty/Stand-by
P-5	Hot Water Heating circulation	Mech. Room	Bell&Gosset Series 90 1AA	14.5 0.91	8 2.44	0.25 0.19	1725	Hot water Circulation
P-6	Recirc. Pump	Boiler Room						Existing Relocated Pump

Pump Schedule

SMS ENGINEERING

Project: **Alternate Communication Centre**
700 Assiniboine Park Drive

File: 05-015-01


Designer: KM/PG

Date: Feb-06

Sheet: **MS-2**


Radiant Ceiling Panel

NO.	LINEAR PANEL TYPE	PANEL WIDTH		OUTPUT		# OF COIL	REMARKS
		in	mm	BTH/Ft	W/m	PASSES	
RCP-1	HEF-2	24	600	389	373	4.0	
RCP-2	HEF-2	24	600	389	373	4.0	45° Mitred cut
NOTE:	UNIT HEATERS BASED ON HOT WATER AT 180°F (82.2°C) EWT, 20°F (11.1°C) Delta T, 60°F (15.55°C) EAT						

	Radiant Ceiling Panel Schedule	
	Project: Alternate Communication Centre	
	700 Assiniboine Park Drive	
	File: 05-015-01	Designer: MA
	Date: Dec-05	Sheet: MS-3

Unit Heaters

NO.	LOCATION	MODEL	OUTPUT (mbh) (kW)	LIQUID (usgpm) (l/s)	CAP. (cfm) (l/s)	SPD. (rpm)	MOTOR (HP) (kW)	REMARKS
UH-1	Northwest Crawlspace	H-2	37.9 11.10	3.90 0.25	620 293	1500	1/20 0.04	T'stat to cycle fan
UH-2	Northeast Crawlspace	H-2	37.9 11.10	3.90 0.25	620 293	1500	1/20 0.04	T'stat to cycle fan
UH-3	Southeast Crawlspace	H-2	37.9 11.10	3.90 0.25	620 293	1500	1/20 0.04	T'stat to cycle fan
UH-4	Boiler Room	H-4	56.8 16.64	5.90 0.37	1000 472	1500	1/12 0.06	T'stat to cycle fan
NOTE:								
UNIT HEATERS BASED ON ENGINEERED AIR, AND HOT WATER AT 180°F (82.2°C) EWT, 20°F (11.1°C) Delta T, 60°F (15.55°C) EAT								

	Unit Heater Schedule
	Project: Alternate Communication Centre 700 Assiniboine Park Drive File: 05-015-01 Date: Dec-05
	Designer: MA Sheet: MS-4

Relief Valves

VALVE NO.	LOCATION	CAPACITY (usgpm) (l/s)	SET PRES. (psig) (kPa)	SIZE	TYPE
RV-1	Boiler Room	2 0.13	60 413.64	3/4x1	Conbraco 513DDBJMAA0060

Relief Valve Schedule

SMS ENGINEERING

Project: **Alternate Communication Centre**
700 Assiniboine Park Drive

File: 05-015-01


Designer: PG

Date: Feb-06

Sheet: MS-5

Wall Fin

NO.	LENGTH (inches) (mm)	FIN TYPE		ENCLOSURE TYPE	REMARKS
		OUTPUT (mbh) (kW)	SERIES		
WF-1	80 2000	8.00 2.34	AL 4" X 4" X 1 1/4"	WF-1A	12" Enclosure Height
WF-2	128 3200	12.80 3.75	AL 4" X 4" X 1 1/4"	WF-1A	12" Enclosure Height
WF-3	200 5000	20.00 5.86	AL 4" X 4" X 1 1/4"	WF-1A	12" Enclosure Height
WF-4	120 3000	12.00 3.52	AL 4" X 4" X 1 1/4"	WF-1A	12" Enclosure Height
WF-5	120 3000	12.00 3.52	AL 4" X 4" X 1 1/4"	WF-1A	12" Enclosure Height
BASED ON ENGINEERED AIR HOT WATER 180°F (82.22) EWT, 160°F (71.11°C) LWT, 65°F (18.33°C) EAT					

	Wall Fin Schedule		
	Project:	Alternate Communication Centre 700 Assiniboine Park Drive	
File:	05-015-01	Designer:	MA
Date:	Feb-06	Sheet:	MS-6

Expansion Tanks

TANK NO.	TANK SERVICE	LOCATION	ACCEPTANCE VOLUME (liters)(gallons)	MODEL NUMBER	TANK SIZE (mm) (inches) DIA x HEIGHT	PRECHARGE PRESSURE (kPa) (psig)
ET-1	Hot water heating	Boiler room	212.0 56	AL-250V	610 X 1270 24 X 50	58 25

Expansion Tank Schedule



Project: Alternate Communication Centre
700 Assiniboine Park Drive
File: 05-015-01 Designer: PG
Date: Feb-06 Sheet: MS-7

Fan Schedule

FAN NO.	SERVICE	FAN TYPE	LOCATION	FAN MODEL	CAP. (cfm) (l/s)	E.S.P. (in. W.G.) (Pa)	SPD. (rpm)	OUT. VEL. (fpm) (m/s)	MAX BRK. (HP) (BkW)	MTR. (HP) (kW)	REMARKS
F-1	RETURN AIR	INLINE	MECHANICAL ROOM	GREENHECK INLINE FAN BSQ-180-30	5700 2688	1.000 250.000	1600	-	2.78 0.00	5 HP	c/w backdraft damper c/w hanging vibration isolators
F-2	Washroom Ventilation	INLINE	Shower, Locker Washroom 112-113-114	GREENHECK INLINE FAN CSP-A780	600 283	0.600 150.000	1600	-	-	0.41	c/w backdraft damper c/w hanging vibration isolators
F-3	Washroom Ventilation	INLINE	Shower, Locker Washroom 118-119-121	GREENHECK INLINE FAN CSP-A700	578 222	0.600 150.000	1100	-	-	0.35	c/w backdraft damper c/w hanging vibration isolators
F-4	Smoke Exhaust	INLINE	Room 108,109,110	GREENHECK INLINE FAN CSP-A700	700 330	0.500 125.000	1100	-	-	0.35	c/w hanging vibration isolators
F-5	Smoke Exhaust	INLINE	Room 103,104,105	GREENHECK INLINE FAN CSP-A700	700 330	0.500 125.000	1100	-	-	0.35	c/w hanging vibration isolators
F-6	Smoke Exhaust	INLINE	Room 131,132	GREENHECK INLINE FAN CSP-A700	700 330	0.500 125.000	1100	-	-	0.35	c/w hanging vibration isolators
F-7	Smoke Exhaust	INLINE	Room 122,124,125 127,129,130	GREENHECK INLINE FAN CSP-A1410	1400 660	0.500 125.000	1450	-	-	0.82	c/w hanging vibration isolators
F-8	Electrical Room Ventilation	INLINE	Room 115	GREENHECK INLINE FAN CSP-A1450	1200 566	0.750 187.500	1450	-	-	0.82	c/w hanging vibration isolators
F-9	Crawlspace Ventilation	INLINE	Crawlspace	GREENHECK INLINE FAN CSP-A1750	875 413	0.750 187.500	1130	-	-	0.55	c/w hanging vibration isolators
F-10	Boiler Room Ventilation	INLINE	Boiler Room	GREENHECK INLINE FAN BSQ-120-7	1219 575	1.500 375.000	1800	-	0.63 -	1 HP -	c/w hanging vibration isolators
F-11	Kitchen Exhaust		Lunch Room 105	NUTONE KITCHEN	200 94	0.200 50.000	-	-	-	0.46	NUTON KITCHEN RANGE HOOD WS130WWC
F-12	Kitchen Exhaust		Lunch Room 105	NUTONE KITCHEN	200 94	0.200 50.000	-	-	-	0.46	NUTON KITCHEN RANGE HOOD WS130WWC
F-13	Closet Ventilation		Corridor 201	GREENHECK CEILING FAN SP-C50	46 21	0.200 50.000	-	-	-	0.05	
F-14	Elevator Machine Room Ventilation		Elevator Machine Room Crawlspace	GREENHECK CEILING FAN SP-B150	150 71	0.300 75.000	1050	-	-	0.13	

Condensing Units

NO.	LOC.	TYPE / MODEL	SAT. SUCT. °F °C	OUT-DOOR °F °C	REFRIG. CAPACITY MBH kW	REMARKS
CU-1	Roof	Liebert DCSL083-B	44.0 6.7	95.0 35.0	64.7 19.0	Challenger 3000 series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-1
CU-2	Roof	Liebert DCSL083-B	44.0 6.7	95.0 35.0	64.7 19.0	Challenger 3000 series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-2
CU-3	Roof	Liebert DCSL083-B	44.0 6.7	95.0 35.0	64.7 19.0	Challenger 3000 series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-3
CU-4	Roof	carrier 38ARD016	37.4 3.0	95.0 35.0	179.0 52.4	Two Scroll Compressors
CU-5	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	24.0 7.0	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-5
CU-6	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	24.0 7.0	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-6
CU-7	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	24.0 7.0	Mr. Slim Series outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-7
CU-8 EXIST	Roof	Mitsubishi PU18EK	44.0 6.7	95.0 35.0	18.0 5.3	Existing outdoor unit, pipe to AC-8
CU-9 EXIST	Roof	Mitsubishi PU18EK	44.0 6.7	95.0 35.0	18.0 5.3	Existing outdoor unit, pipe to AC-9
CU-10	Roof	Mitsubishi PU24EK	44.0 6.7	95.0 35.0	24.0 7.0	Mr. Slim Series outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-10
CU-11	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	30.0 8.8	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-11
CU-12	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	30.0 8.8	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-12
CU-13	Roof	Mitsubishi PU360EK	44.0 6.7	95.0 35.0	30.0 8.8	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-13
CU-14	Roof	Mitsubishi PU36EK	44.0 6.7	95.0 35.0	36.0 10.5	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-14
CU-15	Roof	Mitsubishi PU36EK3	44.0 6.7	95.0 35.0	36.0 10.5	Mr.Slim series, outdoor unit, c/w -40°C extra-low ambient kit, pipe to AC-15
CU-16 EXIST	North-East Crawlspace	Climette HMC024KD1	44.0 6.7	95.0 35.0	24.0 7.0	Existing outdoor unit, pipe to AC-16
CU-17 EXIST	North-East Crawlspace	Climette HMC024KD1	44.0 6.7	95.0 35.0	24.0 7.0	Existing outdoor unit, pipe to AC-17

Condensing Unit Schedule

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Project: **Alternate Communication Centre**
 700 Assiniboine Park Drive
 File: 05-015-01 Designer: MA
 Date: Dec-05 Sheet: MS-9

Evaporator Coils

NO.	LOCATION	MODEL / SIZE	IN-DOOR	REFRIG. CAPACITY	REMARKS
			°F °C	MBH kW	
AC-1	CIT BACKUP 132	Floor Mounted Liebert BU067A-BA00	80.0 26.7	64.7 19.0	Challenger 3000 Series, indoor unit, connect/pipe to condenser unit CU-1
AC-2	CIT BACKUP 132	Floor Mounted Liebert BU067A-BA00	80.0 26.7	64.7 19.0	Challenger 3000 Series, indoor unit, connect/pipe to condenser unit CU-2
AC-3	CIT BACKUP 132	Floor Mounted Liebert BU067A-BA00	80.0 26.7	64.7 19.0	Challenger 3000 Series, indoor unit, connect/pipe to condenser unit CU-3
OPEN NO.					
AC-5	WIRING CLOSET 125	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	24.0 7.0	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-5
AC-6	WIRING CLOSET 125	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	24.0 7.0	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-6
AC-7	WIRING CLOSET 125	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	24.0 7.0	Mr. Slim Series indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-7
AC-8 EXIST	COMM. CENTRE 122	Wall Mounted Mitsubishi PK18FK	80.0 26.7	18.0 5.3	Existing indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-8
AC-9 EXIST	COMM. CENTRE 122	Wall Mounted Mitsubishi PK18FK	80.0 26.7	18.0 5.3	Existing indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-9
AC-10	COMM. CENTRE 122	Wall Mounted Mitsubishi PK24FK	80.0 26.7	24.0 5.3	Mr. Slim Series indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-10
AC-11	USP ROOM 104	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	30.0 8.8	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-11
AC-12	USP ROOM 104	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	30.0 8.8	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-12
AC-13	USP ROOM 104	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	30.0 8.8	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-13
AC-14	SERVER OFFICE 109	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	36.0 10.5	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-C14
AC-15	SERVER OFFICE 109	Wall Mounted Mitsubishi PK36FK3	80.0 26.7	36.0 10.5	Mr.Slim series, indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-C15
AC-16 EXIST	COMM. CENTRE 110	Wall Mounted HMC024KD1	80.0 26.7	24.0 5.3	Existing indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-C16
AC-17 EXIST	COMM. CENTRE 110	Wall Mounted HMC024KD1	80.0 26.7	24.0 5.3	Existing indoor unit, c/w wall mounted thermostat, connect/pipe to cond. unit CU-C17

Evaporator Coil Schedule


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Project: Alternate Communication Centre
700 Assiniboine Park Drive

File: 05-015-01 Designer: MA
Date: Dec-05 Sheet: MS-10

Silencers

NO.	SYSTEM	MODEL & LENGTH (in.) (mm)	DUCT SIZE			PRES. DROP (in. W.G.) (Pa)	CAP-ACITY (cfm) (l/s)	CLASS	I.L. (db)							
			(in.) (mm)	X	(in.) (mm)				63	125	250	500	1K	2K	4K	8K
S-1	F-1 Return Air	32REL-30X84 Elbow	32 800	X X	12 300	0.21 52.5	2300 1085.5	1	13	19	25	35	39	37	35	32
S-2	F-1 Return Air	24RMLP-30X108 Straight	24 600	X X	10 250	0.33 82.5	1200 566.3	1	14	27	40	49	49	44	32	28
S-3	F-1 Return Air	12REL-20X72 Elbow	28 700	X X	12 300	0.62 155	2200 1038.3	1	16	25	38	47	50	50	50	50
S-4	AHU Supply Air	21RMP-25X60 Straight	42 1050	X X	22 550	0.36 90	6700 3162.0	1	9	17	25	36	39	38	29	20
NOTES: 1. SILENCER SELECTIONS BASED ON VAW SYSTEMS PRODUCT. 2. SILENCERS C/W MYLAR FILM LINER.																

	Silencer Schedule	
	Project: Alternate Communication Centre 700 Assiniboine Park Drive File: 05-015-01 Designer: MA Date: Feb-06 Sheet: MS-11	

Grilles, Registers and Diffusers

TYPE	MANUFACTURER	MODEL	BORDER	CORE	VOLUME CONT.	FRAME	FASTNG.	FINISH	REMARKS
A	E.H. PRICE	SCD	31	24x24	VCR7	31	N/A	B12	Lay-in T-Bar Mount c/w SPF Mounting Frame White Color
B	E.H. PRICE	SCD	31	24x24	VCR7	31	N/A	B12	Surface Mount White Color
C	E.H. PRICE	80	TB	80	_	_	N/A	B12	Lay-in T-Bar
D	E.H. PRICE	80	F	80	_	_	A	B12	Surface Mount c/w SPF Mounting Frame
E	E.H. PRICE	SCD	31	12x12	VCR7	31	N/A	B12	Surface Mount c/w SPF Mounting Frame White Color
F	E.H. PRICE	620D	F	620	_	D	A	B12	Surface Mount White Color Double Deflection
	NOTES: 1. SPF MOUNTING FRAME C/W RETAINING CLIPS REQUIRES FOR TYPE B DIFFUSER IN DRYWALL OR PLASTER CEILING. 2. EXACT MOUNTING AND FASTENING STYLE FOR TYPE B DIFFUSERS TO BE DETERMINED BY CEILING TYPE AS VERIFIED BY CONTRACTOR. 3. TYPE B DIFFUSERS SHALL HAVE VOLUME CONTROL DAMPERS THAT ARE ADJUSTABLE FROM "ROOM" SIDE ACCESS.								


Grille, Register and Diffuser Schedule



Project: Alternate Communication Centre
 700 Assiniboine Park Drive
 File: 05-015-01 Designer: MA
 Date: Dec-05 Sheet: MS-12


Electric Reheat Coils

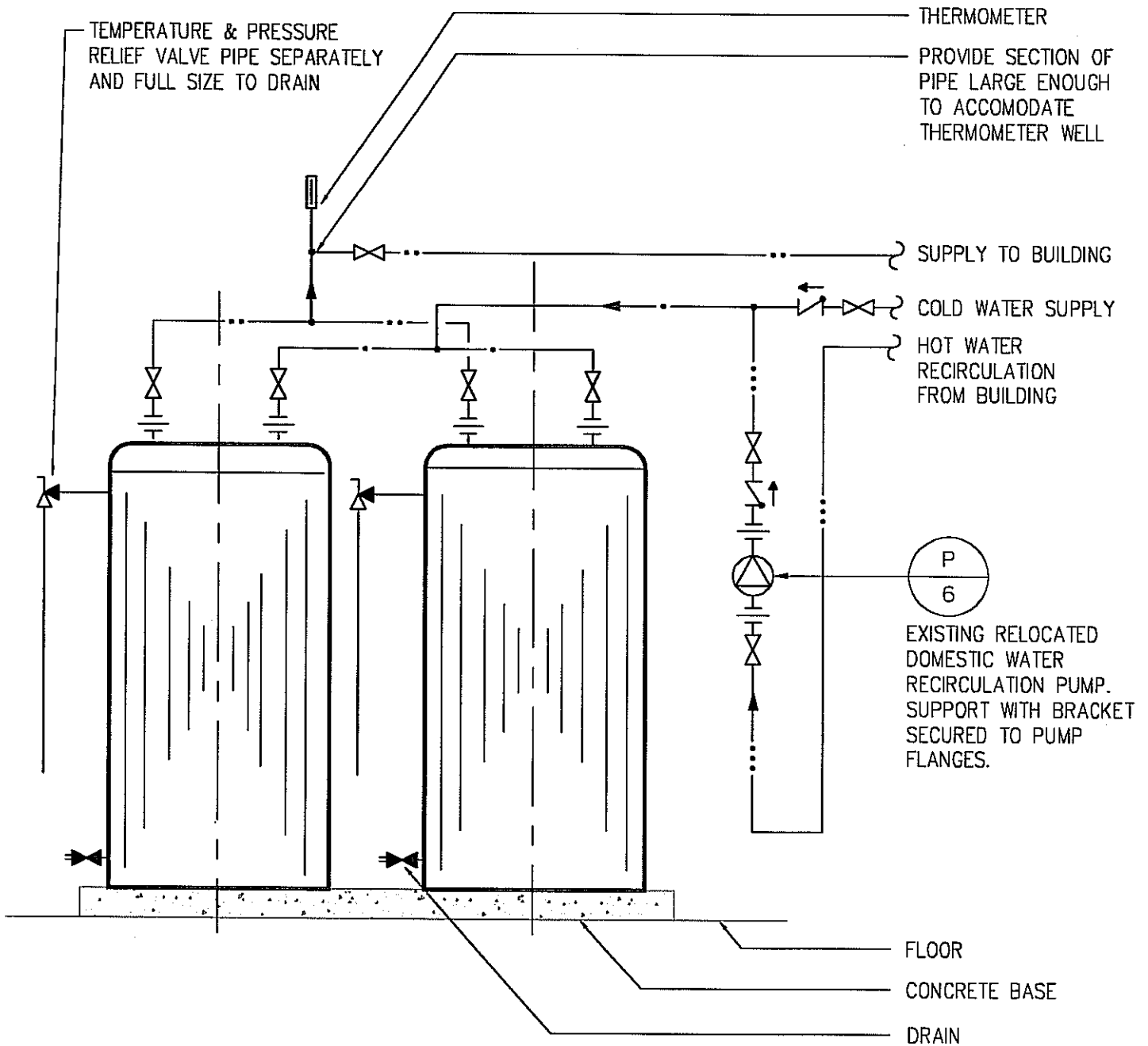
NO.	CAPACITY (kW)	NO. OF STEPS	SIZE H x L mm	AIR VOL. (cfm) (l/s)	TEMP. (°F) (°C)		LOCATION
					IN	OUT	
ERC-1	2.1	SCR	200x200	175 83	55.0 12.8	93.0 33.9	Room 103
ERC-2	3.3	SCR	200x350	580 274	55.0 12.8	73.0 22.8	Room 105
ERC-3	4.7	SCR	200x500	830 392	55.0 12.8	73.0 22.8	Room 131
ERC-4	10	SCR	250x900	1760 831	55.0 12.8	74.0 23.3	Room 122
ERC-5	8	SCR	200x800	1400 661	55.0 12.8	73.0 22.8	Room 110
ERC-6	1.7	SCR	200x200	200 94	55.0 12.8	80.0 26.7	Room 121
ERC-7	2	SCR	200x200	250 118	55.0 12.8	75.0 23.9	Room 112

	Electric Reheat Coil Schedule	
	Project:	Alternate Communication Centre 700 Assiniboine Park Drive
	File:	05-015-01 Designer: MA
	Date:	Feb-06 Sheet: MS-13

Humidifiers

NO.	DESCRIPTION	LOCATION	CAPACITY (cfm) (l/s)	% O/A	ROOM %RH & °C	ABSORPTION DISTANCE (ft) (m)	STEAM LOAD (lbs / hr) (Kg/hr)	HUMIDIFIER MODEL	DISPERSION METHOD DUCT SIZE
HU-1	c/w Short Absorption Manifold	Mechanical Room	6700 3162	Min. 15 Note 1	35 22	0.5 0.2	46.0 20.9	NORTEC NH 050-100	6 Tubes- 6" o.c. 42x22
			Note 1: Modulating Economizer.						

	Project:	Alternate Communication Centre 700 Assiniboine Park Drive
	File:	05-015-01 Designer: MA
	Date:	Feb-06 Sheet: MS-14
<h3>Humidifier Schedule</h3>		



DOMESTIC WATER HEATERS
NTS

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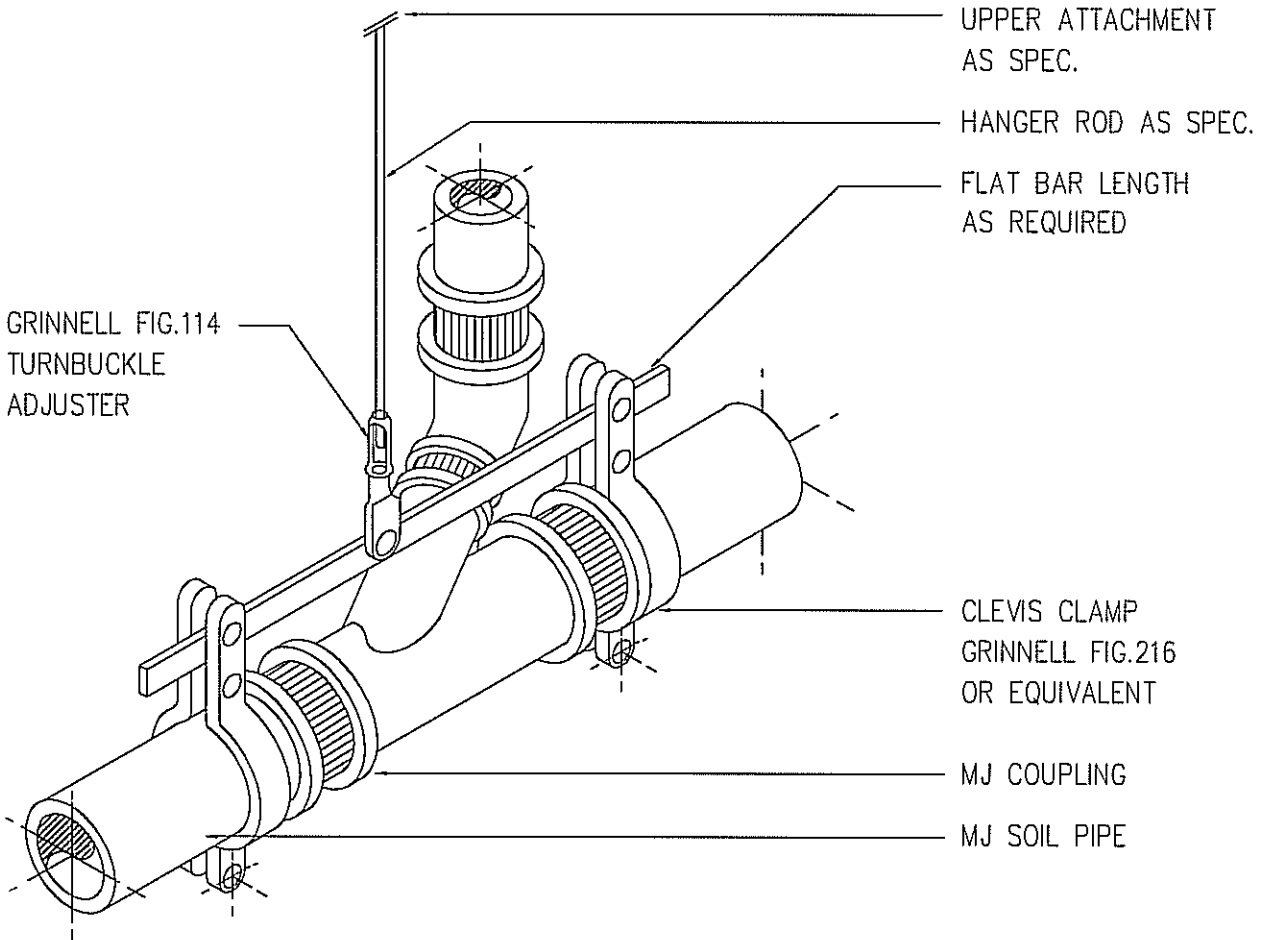
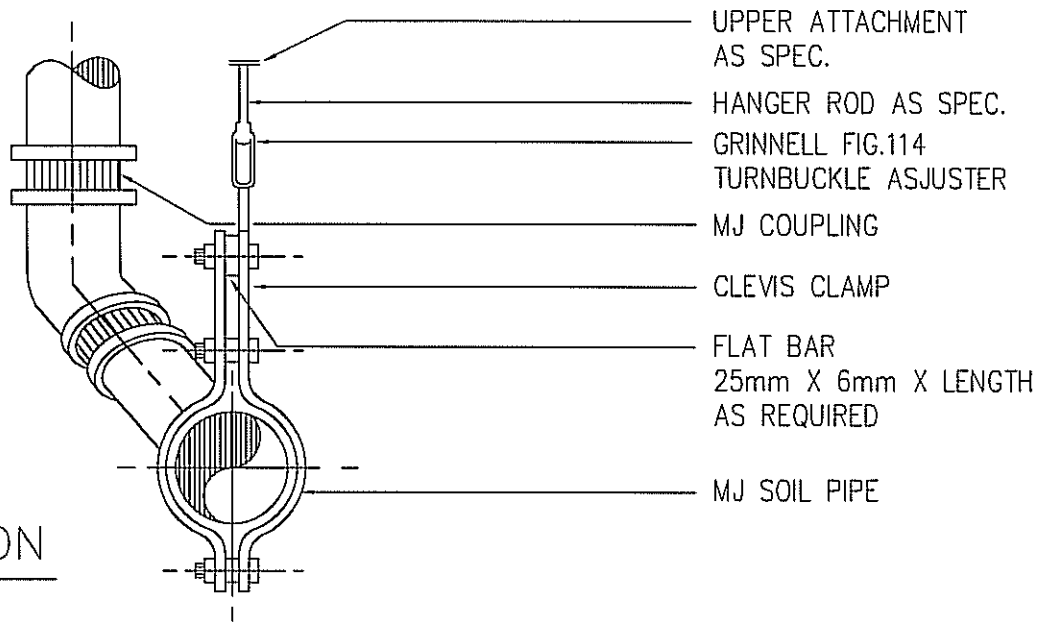
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 sms@smseng.com

**SPECIFICATION
 DETAIL**

DOMESTIC WATER HEATERS

Drawn By SMS	Approved By SMS	Reference 4010
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-1

SECTION



M.J. PIPE & FITTING – HANGER DETAIL

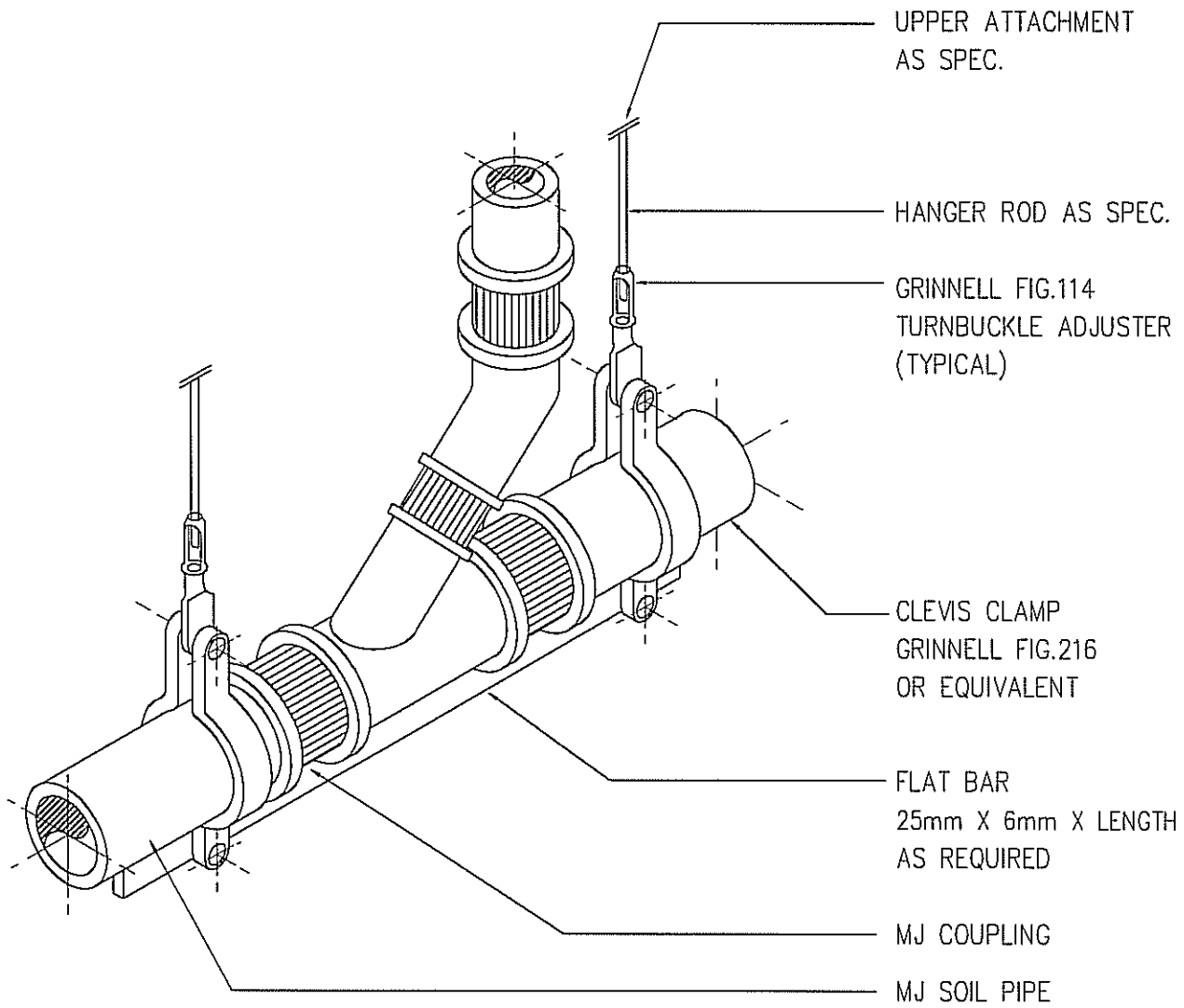
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SPECIFICATION
 DETAIL

HANGER DETAIL
 ABOVE GRADE

Drawn By SMS	Approved By SMS	Reference 4150
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-2



M.J. PIPE & FITTING – HANGER DETAIL

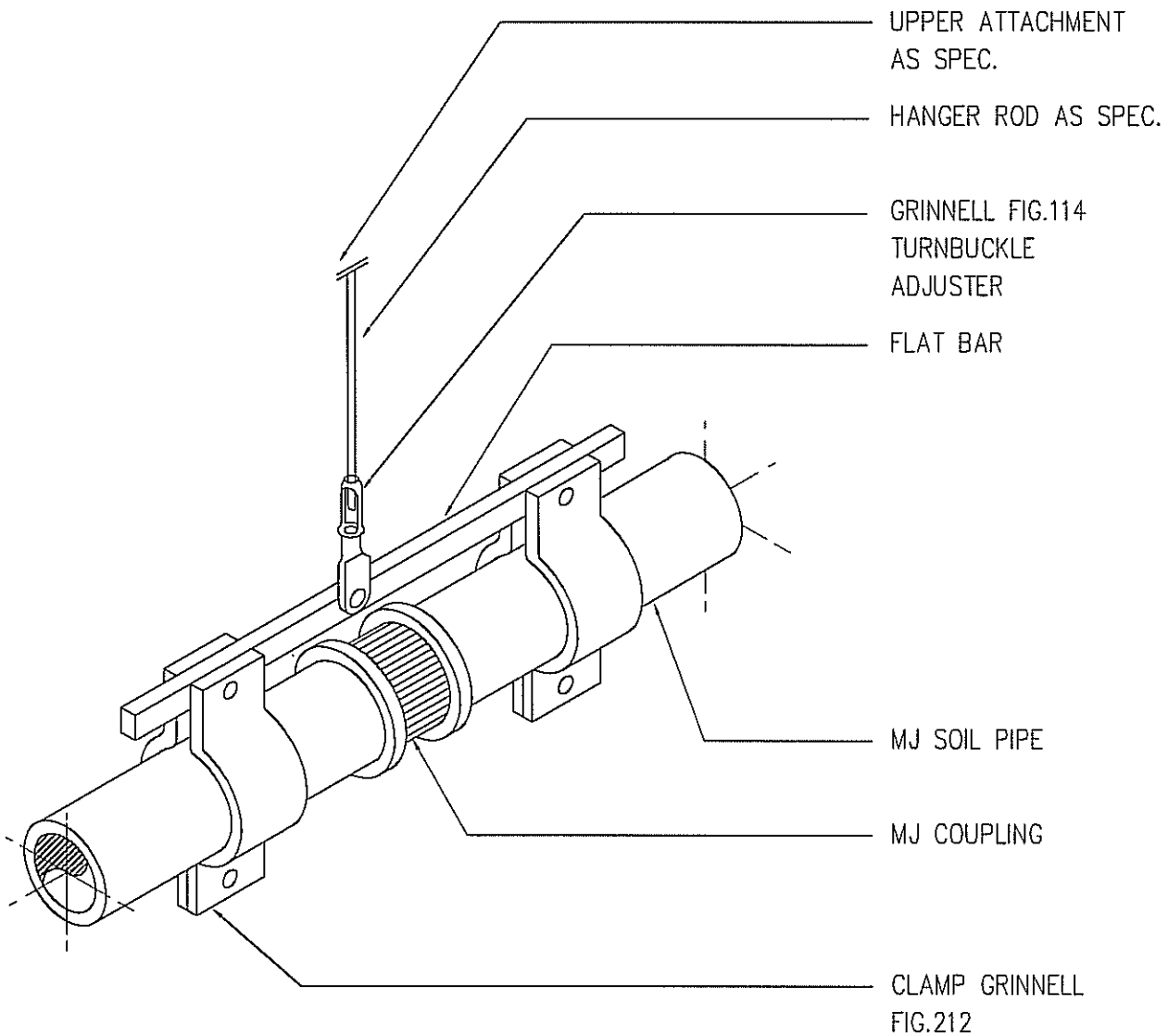
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SPECIFICATION
 DETAIL

HANGER DETAIL
 ABOVE GRADE

Drawn By SMS	Approved By SMS	Reference 4151
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-3



M.J. PIPE & FITTING – HANGER DETAIL

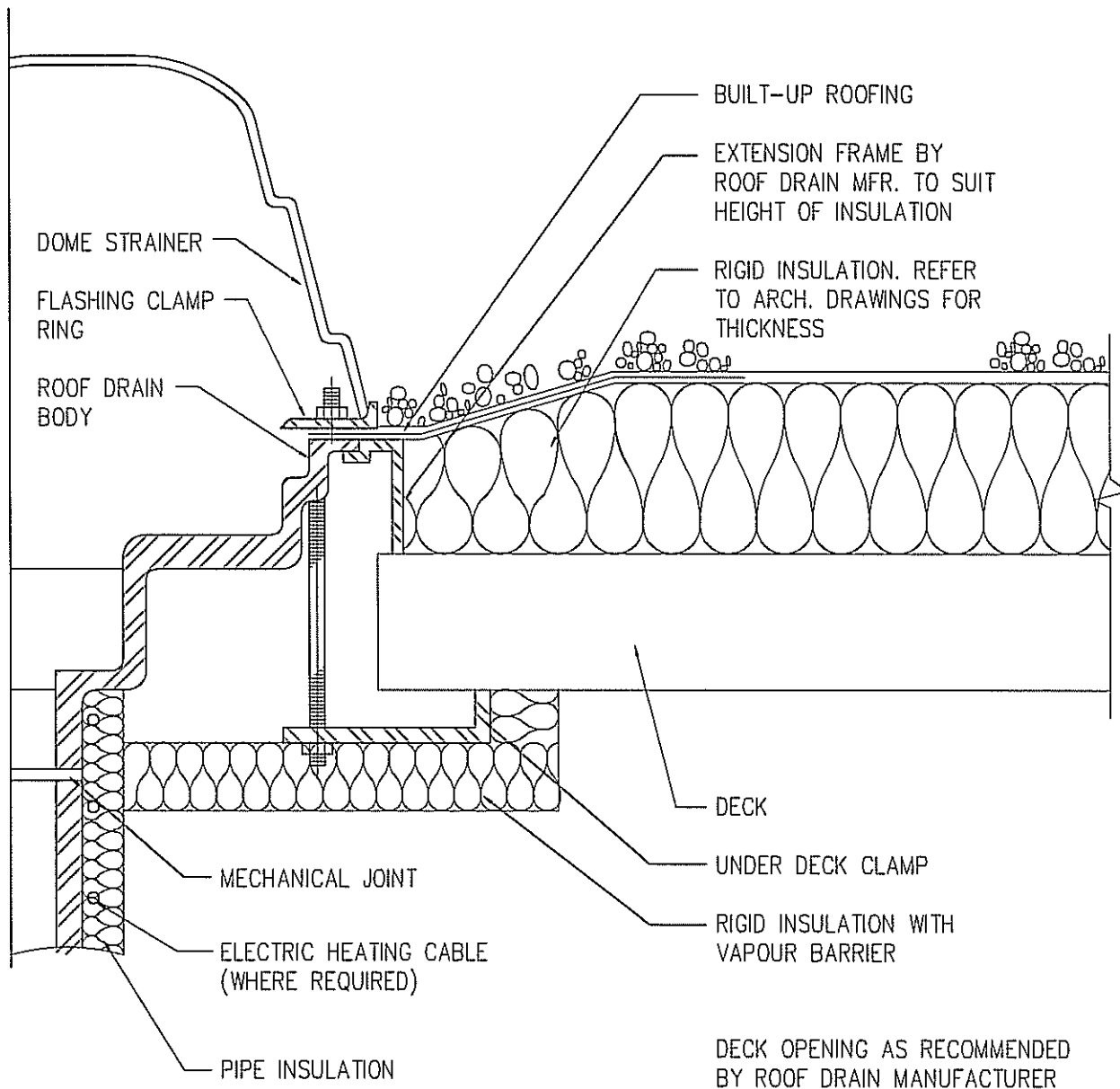
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SPECIFICATION
DETAIL

HANGER DETAIL
ABOVE GRADE

Drawn By SMS	Approved By SMS	Reference 4152
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-4



DETAIL OF ROOF DRAIN

N.T.S.

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SPECIFICATION
 DETAIL

ROOF DRAIN DETAIL
 STANDARD TYPE ROOF

Drawn By SMS	Approved By SMS	Reference 4170
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-5

FIXTURE HEIGHT ROUGH-IN SCHEDULE

WALL HUNG WATER CLOSET

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED FLOOR TO THE TOP OF SEAT.

- 1) NORMAL INSTALLATION 16" (406mm)
- 2) SENIOR CITIZENS & NURSING HOMES 16" (406mm)
- 3) SENIOR CITIZENS & NURSING HOMES 18" (460mm)
- 4) HOSPITAL (WARDS) 16" (406mm)
- 5) HOSPITAL (WARDS) 18" (560mm)
- 6) WHEELCHAIR 16" (406mm)
- 7) WHEELCHAIR 18" (460mm)

FLOOR MOUNTED WATER CLOSET

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED FLOOR TO THE TOP OF THE BOWL.

- 1) NORMAL INSTALLATION 15" (380mm)
- 2) SENIOR CITIZENS & NURSING HOMES 15" (380mm)
- 3) SENIOR CITIZENS & NURSING HOMES 18" (460mm)
- 4) HOSPITAL (WARDS) 15" (406mm)
- 5) HOSPITAL (WARDS) 18" (560mm)
- 6) WHEELCHAIR 15" (406mm)
- 7) WHEELCHAIR 18" (460mm)

WALL HUNG LAVATORY

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED FLOOR TO THE TOP OF THE BOWL.

- 1) NORMAL INSTALLATION 31" (790mm)
- 2) ELEMENTARY SCHOOLS (WHERE USED BY STUDENTS) 30" (760mm)
- 3) KINDERGARTEN (WHERE USED BY STUDENTS) 24" (610mm)
- 4) WHEELCHAIR 32" (815mm)

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SPECIFICATION
DETAIL

PLUMBING FIXTURES
INSTALLATION HEIGHT

Drawn By SMS	Approved By SMS	Reference 4180
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-6

FIXTURE HEIGHT ROUGH-IN SCHEDULE

WALL HUNG URINAL

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED FLOOR TO THE TOP OF THE BOWL.

- 1) NORMAL INSTALLATION 22" (560mm)
- 2) ELEMENTARY SCHOOLS (WHERE USED BY STUDENTS) 16" (410mm)
- 3) KINDERGARTEN (WHERE USED BY STUDENTS) 14" (350mm)
- 3) JUNIOR HIGH (WHERE USED BY STUDENTS) 20" (510mm)
- 4) WHEELCHAIR 17" (430mm)

WALL HUNG DRINKING FOUNTAIN

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED FLOOR TO THE TOP OF THE BOWL.

- 1) NORMAL INSTALLATION 40" (1015mm)
- 2) ELEMENTARY SCHOOLS (WHERE USED BY STUDENTS) 32" (815mm)
- 3) KINDERGARTEN (WHERE USED BY STUDENTS) 32" (815mm)
- 4) WHEELCHAIR 32" (815mm)

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SPECIFICATION
DETAIL

PLUMBING FIXTURES
INSTALLATION HEIGHT

Drawn By SMS	Approved By SMS	Reference 4181
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-7

FIXTURE HEIGHT ROUGH-IN SCHEDULE

SHOWERS

ALL MOUNTING HEIGHTS AS INDICATED ARE MEASURED FROM THE FINISHED SHOWER FLOOR TO THE UNDERSIDE OF THE SHOWER HEAD AT 30°. THE MIXING VALVE SHALL BE LOCATED 3'-6" (1070mm) TO THE CENTER LINE OF THE VALVE ABOVE THE FINISHED SHOWER FLOOR.

- 1) NORMAL INSTALLATION MALE 6'-0" (1830mm)
 FEMALE 5'-8" (1730mm)

JANITORS SINK (CURB TYPE)

THE FAUCET SHALL BE MOUNTED 3'-6" (1070mm) FROM THE FINISHED FLOOR TO THE CENTER LINE OF THE INLETS.

NOTE:

THE MECHANICAL SUBCONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING WITH THE CONTRACT ADMINISTRATOR PRIOR TO INSTALLATION AND VERIFY ALL FIXTURE ROUGH-IN HEIGHTS.

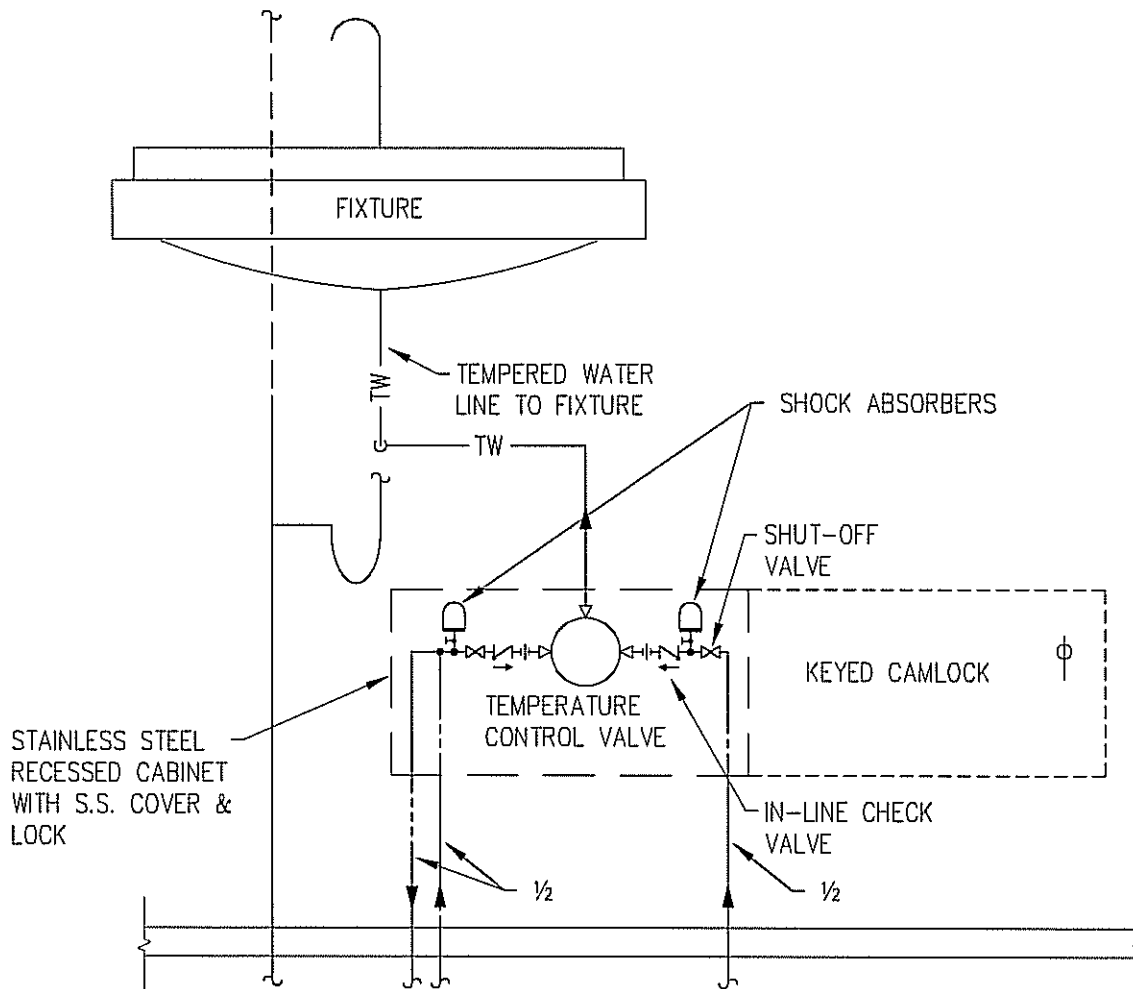


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**SPECIFICATION
DETAIL**

**PLUMBING FIXTURES
INSTALLATION HEIGHT**

Drawn By	Approved By	Reference
SMS	SMS	4182
File No.	Date	Detail Sheet
05-015-01	DEC. 2005	MD-8



TYPICAL SCHEMATIC PIPING DETAIL FOR MIXING VALVE AT HANDS FREE FIXTURES

NOT TO SCALE

NOTE:

- A. FOR SCRUB SINKS, WATER SERVICES SHALL BE 3/4" HOT & COLD AND 3/4" RECIRC.
- B. FAUCET TO BE BATTERY OPERATED.
- C. FOR LOCATION OF DOMESTIC WATER SUPPLY LINES REFER TO FLOOR PLANS.

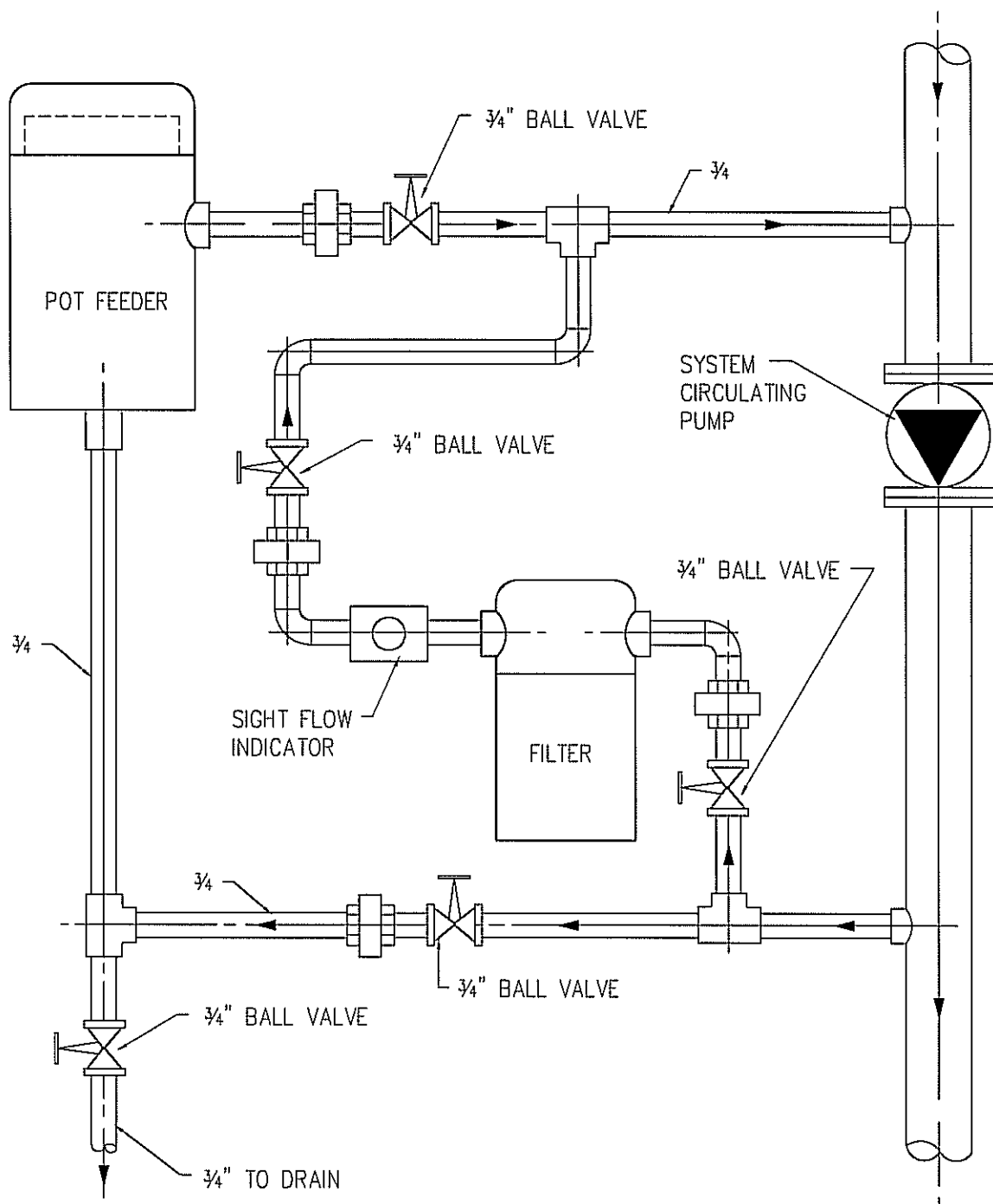
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SPECIFICATION DETAIL

HANDS FREE FIXTURE MIXING VALVE SCHEMATIC

Drawn By SMS	Approved By JTW	Reference 4311
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-9



NOTE:
 INSTALL ON HOT WATER HEATING, GLYCOL HEATING,
 GLYCOL HEAT RECOVERY AND CHILLED WATER SYSTEMS.

CHEMICAL POT FEEDER AND FILTER

N.T.S.

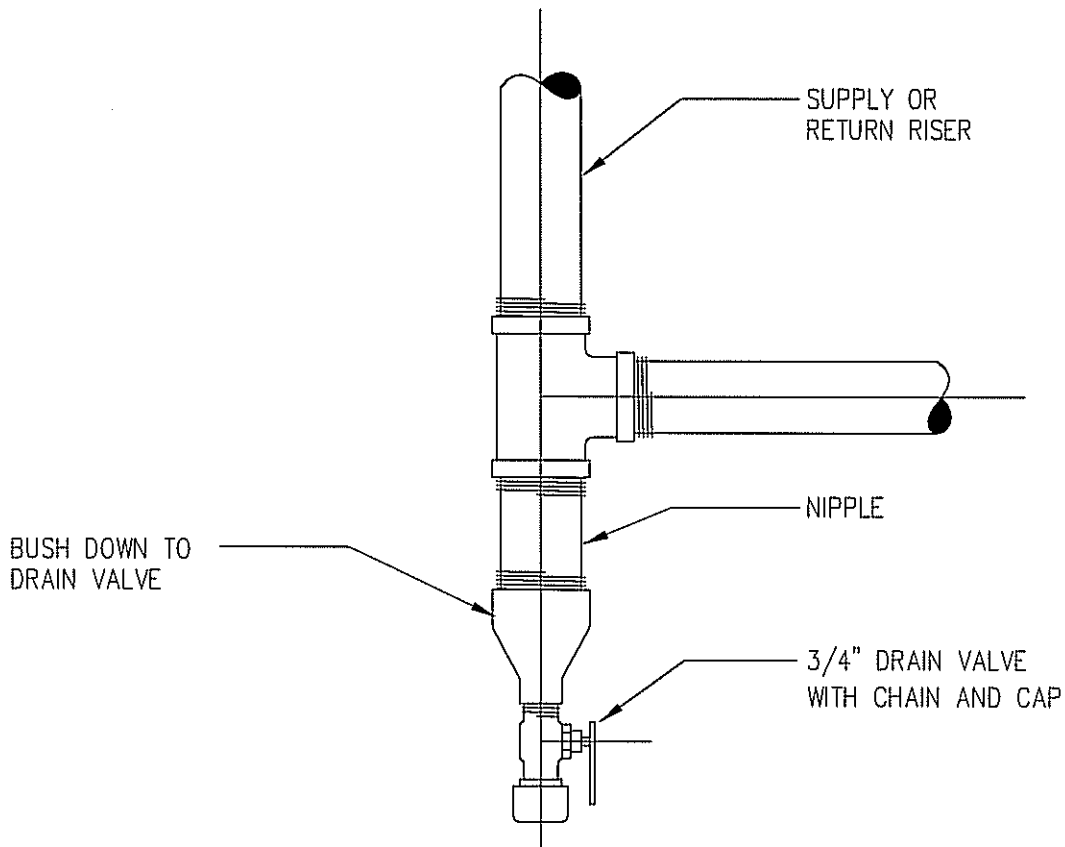
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SPECIFICATION
 DETAIL

CHEMICAL POT FEEDER
 AND FILTER

Drawn By SMS	Approved By SMS	Reference 6020
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-10



WATER RISER DRAIN

N.T.S.

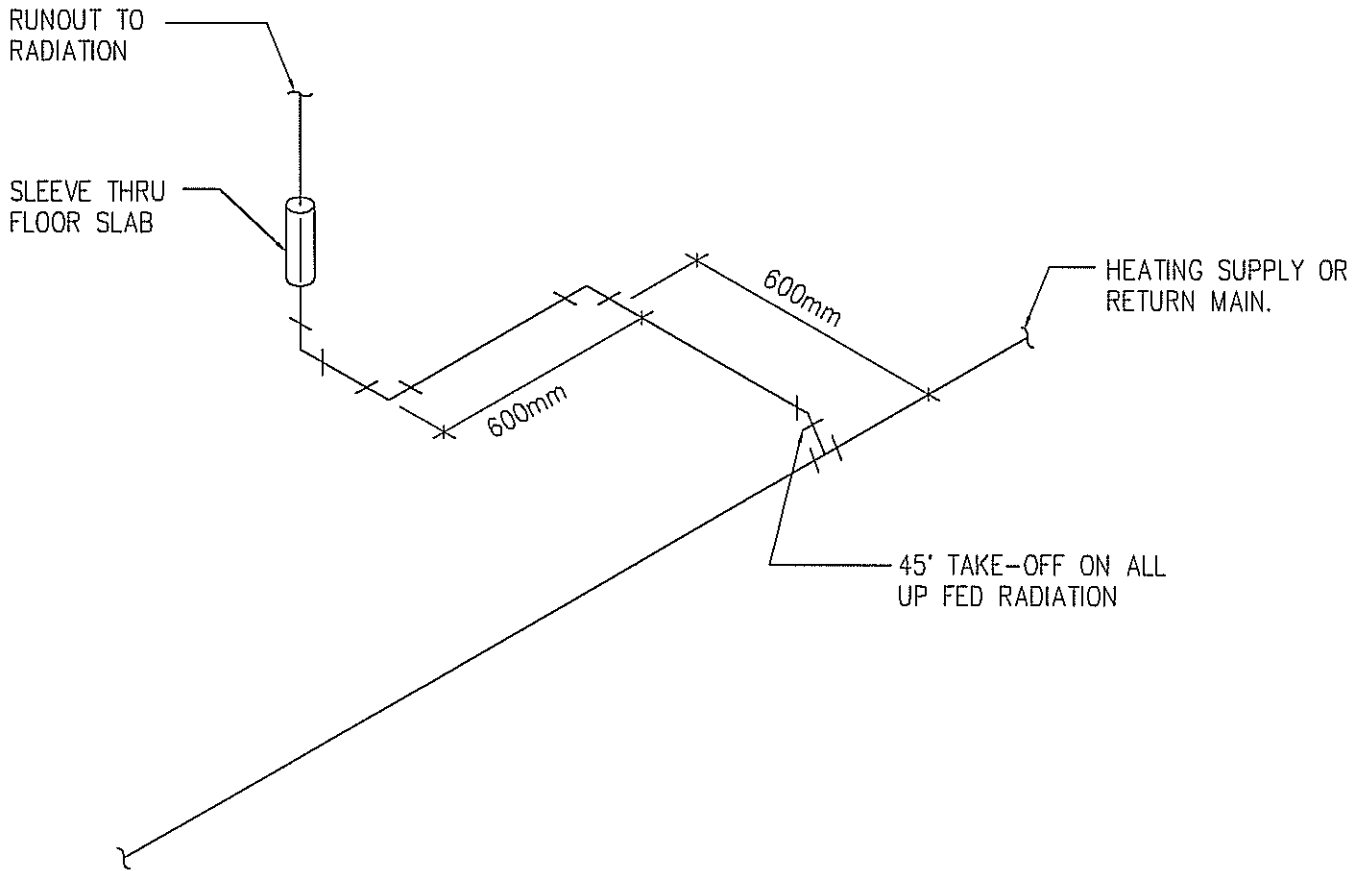
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SPECIFICATION
 DETAIL

WATER RISER DRAIN

Drawn By SMS	Approved By SMS	Reference 6051
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-11



TYPICAL TAKE-OFF TO HOT WATER RADIATION

N.T.S.

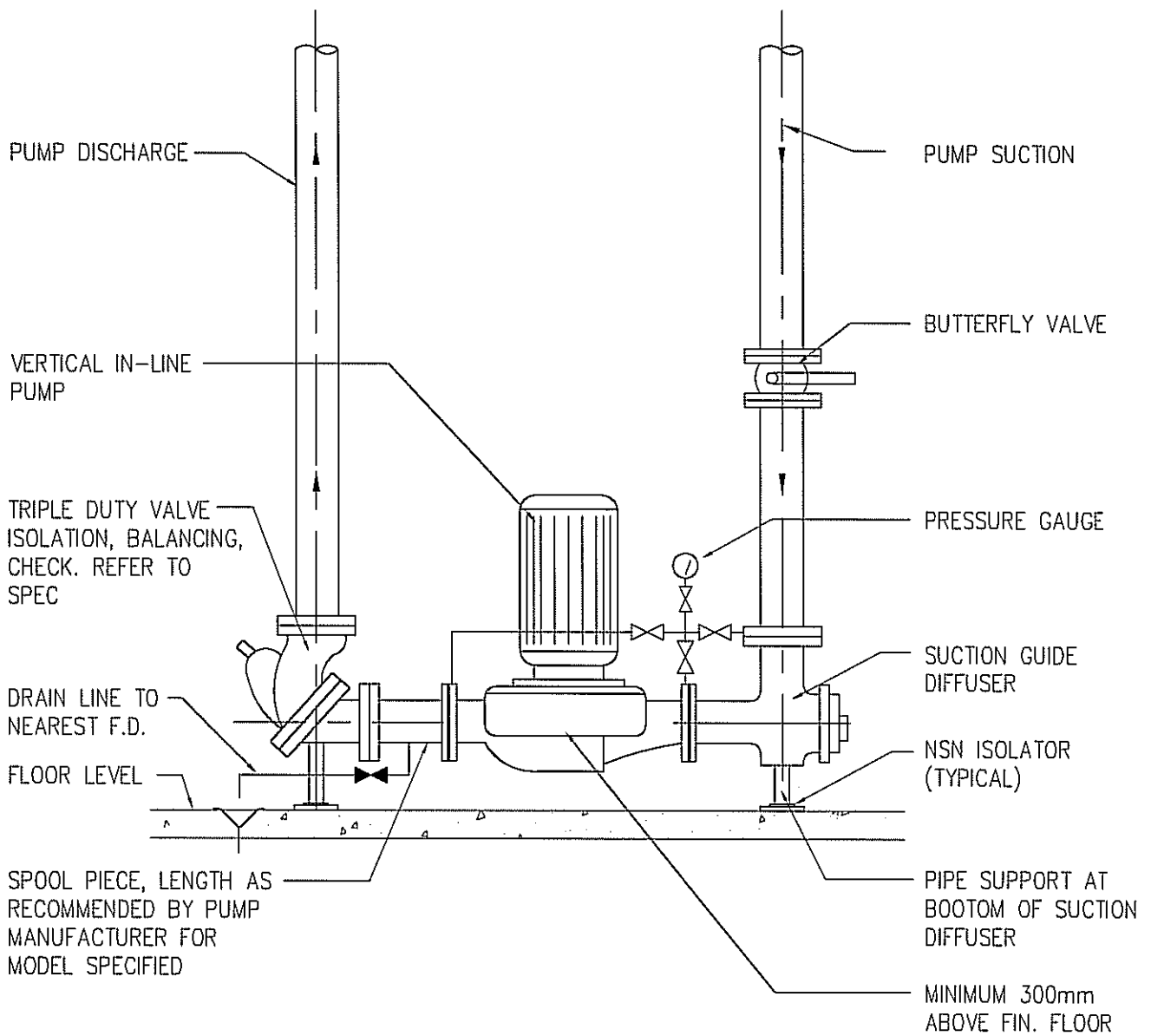
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SPECIFICATION
 DETAIL

RADIATION TAKE-OFF

Drawn By SMS	Approved By SMS	Reference 6050
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-12



VERTICAL IN-LINE PUMP INSTALLATION

N.T.S.

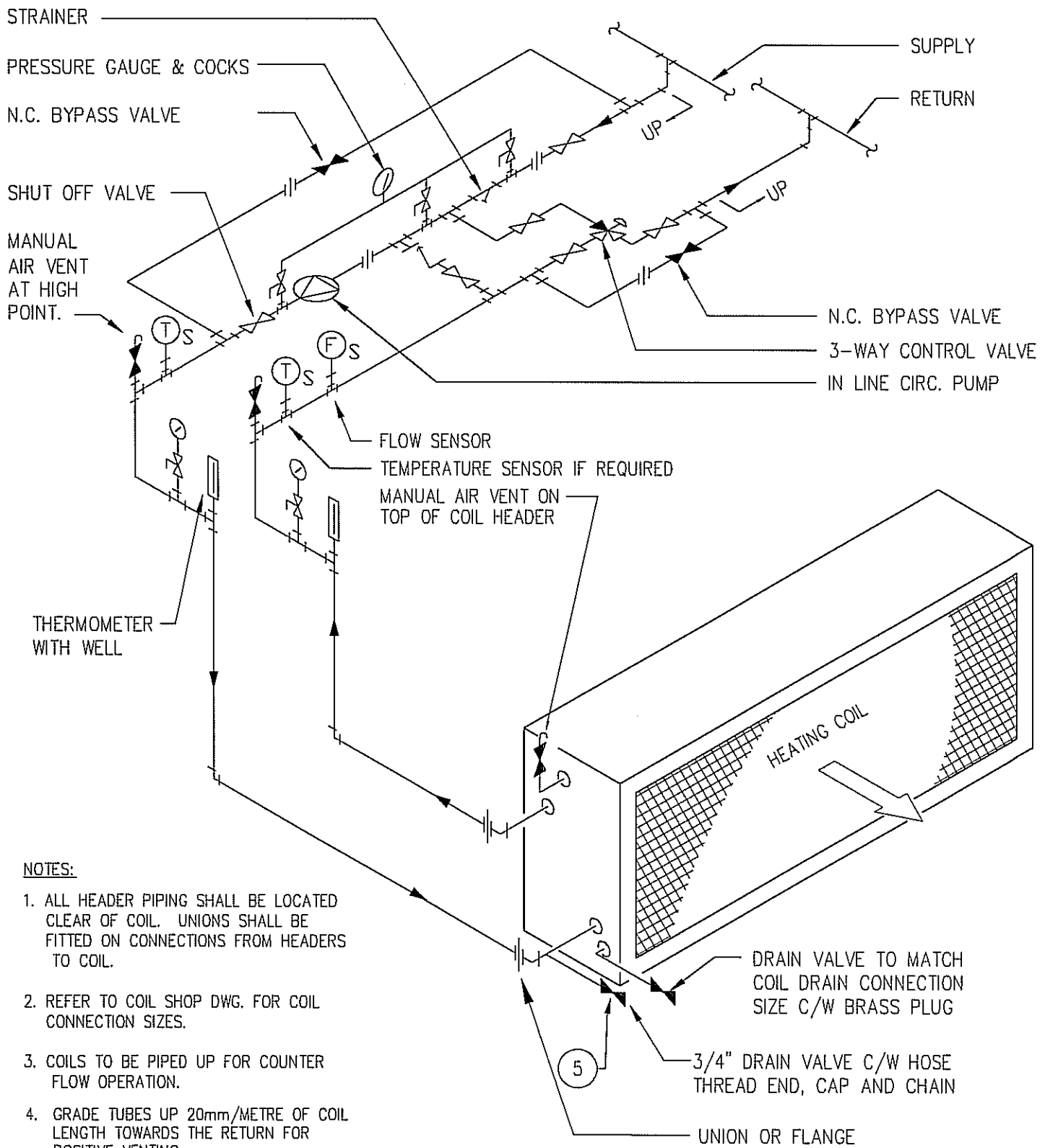
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SPECIFICATION
 DETAIL

VERTICAL IN-LINE PUMP DETAIL
 FLOOR SUPPORT

Drawn By SMS	Approved By SMS	Reference 6072
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-13



NOTES:

1. ALL HEADER PIPING SHALL BE LOCATED CLEAR OF COIL. UNIONS SHALL BE FITTED ON CONNECTIONS FROM HEADERS TO COIL.
2. REFER TO COIL SHOP DWG. FOR COIL CONNECTION SIZES.
3. COILS TO BE PIPED UP FOR COUNTER FLOW OPERATION.
4. GRADE TUBES UP 20mm/METRE OF COIL LENGTH TOWARDS THE RETURN FOR POSITIVE VENTING.
5. NOT REQUIRED IF COIL DRAIN CONNECTION IS 3/4" OR LARGER. IN THIS CASE COIL DRAIN VALVE SHALL BE C/W HOSE THREAD END, CAP AND CHAIN

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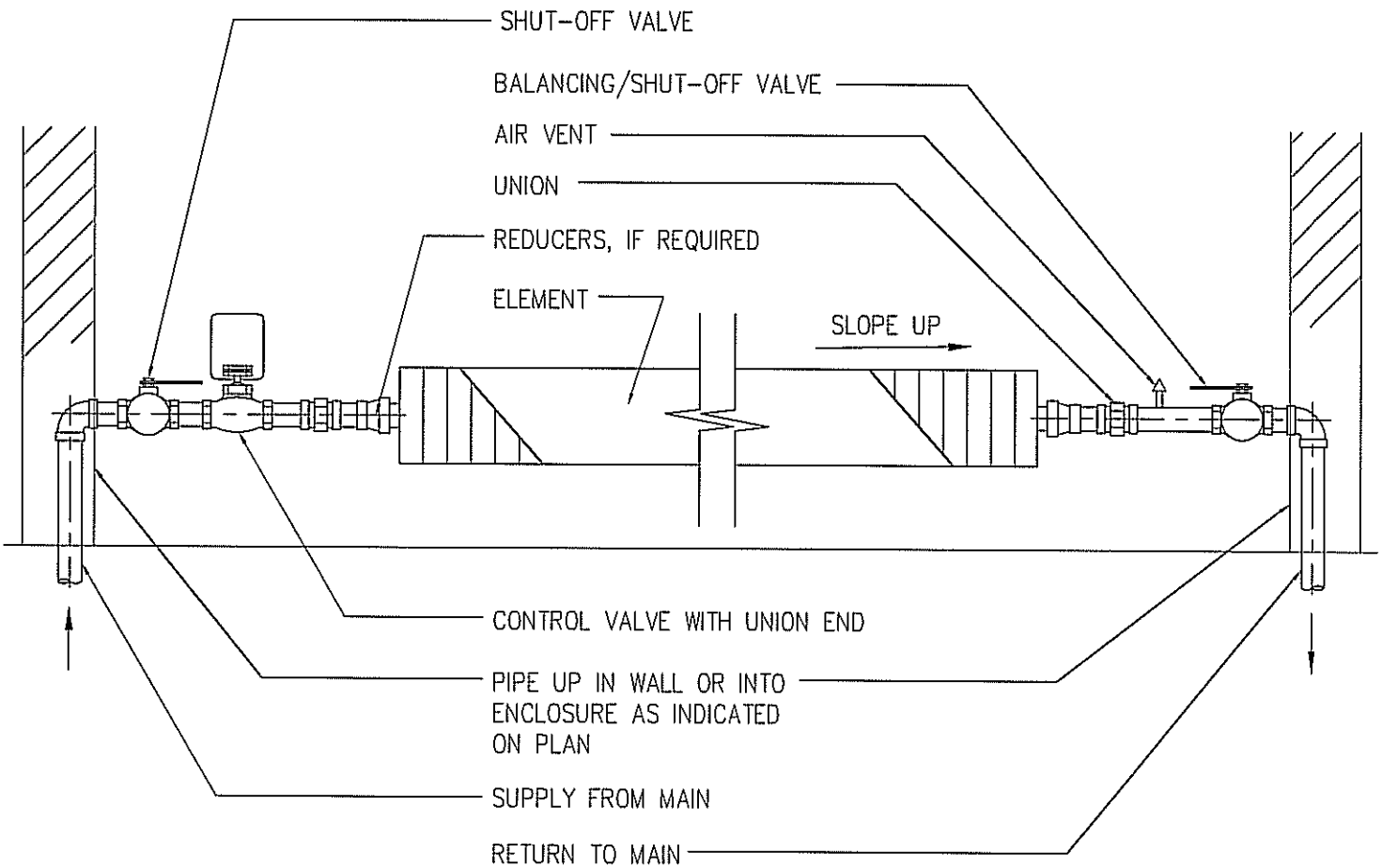
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**SPECIFICATION
 DETAIL**

GLYCOL OR HOT WATER HTG. COIL
 SINGLE BANK, 3-WAY CONTROL, PUMP

Drawn By SMS	Approved By SMS	Reference 6077
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-14

Revised JUNE 2002



HOT WATER PIPING FOR WALL FIN

N.T.S.

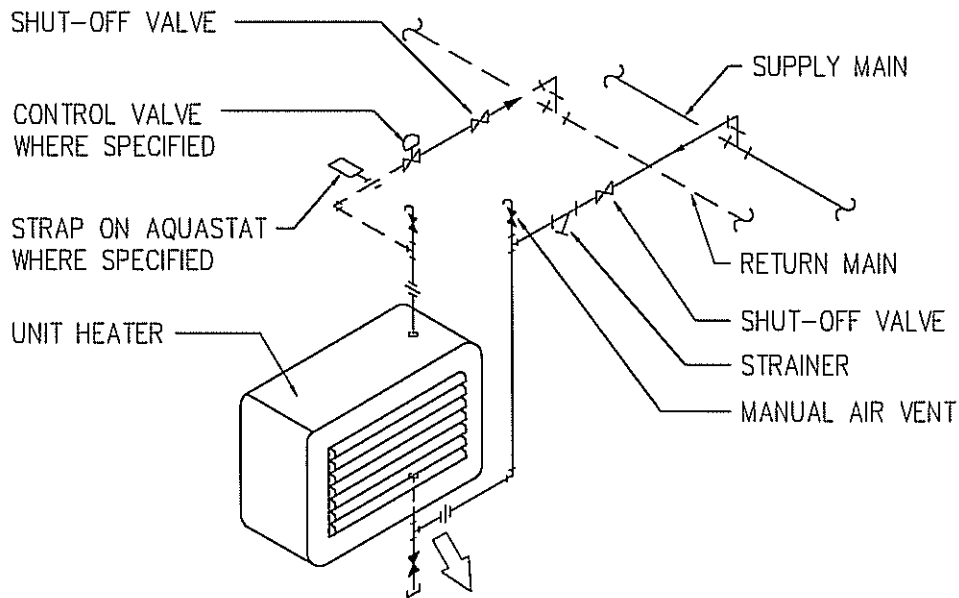
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 sms@smseng.com

SPECIFICATION
 DETAIL

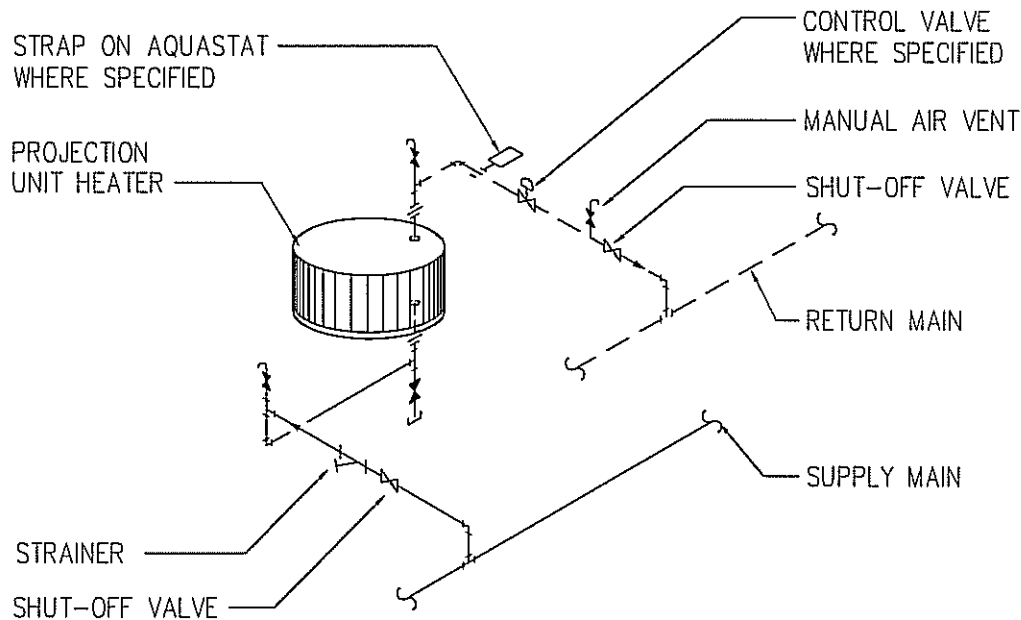
HOT WATER PIPING -
 WALLFIN

Drawn By SMS	Approved By SMS	Reference 6120
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-15



HORIZONTAL UNIT HEATER

N.T.S.



PROJECTION UNIT HEATER

N.T.S.

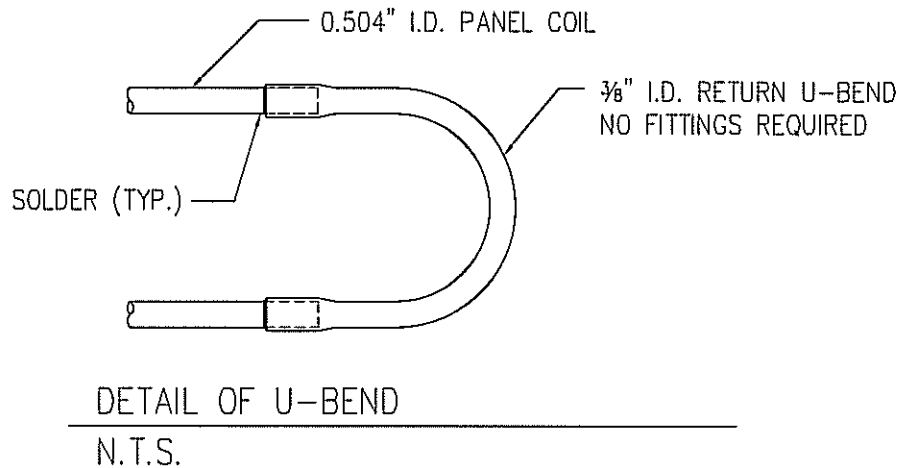
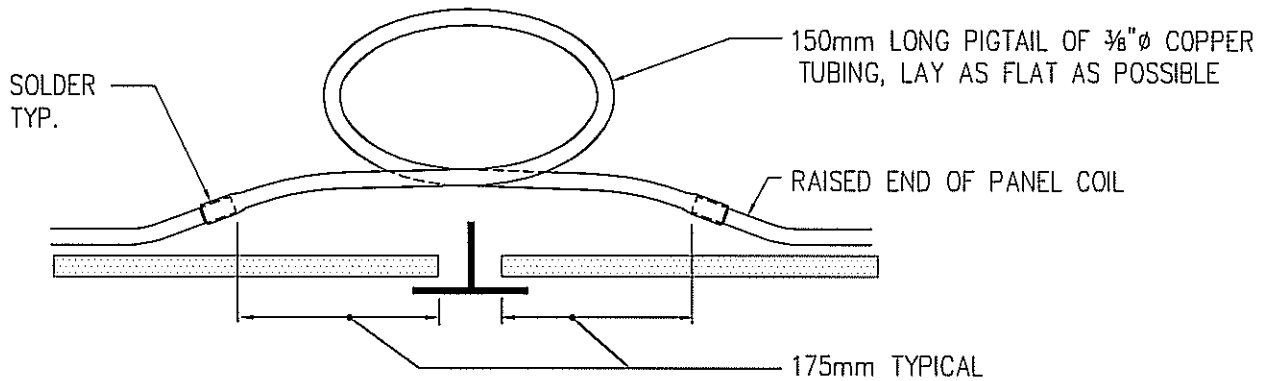
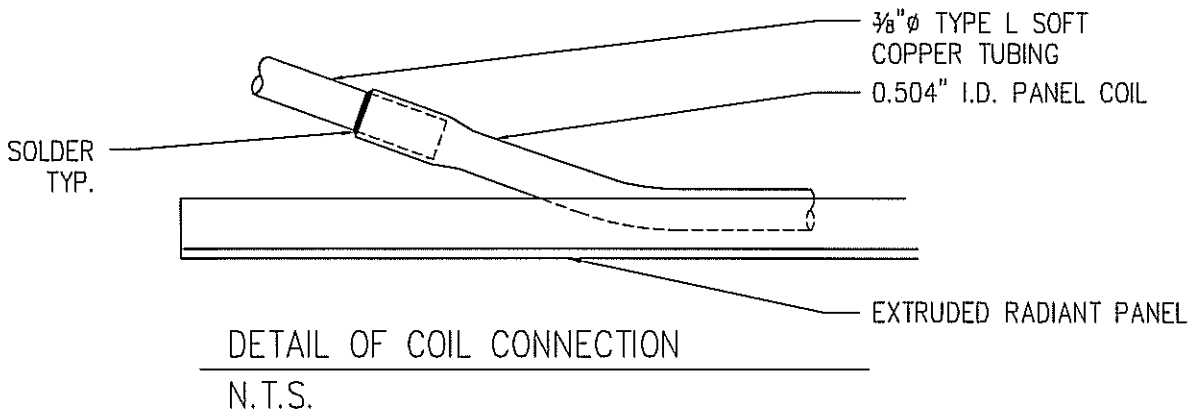
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**SPECIFICATION
 DETAIL**

**UNIT HEATERS - GLYCOL OR
 HOT WATER. UPFEED**

Drawn By SMS	Approved By SMS	Reference 6171
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-16



NOTES:

1. PANEL COIL MUST BE RAISED BEFORE INSERTING COPPER TUBE.
2. TOOLS FOR RAISING END OF COIL AND RESIZING COIL TO BE BORROWED FROM SUPPLIER.

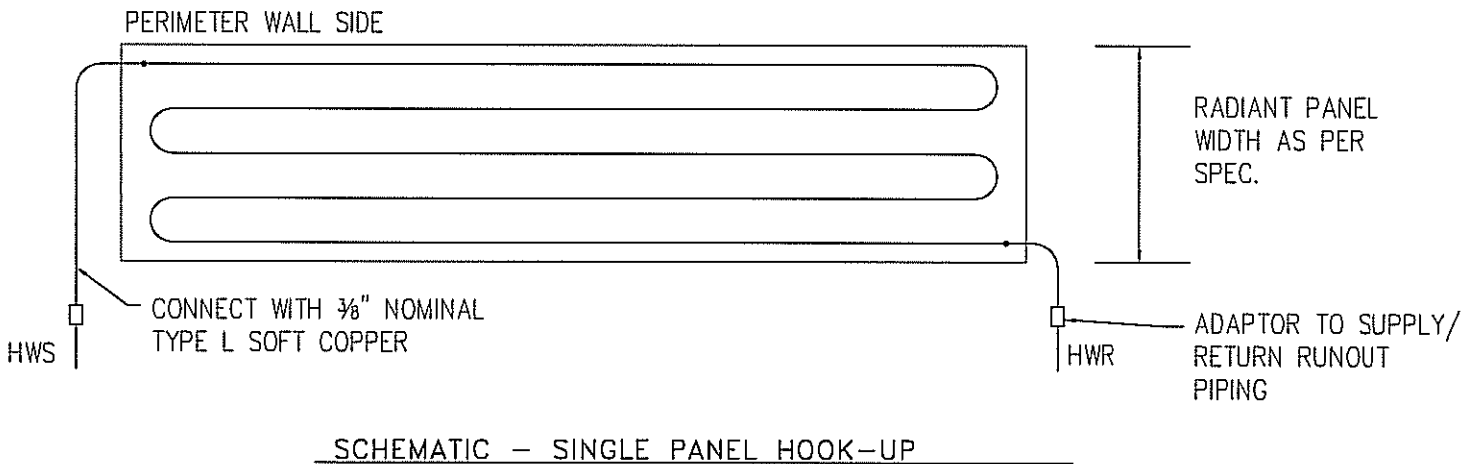
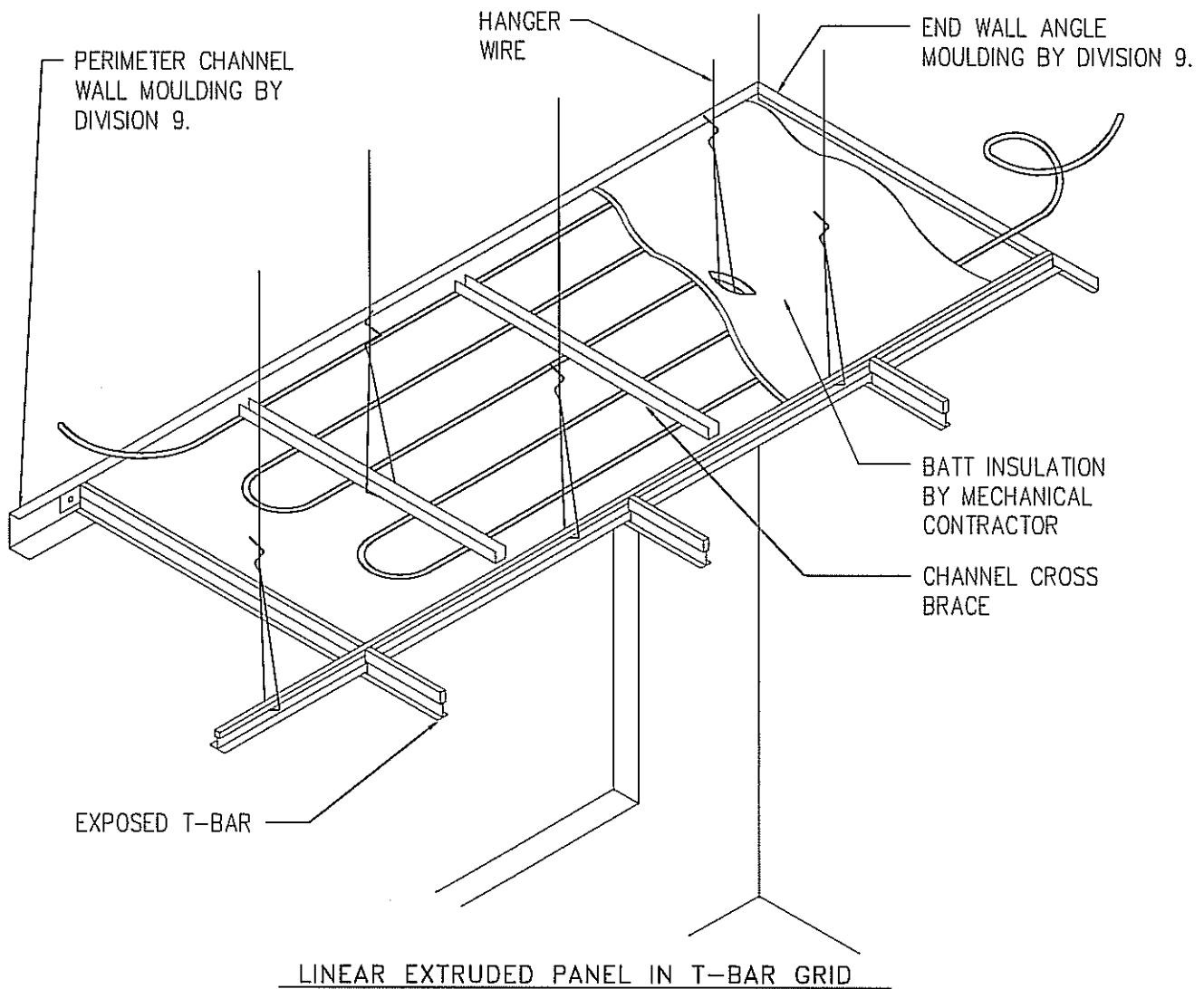
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SPECIFICATION
DETAIL

LINEAR RADIANT PANEL
CONNECTION DETAILS

Drawn By SMS	Approved By SMS	Reference 6292
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-17



PANEL LENGTH VARIES TO SUIT ROOM DIMENSIONS
REFER TO DRAWINGS

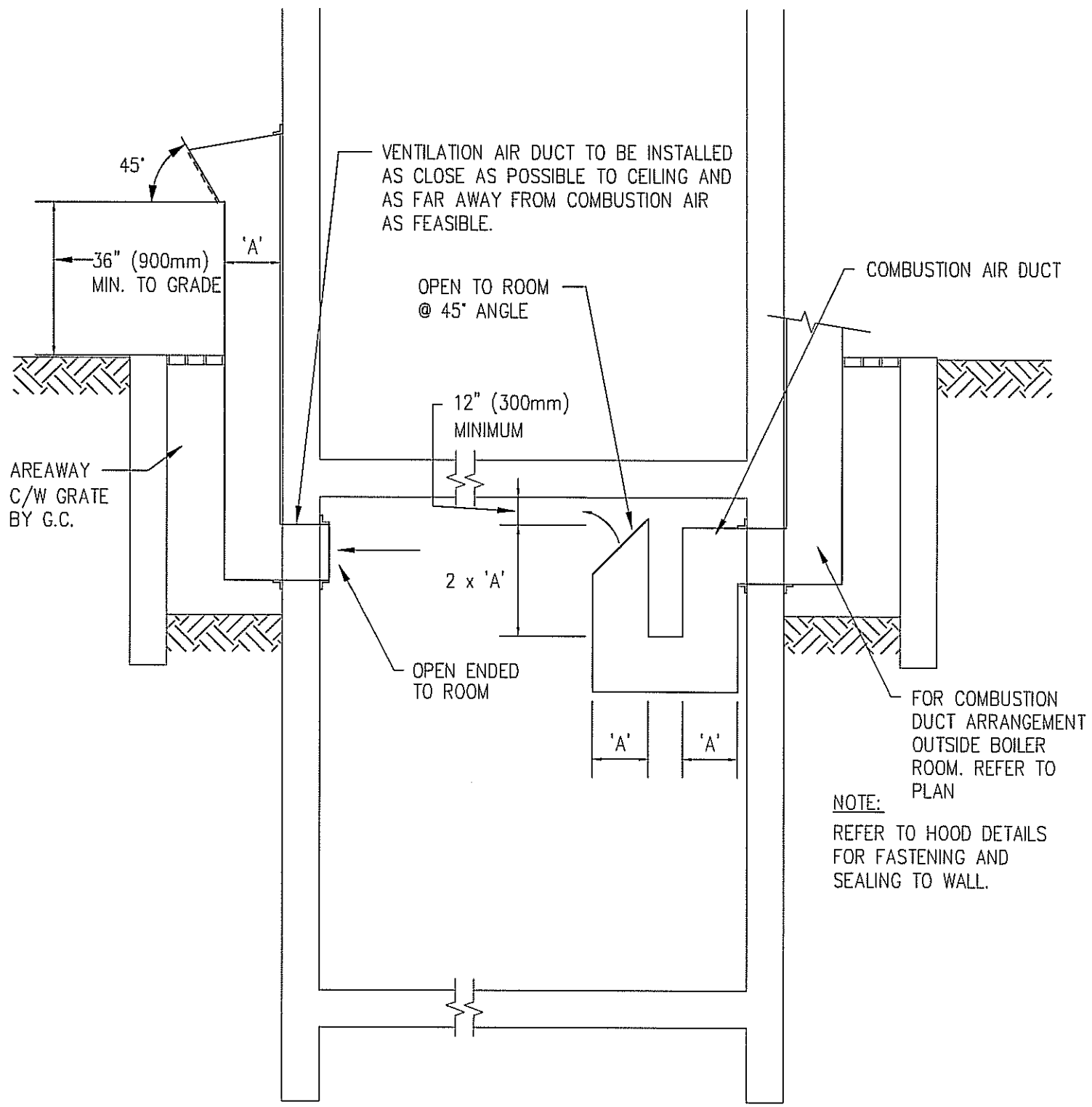
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SPECIFICATION
DETAIL

TYPICAL SINGLE LINEAR
RADIANT PANEL HOOK-UP

Drawn By SMS	Approved By SMS	Reference 6291
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-18



VENTILATION AIR DUCT TO BE INSTALLED AS CLOSE AS POSSIBLE TO CEILING AND AS FAR AWAY FROM COMBUSTION AIR AS FEASIBLE.

OPEN TO ROOM @ 45° ANGLE

12" (300mm) MINIMUM

2 x 'A'

OPEN ENDED TO ROOM

COMBUSTION AIR DUCT

FOR COMBUSTION DUCT ARRANGEMENT OUTSIDE BOILER ROOM. REFER TO PLAN

NOTE:
REFER TO HOOD DETAILS FOR FASTENING AND SEALING TO WALL.

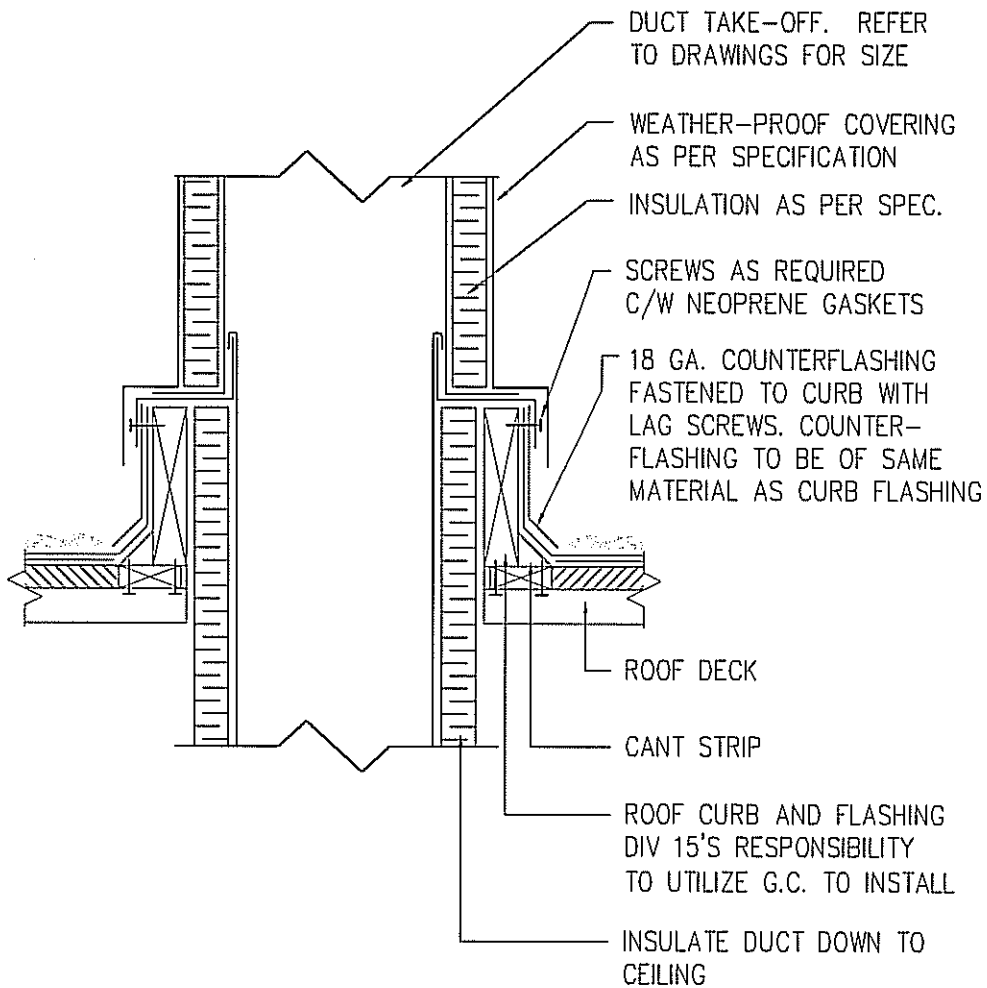
WALL SECTION
N.T.S.

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**SPECIFICATION
DETAIL**

**VENTILATION / COMBUSTION AIR
DETAIL- ROOM BELOW GRADE**

Drawn By SMS	Approved By SMS	Reference 8257
File No. 05-015-01	Date DEC 2005	Detail Sheet MD-19



DUCT THROUGH ROOF

N.T.S.

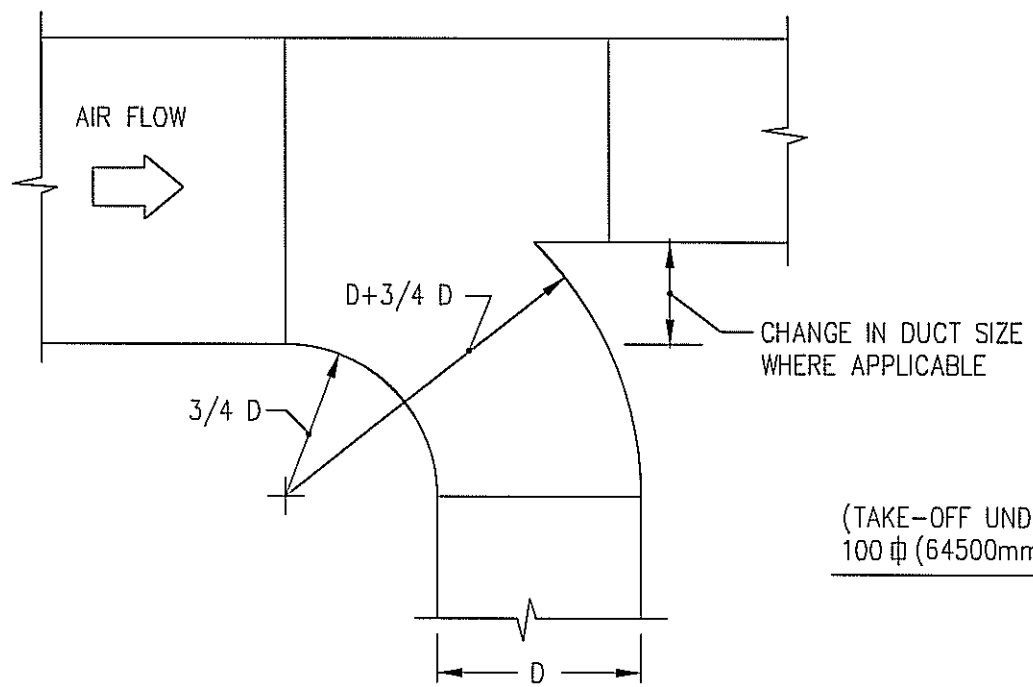
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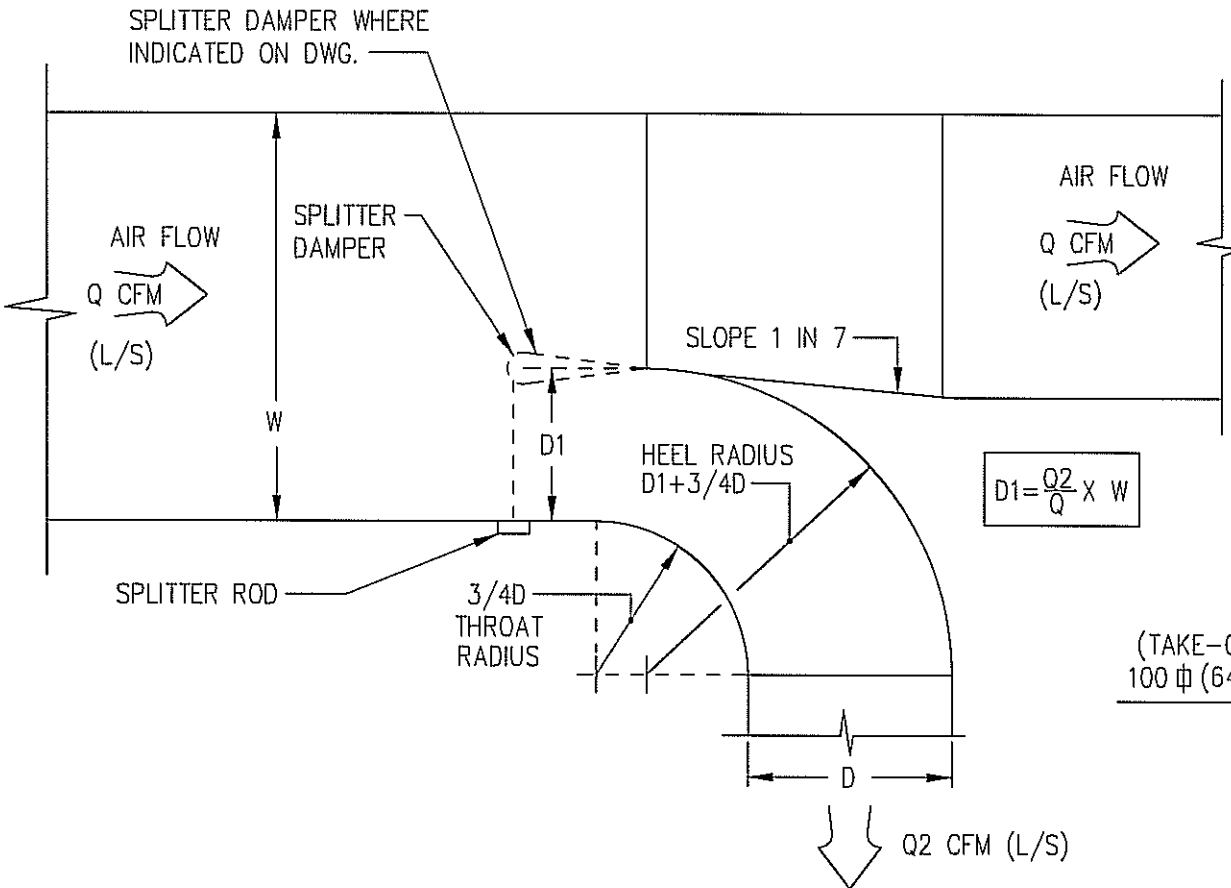
SPECIFICATION
 DETAIL

DUCT THROUGH ROOF

Drawn By SMS	Approved By SMS	Reference 8011
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-20



(TAKE-OFF UNDER
100 ϕ (64500mm²))



(TAKE-OFF OVER
100 ϕ (64500mm²))

DUCT TAKE-OFFS

N.T.S.

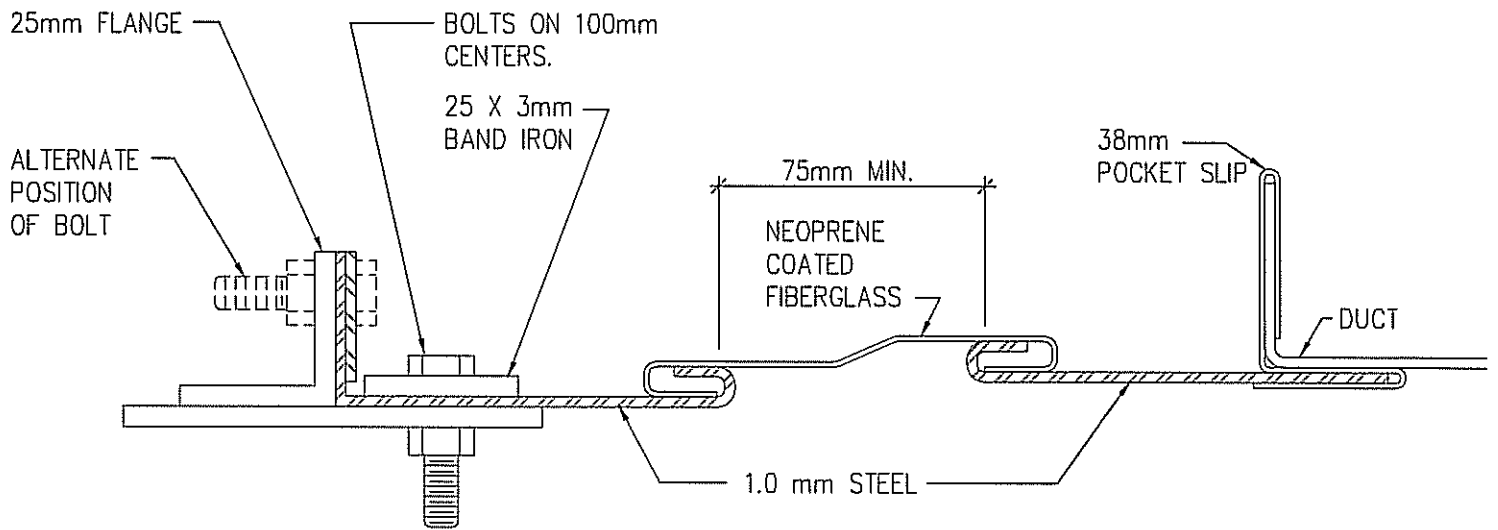
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SPECIFICATION
DETAIL

DUCT TAKE-OFFS

Drawn By SMS	Approved By SMS	Reference 8005
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-21



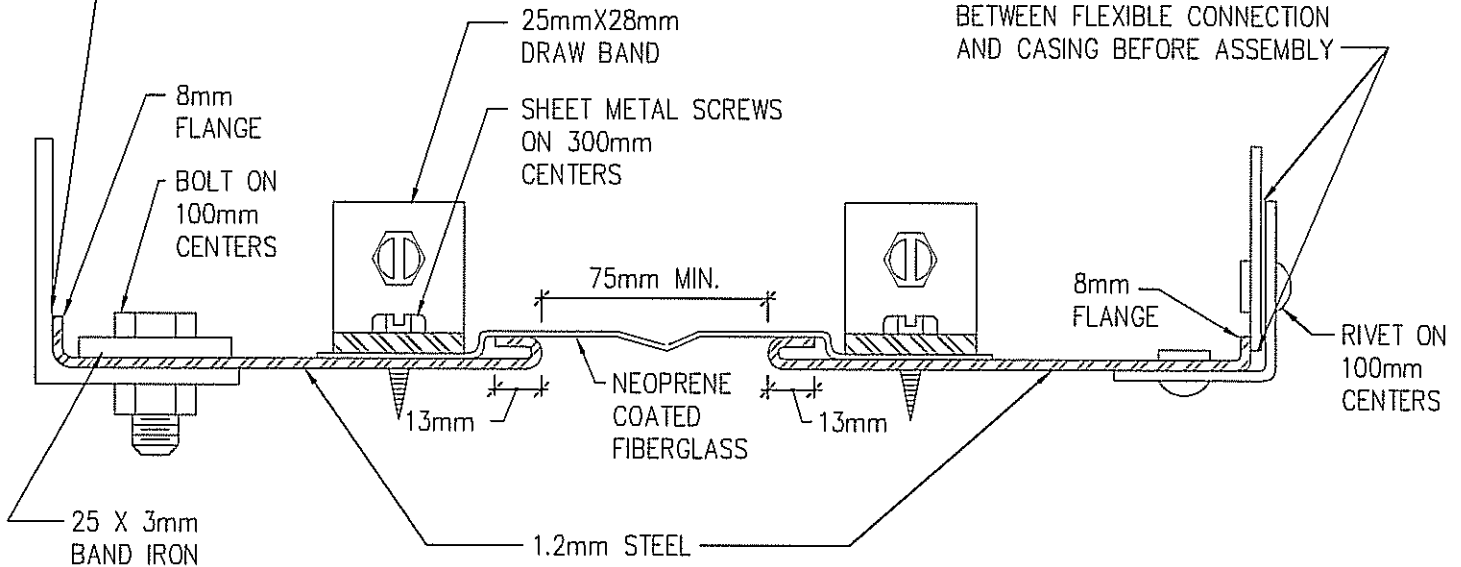
RECTANGULAR CONNECTION
N.T.S.

*REQUIRED ON HIGH PRESSURE SYSTEM ONLY

* SEALING COMPOUND APPLIED BETWEEN FLEXIBLE CONNECTION BEFORE ASSEMBLY.

* SEALING COMPOUND APPLIED BETWEEN FABRIC BAND AND 1.2mm STEEL BEFORE ASSEMBLY

* SEALING COMPOUND APPLIED BETWEEN FLEXIBLE CONNECTION AND CASING BEFORE ASSEMBLY



ROUND CONNECTION
N.T.S.

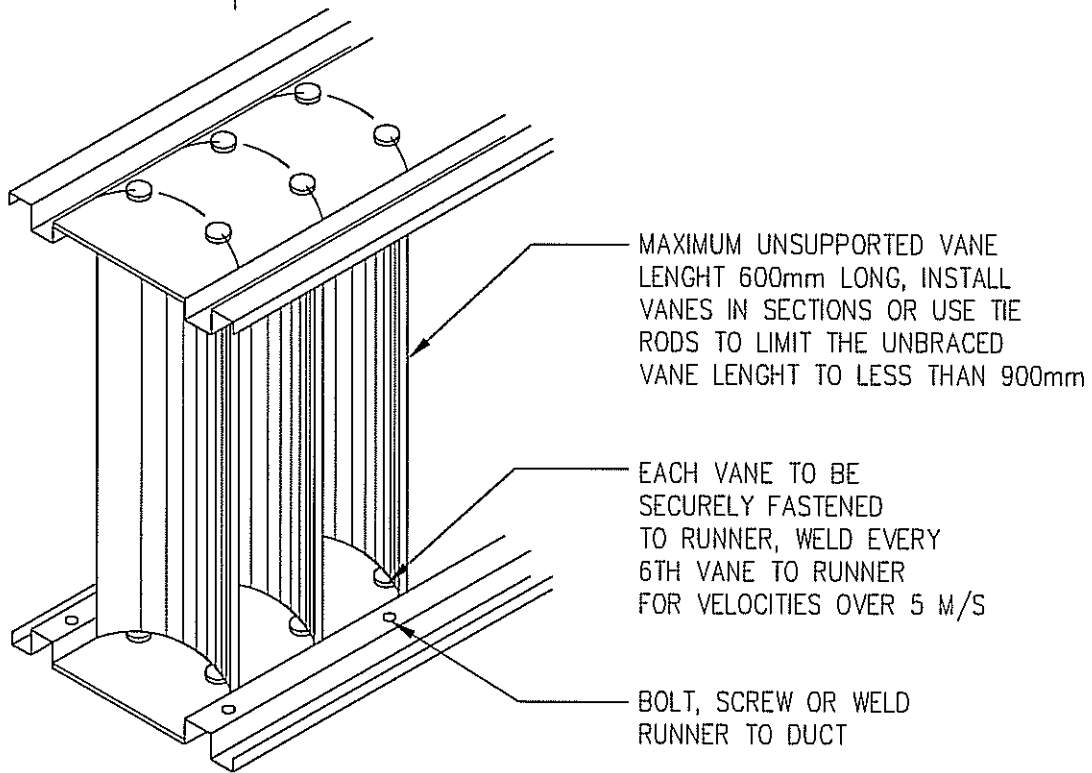
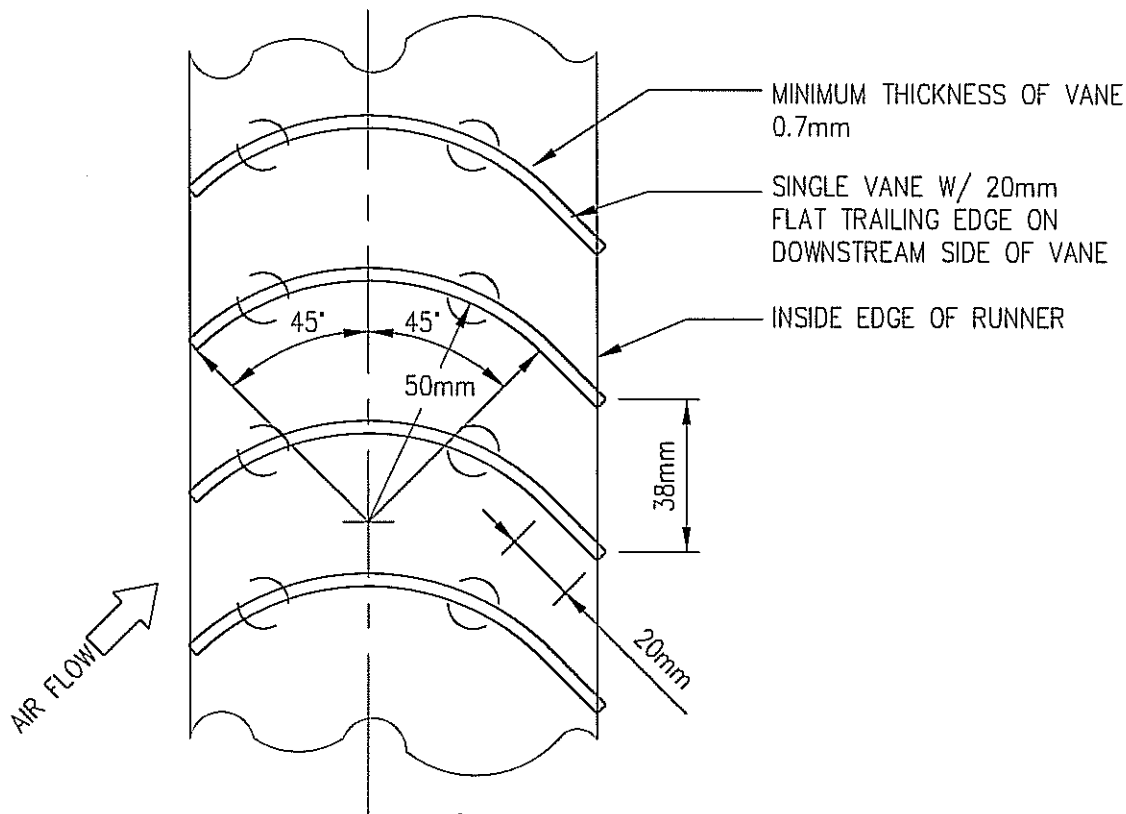
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SPECIFICATION
DETAIL

FLEX CONNECTION

Drawn By SMS	Approved By SMS	Reference 8000
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-22



TURNING VANE CONSTRUCTION

NTS

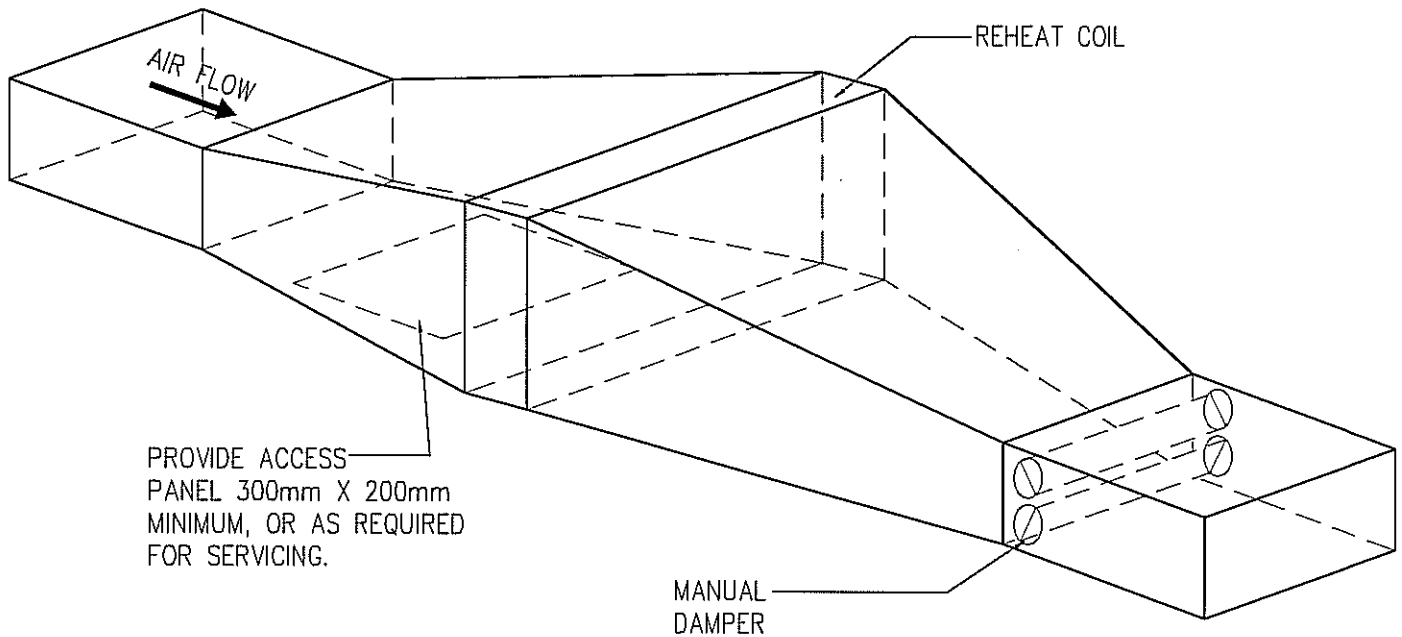
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SPECIFICATION
 DETAIL

TURNING VANE CONSTRUCTION

Drawn By SMS	Approved By SMS	Reference 8006
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-23



REHEAT COIL ACCESS DOOR

N.T.S.

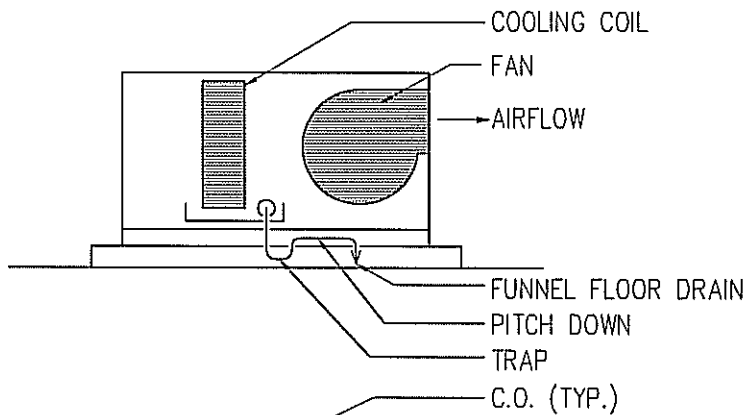
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SPECIFICATION
 DETAIL

ACCESS DOOR DETAIL

Drawn By SMS	Approved By SMS	Reference 8070
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-24

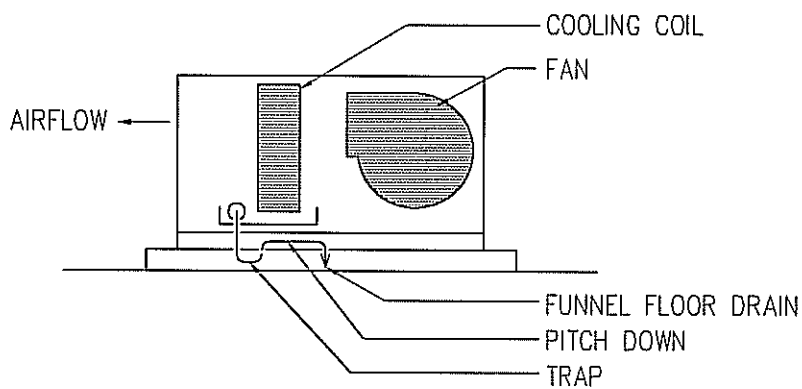
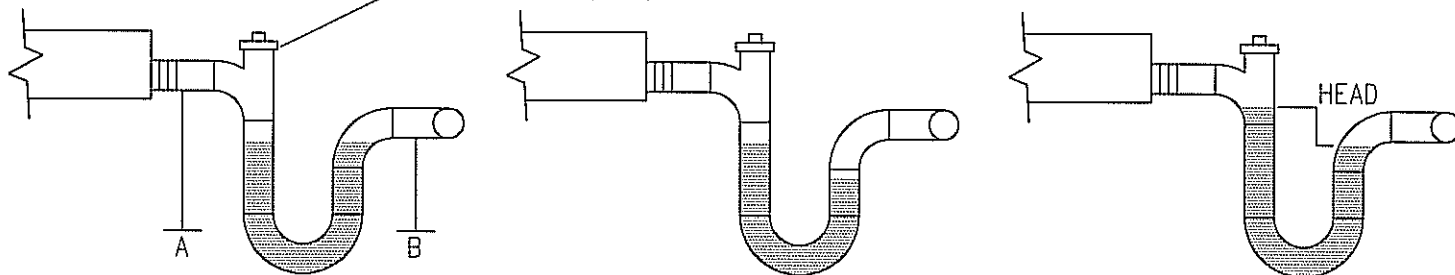


DRAW THRU UNIT

MINIMUM DIMENSIONS

- (A) EQUAL TO 1½ TIMES OPERATING SUCTION PLUS 2.0"
- (B) EQUAL TO ½ OF OPERATING SUCTION PLUS 1.0"

USE 1½" DWV PIPE & FITTINGS

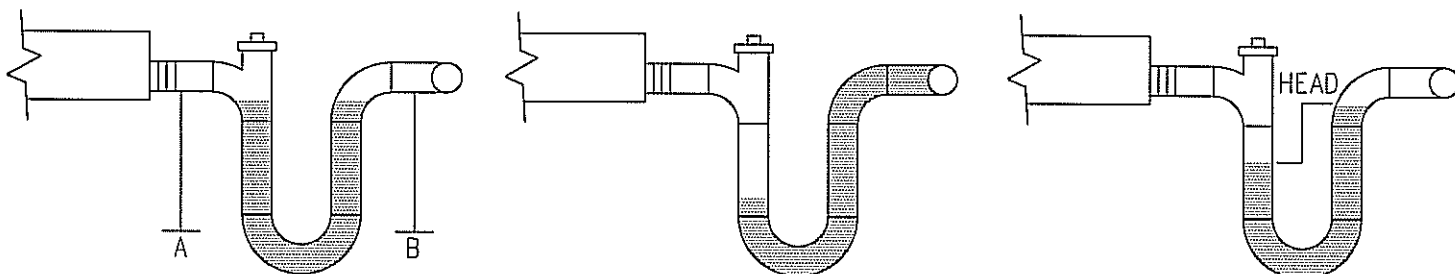


BLOW THRU UNIT

MINIMUM DIMENSIONS

- (A) EQUAL TO 1½ TIMES OPERATING PRESSURE PLUS 1.0"
- (B) EQUAL TO ½ OF OPERATING PRESSURE PLUS 2.0"

USE 1½" DWV PIPE & FITTINGS



NOTE:
THE TRAP IS CONSTRUCTED TO HOLD A HEAD OF WATER, THE WEIGHT OF WHICH EQUALS THE PRESSURE DIFFERENCE THAT EXISTS BETWEEN THE COIL ON ONE SIDE AND THE ATMOSPHERE ON THE OTHER. WHEN THE FAN IS STARTED, THE PRESSURE WITHIN THE UNIT IS DRAWN DOWN, CAUSING THE WATER WITHIN THE TRAP TO RISE IN THE VERTICAL PIPING. THIS PRODUCES A WATER COLUMN OF SUFFICIENT HEIGHT TO BALANCE THE PRESSURE DIFFERENCE. ONCE THE WATER COLUMN IS ESTABLISHED, ADDITIONAL CONDENSATE SIMPLY FILLS AND OVERFLOWS THE TRAP ON ITS WAY TO THE DRAIN.

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SPECIFICATION
DETAIL

DEEP SEAL TRAP SCHEDULE

Drawn By SMS	Approved By SMS	Reference 8090
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-25

ON KITCHEN HOOD EXH. INSTALLATION
 PROVIDE 2" (50) EXTERNAL VAPOUR
 SEAL INSULATION C/W CANVAS
 & ASPHALT FINISH ABOVE ROOF

PROVIDE BACK-DRAFT DAMPER
 ON EXHAUST OR RELIEF WHEN
 NO MOTORIZED DAMPER IS
 PROVIDED

1" (25) ACOUSTIC
 LINING

ACCESS DOOR

ANGLE ON 4 SIDES
 FASTENED TO CURB

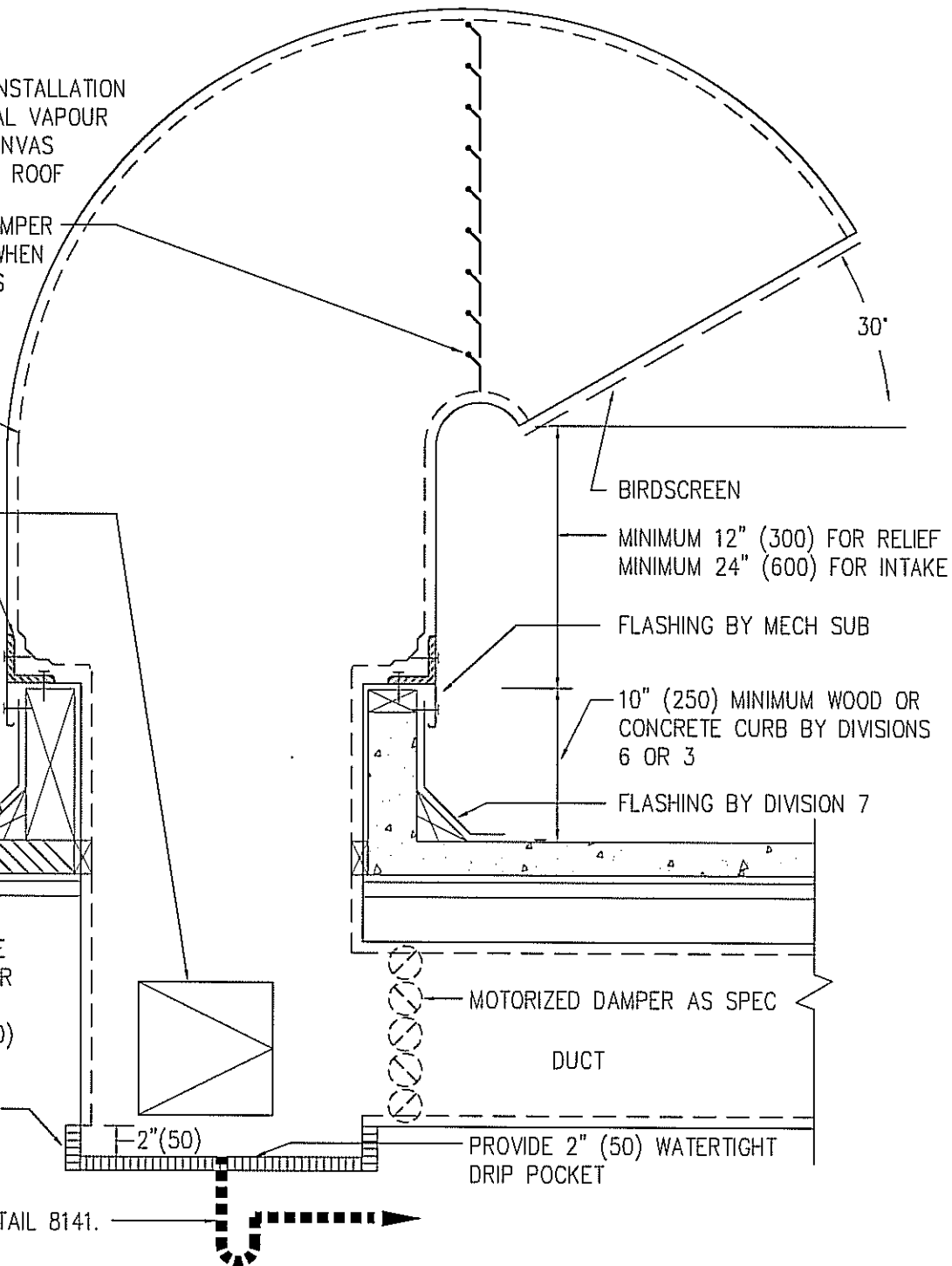
CANT STRIP BY
 DIVISION 6

ROOF

ON KITCHEN EXH. PROVIDE
 2" (50) EXTERNAL VAPOUR
 SEAL INSULATION FOR
 DISTANCE OF 6"-0" (1800)
 BACK FROM ROOF LINE

2" (50) RIGID INSULATION
 C/W VAPOUR BARRIER

1/4" DRAIN, REFER TO DETAIL 8141.



BIRDSCREEN

MINIMUM 12" (300) FOR RELIEF
 MINIMUM 24" (600) FOR INTAKE

FLASHING BY MECH SUB

10" (250) MINIMUM WOOD OR
 CONCRETE CURB BY DIVISIONS
 6 OR 3

FLASHING BY DIVISION 7

MOTORIZED DAMPER AS SPEC

DUCT

PROVIDE 2" (50) WATERTIGHT
 DRIP POCKET

NOTES

- GOOSENECKS CAN BE MOUNTED ON EITHER WOOD OR CONCRETE ROOF AS SHOWN ON DRAWING
- ON GOOSENECKS NOT DUCTED PROVIDE A 2"(50) DEEP WATERTIGHT DRIP PAN UNDER ROOF OPENING. THE PAN SHALL BE 4"(100) LARGER THAN ROOF OPENING & SHALL BE SUSPENDED A MINIMUM OF 1'-0"(300) BELOW OPENING

INTAKE OR OUTLET AIR GOOSENECK

N.T.S.

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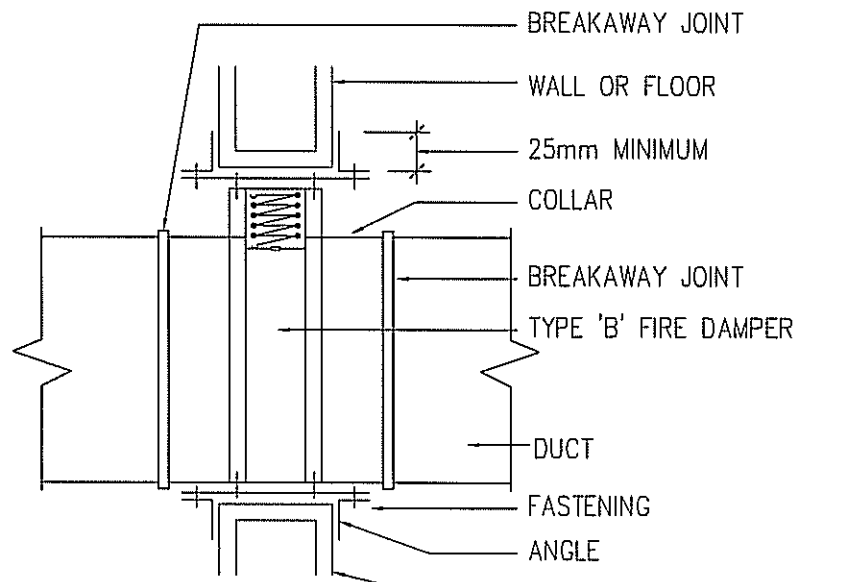
**SPECIFICATION
 DETAIL**

**INTAKE OR OUTLET
 GOOSENECK**

Drawn By SMS	Approved By SMS	Reference 8180
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-26

NOTES

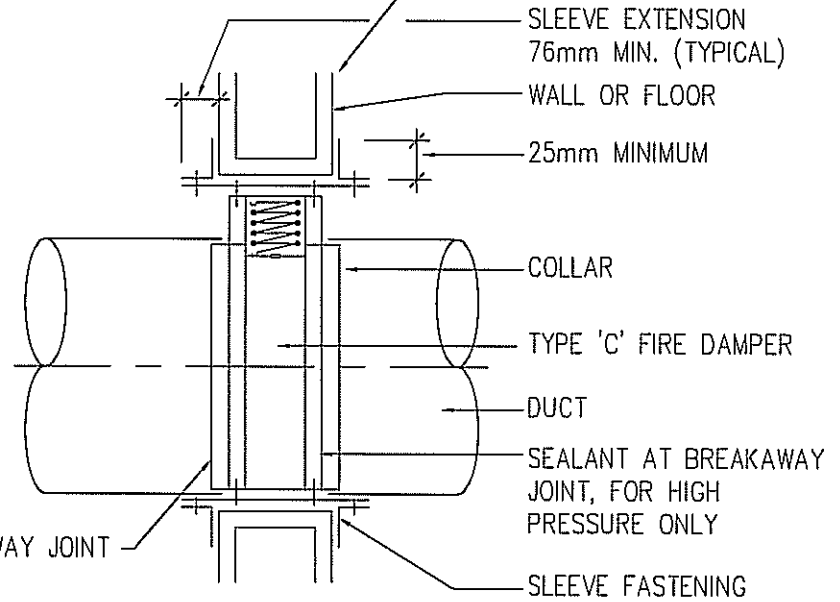
1. MINIMUM OPENING SIZE TO BE LARGER BY 3mm FOR EACH 305mm OF DAMPER WIDTH OR HEIGHT
2. MAXIMUM OPENING SIZE TO BE 13mm LARGER THAN EACH MIN. DIMENSION.
3. HORIZONTAL CLEARANCE TO BE EQUAL ON BOTH SIDES. VERTICAL CLEARANCE TO BE ALL AT TOP.
4. MOUNTING ANGLES TO BE 13X13X1.6mm (MINIMUM) ON DAMPER SIDE INCREASE ANGLES PROPORTIONATELY SO THAT THERE WILL BE A MINIMUM OF 25mm OVERLAP ON THE PARTITION
5. ATTACH ANGLES WITH 19mm #10 SHEET METAL SCREWS ON 305mm CENTERS OR 6mm #20 BOLTS AND NUTS ON 305mm CENTERS
6. DAMPER BLADES TO BE OUT OF AIR STREAM
7. NEITHER ANGLES OR DAMPER TO BE FASTENED TO WALL
8. BREAKAWAY JOINT TO BE PLAIN "S" SLIP OR AS APPROVED BY ENGINEER
9. SLEEVE THICKNESS MAY BE SAME AS DUCT
10. HORIZONTAL DAMPERS TO BE SPRING LOADED



RECTANGULAR DUCT INSTALLATION

N.T.S.

FOR DETAIL OF OPENING REFER TO ARCHITECTURAL DRAWINGS



ROUND DUCT INSTALLATION

N.T.S.

(REFER TO ENCLOSURE DETAIL FOR EXPOSED DUCTWORK)

HORIZONTAL AND/OR VERTICAL FIRE DAMPER INSTALLATION

NTS

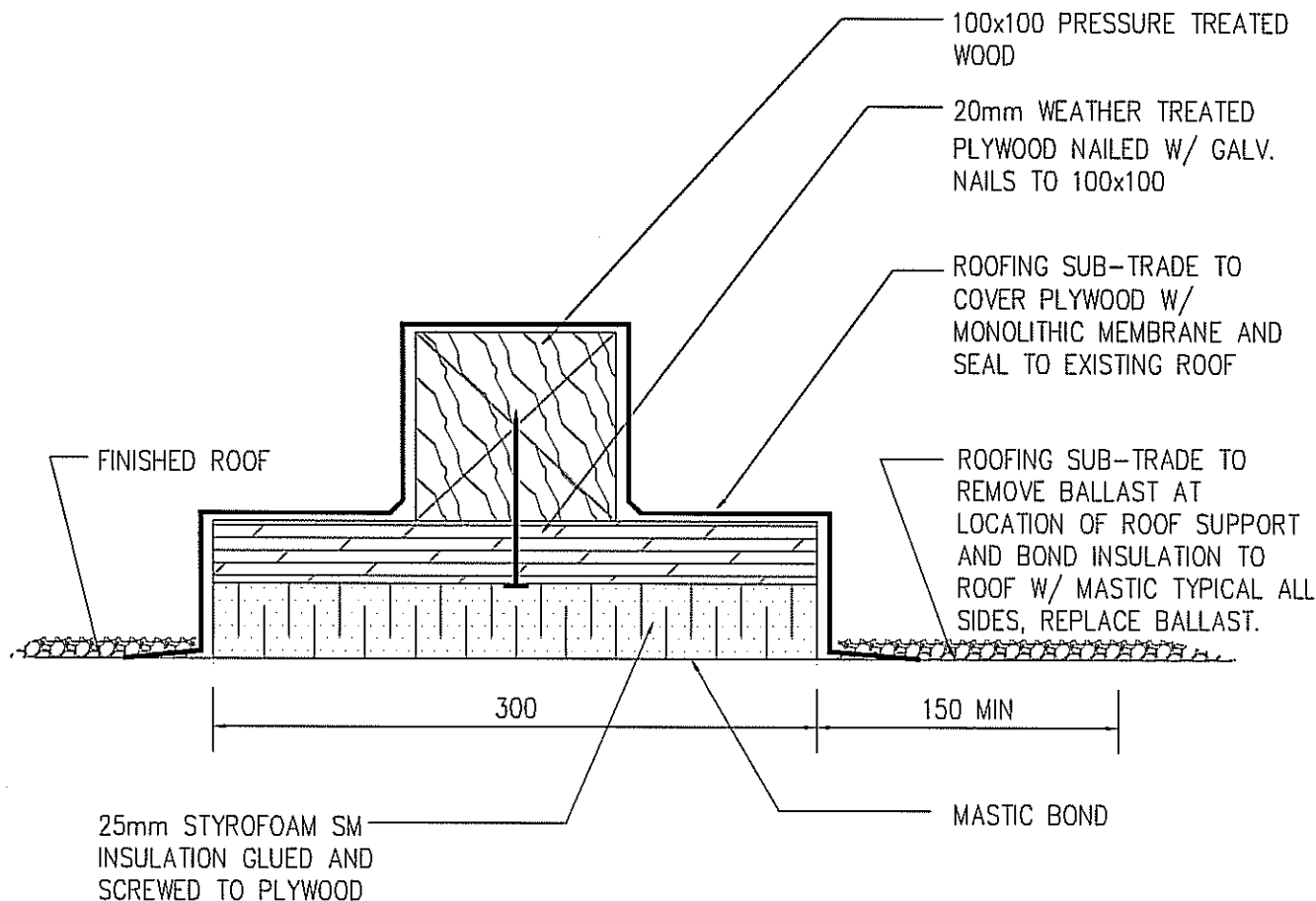
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**SPECIFICATION
 DETAIL**

FIRE DAMPER INSTALLATION

Drawn By SMS	Approved By SMS	Reference 8450
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-27



EQUIPMENT SUPPORT ON EXISTING ROOF

NTS

NOTE

1. LENGTH OF SUPPORT TO EXCEED WIDTH OF EQUIPMENT BY 600mm.
2. IF HIGHER SUPPORTS REQUIRED TO SUIT ROOF DRAINAGE ETC. ADD 150mm WIDE TREATED WOOD SPACERS BETWEEN 100x100mm BLOCK AND PLYWOOD.

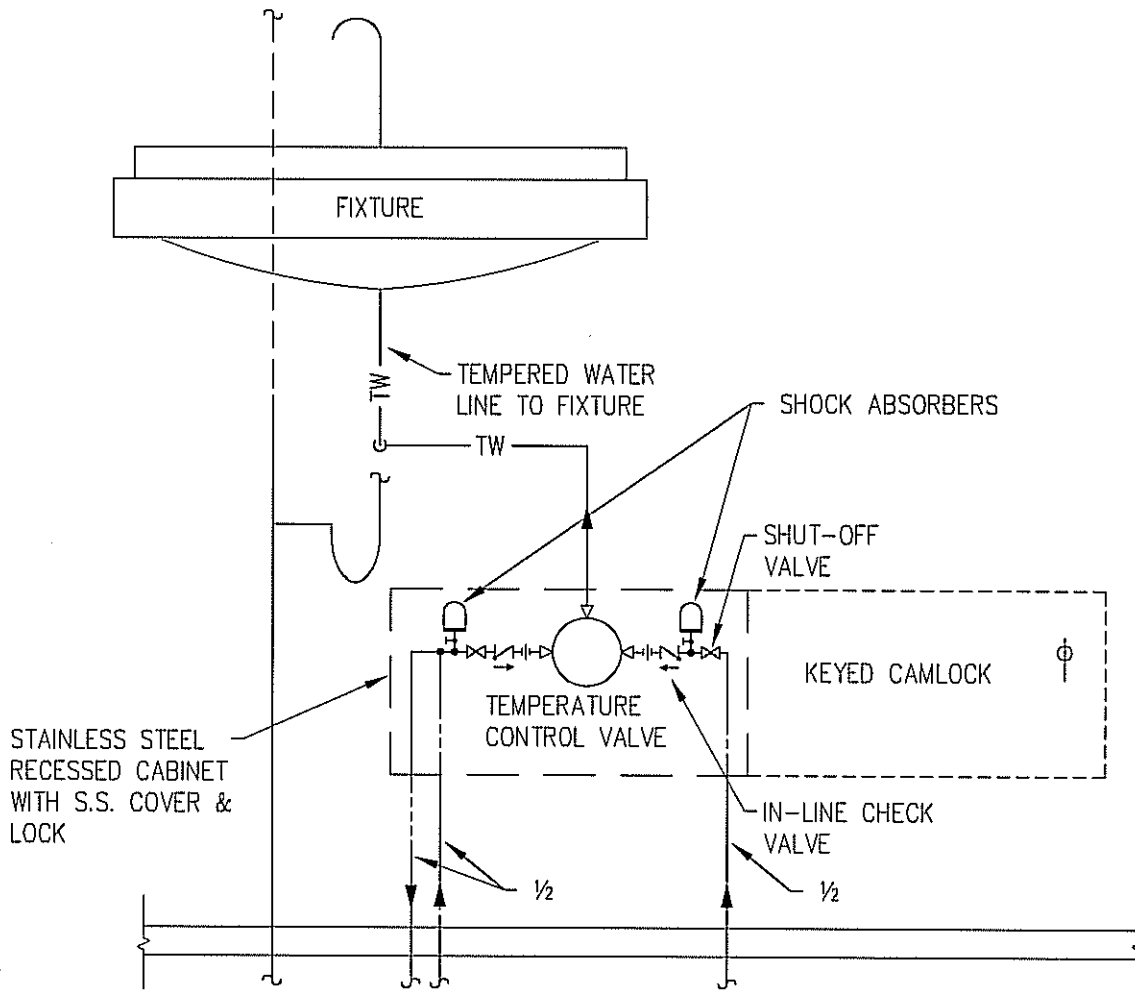
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SPECIFICATION DETAIL

EQUIPMENT SUPPORT ON EXISTING ROOF

Drawn By SMS	Approved By SMS	Reference 8615
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-28



TYPICAL SCHEMATIC PIPING DETAIL FOR MIXING VALVE AT HANDS FREE FIXTURES

NOT TO SCALE

NOTE:

- A. FOR SCRUB SINKS, WATER SERVICES SHALL BE 3/4" HOT & COLD AND 3/4" RECIRC.
- B. FAUCET TO BE BATTERY OPERATED.
- C. FOR LOCATION OF DOMESTIC WATER SUPPLY LINES REFER TO FLOOR PLANS.





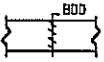
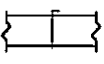
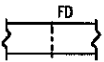
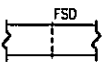
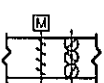
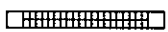

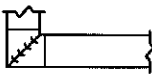
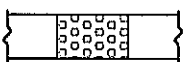
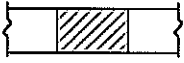













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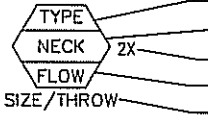






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SPECIFICATION
DETAIL

HANDS FREE FIXTURE
MIXING VALVE SCHEMATIC

Drawn By SMS	Approved By JTW	Reference 4311
File No. 05-015-01	Date DEC. 2005	Detail Sheet MD-29

	CHEMICAL FEED	
	COIL CONDENSATE	
	HEATING WATER RETURN	
	HEATING WATER SUPPLY	
	BACK DRAFT DAMPER	
	MANUAL BALANCING DAMPER	
	FIRE DAMPER	
	MOTORIZED FIRE/SMOKE DAMPER	
	MOTORIZED DAMPER	SINGLE LINE DUCT PLAN ELEVATION/SECTION
	WALL FIN	
	RADIANT CEILING PANEL	
	TURNING VANES	
	DUCT SILENCER	
	ACOUSTIC INSULATION	
	FLEXIBLE DUCT CONNECTION	
	SUPPLY/MAKE-UP/OUTSIDE/COMBUSTION AIR DUCT SHAFT	
	RETURN/EXHAUST/RELIEF AIR DUCT SHAFT	
	SUPPLY/MAKE-UP/OUTSIDE/COMBUSTION AIR DUCT	
	RETURN/EXHAUST/RELIEF AIR DUCT	
	FLEXIBLE DUCTWORK	
	DOOR UNDERCUT	
	THERMOSTAT	
	EXISTING, RELOCATED, THERMOSTAT	
	HUMIDISTAT	
	DDC TEMPERATURE SENSOR	
	DDC HUMIDITY SENSOR	
	EQUIPMENT DESIGNATION	

 <p>TYPE NECK FLOW SIZE/THROW</p>	<p>GRILLE/DIFFUSER TYPE NECK SIZE QUANTITY OR NUMBER OF FLOW RATE (CFM OR L/S) FACE SIZE OR THROW</p>	GRILLE OR DIFFUSER DESIGNATION
 <p>TYPE SIZE OUTPUT</p>	RADIATION UNIT DESIGNATION	
 <p>##</p>	TAGS/NOTES DESIGNATION FOR HVAC DRAWINGS	
	ACOUSTICAL LINED AIR TRANSFER DUCT	
	ELECTRIC REHEAT COIL	
	FILTER BANK	
	AIR DAMPER VALVE	

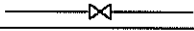
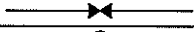
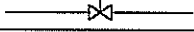

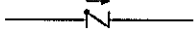

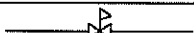
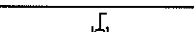
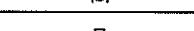
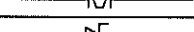
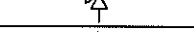
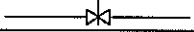

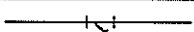
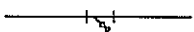


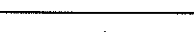
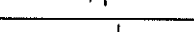
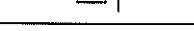


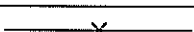
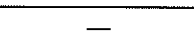

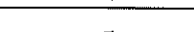

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SPECIFICATION DETAIL

STANDARD HVAC LEGEND

Drawn By SMS	Approved By SMS	Reference
File No. 05-015-01	Date FEB. 2006	Detail Sheet MD-30

	SHUT-OFF VALVE
	NORMALLY CLOSED SHUT-OFF VALVE
	CONTROL VALVE
	3-WAY VALVE
	CHECK VALVE
	MANUAL BALANCING VALVE
	PRESSURE REDUCING VALVE
	CIRCUIT BALANCING VALVE
	NATURAL GAS VALVE
	PRESSURE RELIEF VALVE
	VALVE C/W TAMPER SWITCH
	PRESSURE GAUGE WITH VALVE
	STRAINER
	STRAINER W/ BLOWDOWN VALVE
	UNION
	REDUCER
	HOSE BIBB
	THERMOMETER
	AIR PURGE
	FLEX CONNECTION
	PIPE ANCHOR
	PIPE GUIDE
	PIPE SLEEVE
	DIRECTION OF FLOW
	PUMP
	GAS METER
	WATER METER



















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SPECIFICATION DETAIL

STANDARD MECHANICAL LEGEND

Drawn By SMS	Approved By SMS	Reference
File No. 05-015-01	Date FEB. 2006	Detail Sheet MD-31

	EXISTING PIPING TO BE REMOVED
	EXISTING PIPING TO REMAIN
	FLOOR DRAIN
	ROOF DRAIN
	WET SYSTEM SPRINKLER PIPING
	PRE-ACTION SYSTEM SPRINKLER PIPING
	SEMI-RECESSED SPRINKLER HEAD
	UPRIGHT SPRINKLER HEAD
	NON FREEZE SPRINKLER HEAD
	SIDEWALL SPRINKLER HEAD
	CHECK VALVE
	TAMPER SWITCH
	FLOW SWITCH
	ALARM VALVE
	RELOCATED ABC TYPE FIRE EXTINGUISHER
	NEW ABC TYPE FIRE EXTINGUISHER
	NEW CO2 TYPE FIRE EXTINGUISHER
	EXISTING ABC TYPE FIRE EXTINGUISHER TO REMAIN

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SPECIFICATION
DETAIL

STANDARD PLUMBING AND FIRE
PROTECTION LEGEND

Drawn By SMS	Approved By SMS	Reference
File No. 05-015-01	Date FEB. 2006	Detail Sheet MD-32