

**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.

**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 15800 Air Distribution
  - .4 Section 15900 Controls/Instrumentation
- .2 All Mechanical Work to be bid as a single complete sub-contract even though work of various mechanical trades has been further sub-divided into each Section noted above.

**1.3 EXISTING CONDITIONS**

- .1 Examine local conditions affecting work under this contract. No allowance will be made later for necessary changes, unless notification of interferences have been brought to The Contract Administrator's attention, in writing, prior to closing of Bid Opportunity.

**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. Pay all charges for service connections to municipal mains.
- .3 Furnish certificates confirming work installed conforms to requirements of authorities having jurisdiction.

**1.5 LIABILITY**

- .1 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.
- .2 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.

- .3 Co-ordinate work with other sections to avoid conflict and to ensure proper installation of all equipment. Review all contract drawings.
- .4 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, all items which fail or prove defective within a period of one year after final acceptance of complete contract by the City, always provided such failure is not due to improper usage by the City. 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, shall be construed as acceptance of defective work or acceptance of improper materials. Make good at once, without cost to the The City 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.

#### **1.7 ENGINEERING OBSERVATIONS**

- .1 Contractor's work will be observed periodically by The City, and/or The 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, and/or The 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 The Contract Administrator. At temperature 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 The Contract Administrator. Signature of stamp shall 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 Others 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 sub-trades are aware of these dimensions and shall comply to them.
- .6 Review by the 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 the 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 SUB-TRADES**

- .1 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. Sub-trades 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, all necessary changes or additions to runs to accommodate structural conditions. Locations of pipes, ducts and other equipment to be altered without charge to The City, provided change is made before installation and does not necessitate additional materials and that all such changes are ratified by The 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 the Contract Administrator.

- .3 As work progresses and before installing piping, ductwork, fixtures and equipment interfering with interior treatment and use of building, consult The 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 The 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.

### **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 price 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 sub-trades 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.
  - .3 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'S EXISTING EQUIPMENT**

- .1 All mechanical equipment conflicting with new equipment being installed to be removed or disconnected by Contractor shall remain property of The City. Remove ducts and piping not required in revised systems and interfering with new installation which shall become property of Contractor.
- .2 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.

### **1.14 SUPPORTS, BASES, PITS**

- .1 Supply and erect all special structural work required for installation of tanks, pumps, fans, motors, duct plenums, 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.

### **1.15 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.

### **1.16 ACCESS DOORS**

- .1 Division 15 - Mechanical Subcontractor and his sub-trades to provide access doors where valves, dampers and/or any other mechanical equipment requiring access are built-in.
- .2 In general terms, mechanical sub-trade 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.

### **1.17 IDENTIFICATION OF EQUIPMENT**

- .1 Provide manufacturer's nameplate on each piece of equipment.
- .2 In addition Mechanical Contractor 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.

### **1.18 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.

### **1.19 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 appropriate product for the specific application. Submit ULC firestopping system data sheet for review prior to proceeding.
  - .2 Acceptable firestop system manufacturers: 3M, AD Fire Protection Systems, Hilti, Johns Mansville, and STI Specseal.
  - .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 Follow manufacturer's published installation instructions precisely including field quality control after installation.
  - .3 Submit to The Contract Administrator, suitable document signed by manufacturer's local representative, stating:
    - .1 Div. 15 sub-contractor received sufficient installation instruction from manufacturer's representative.

### **1.20 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 On completion of inspections, supply to The Contract Administrator letters and/or certificates for their record, confirming that inspections have been completed.

### **1.21 RECORD DRAWINGS**

- .1 Provide one set of Contract prints to form Record Drawings, marked clearly with all changes and deviations from piping and ductwork, including all Contract Changes.

- .2 Use different colour ink for each service.
- .3 Update Record drawings on a regular basis to ensure they are accurate, and have available for reference and inspection at all times.
- .4 Provide Record Drawings on CAD. Confirm version with Contract Administrator.

## **1.22 INSTRUCTIONS TO THE CITY'S PERSONNEL**

- .1 In addition to start-up supervision and instruction of The City's personnel required of individual equipment manufacturers and systems as noted, Contractor's construction supervisor to instruct The City's personnel in operation and maintenance of all equipment and systems to satisfaction of The Contract Administrator.
  - .1 All instructions to The City's personnel shall be video taped by the Contractor.
  - .2 This video will remain property of the The City and will be used for the sole purpose of training and orientation of The City'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 with one copy of video taped session in DVD format
- .2 Provide The City 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.
- .3 Forward manuals to The Contract Administrator for review. Final payment will not be made until all required manuals have been received.
- .4 Review instructions with The City's representative to ensure The City's representative has a thorough understanding of equipment and its operation.
- .5 Contractor shall submit to The Contract Administrator, suitable document signed by The City's representative, stating:
  - .1 The City has received satisfactory instruction in operation and maintenance of all equipment and systems.
  - .2 Operation and maintenance manuals have been reviewed with The City.
  - .3 Specified spare parts, keys, removable handles and the like, have been turned over to The City.

## **1.23 PAINTING**

- .1 Finish painting of mechanical equipment, piping, ductwork and the like shall be performed by a competent painting sub-trade of Division 15 - Mechanical.
- .2 Following areas shall have equipment and materials painted:
  - .1 Emergency Generator Room

- .3 Thoroughly clean off rust and oil, all exposed iron and steel work of every description, including hangers, pipes, ducts, etc. paint with a coat of chrome oxide phenolic base primer and a coat of 100% Alkyd base enamel of approved colour. Paint exposed galv. metal surfaces in above areas with a coat of zinc dust galvanize primer and a coat of 100% Alkyd base enamel of approved colour.
- .4 Paint exposed covering in above room and areas with two coats of 100% Alkyd base enamel of approved colour.
- .5 All roof top and outdoor exposed mechanical equipment, ductwork, piping, etc. shall have base prime coat and two finish coats of top-quality, exterior rubber-based paint.
- .6 After piping, etc. has been painted, paint neatly stencilled letters, about 25mm (1") high, designating pipe service and arrows showing direction of flow. Wording to be as later directed by The Contract Administrator. Stencilling to occur at not more than fifty foot intervals. "Mystik" tape arrows and identification letters may be substituted, at discretion of The Contract Administrator. Stencil all pipes at access doors also.
- .7 All colours shall be approved by The Contract Administrator.

#### 1.24 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.

<b><u>PIPE MARKER</u></b>	<b><u>VALVE TAG</u></b>	<b><u>PRIMARY</u></b>	<b><u>SECONDARY</u></b>
<b><u>LEGEND</u></b>	<b><u>LEGEND</u></b>	<b><u>COLOUR</u></b>	<b><u>COLOUR</u></b>
Engine exhaust	E.E.	Yellow	Black
Natural gas	N.G.	Yellow	Orange

#### 1.25 CUTTING AND PATCHING

- .1 Div. 15 - Mechanical to perform all cutting only of existing surfaces as required as a result of the removal and/or relocation of existing equipment and piping and/or installation of new equipment and piping in the existing building to be included by the M.S. in the Bid Opportunity price.
  - .1 If, in the opinion of The Contract Administrator, cutting of holes has been improperly performed (i.e. too large for ducts or pipes) Division 15 - Mechanical to do all patching as per original specifications and all costs will be borne by him.



**1.26 SALVAGE**

- .1 All usable salvaged equipment and materials shall remain the property of the The City unless specifically noted otherwise. Such material shall be neatly stored on site for removal by the The City. Contractor shall remove all rejected salvage from the site and legally dispose of it.
- .2 Mechanical equipment, ductwork, and piping for mechanical systems not required in new layout to become property of Contractor. Remove material from site.
- .3 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.

**1.27 POWER FEED TRANSFER FOR MECHANICAL EQUIPMENT**

- .1 The Mechanical Contractor shall be on site to de-power and subsequently re-start the mechanical pieces of equipment which will be affected by the power transfer.
- .2 For detail on the power transfer refer to Division 16 specification.
- .3 Co-ordinate with Division 16.

**END OF SECTION**

**Part 1            General**

**1.1                GENERAL**

- .1        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 The Contract Administrator without qualification. Equipment proposed from other manufacturers listed as 'Approved Manufacturers' and alternates shall meet same standards.
- .2        Contractor to submit within forty-eight hours of notification from The 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.
- .3        Submit shop drawings for all items marked with asterisk(\*)).

**1.2                EQUIPMENT OR MATERIAL & APPROVED MANUFACTURERS**

- .1        INSULATION
  - .1        External Duct Insulation            Manville; Fibreglas; Knauf
  - .2        Fire Retardant Canvas                Fattal; Radley
  - .3        Lagging Adhesive/Coating            Bakor; Childers; Fosters
- .2        AIR DISTRIBUTION
  - .1        Ducturns, damper hardware,  
fan connections\*                        Duro-Dyne
  - .2        Duct Sealer                              Duro-Dyne; 3M; Flexa-Duct; United; Bakelite
- .3        CONTROLS/INSTRUMENTATION
  - .1        Temperature control system\*        Honeywell; Johnson
  - .2        Damper Actuators                      Belimo

**END OF SECTION**

**Part 1            General**

**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 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.
- .5        U.L.C. label or satisfactory certified report from approved testing laboratory is required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified.
- .6        Flameproofing treatments subject to deterioration due to effects of high humidity are not acceptable.
- .7        The Contract Administrator reserves the right to demand test samples of components of insulation systems for fire hazard test rating.

## **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 INSULATION CLADDING**

- .1 Cover insulation with aluminum jacket CSA HA Series - M1980.
- .2 Embossed alloy jacketting 0.4mm thick with longitudinal slip joints and 50mm end laps with factory attached protective straps with mechanical fastener.
- .3 Jackets on fittings, 0.4mm thick, die shaped components of alloy with factory attached protective liner on interior surface.
- .4 Location
  - .1 All genset exhaust piping and silencer.

## **2.4 GENSET SILENCER INSULATION**

- .1 Genset silencer shall be covered with two - 50mm (2") thick layers of Thermo - 12 pre-formed pipe insulation.
- .2 Insulate fittings with mitred sections of same insulation.

## **2.5 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 50mm (2") Thickness
    - .1 All rectangular intake, exhaust and relief ducts, 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. This shall include the generator set discharge plenum and OA intake duct.

## **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 Use pipe covering protection saddles with roll type hangers unless otherwise indicated.
- .10 Butt joints
  - .1 Place joints on top of duct wherever practical. Butt joints on side of duct for flexible duct insulation.
  - .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.
- .11 Sagging of duct insulation will not be acceptable.
- .12 Stagger both longitudinal and horizontal joints, on duct insulation of multilayered construction.
- .13 Duct insulation with vapour barrier shall be continuous, except at fire dampers.
- .14 Protect insulation against elements during all stages of application.
- .15 Do not cover manufacturer's nameplates. Cut insulation on 45 deg. angle to nameplate edge and seal.
- .16 Covering to be uniform in diameter, smooth in finish. Place longitudinal seams so as to be invisible.

### **3.2 INSULATION CLADDING**

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

### **3.3 GENSET SILENCER INSULATION**

- .1 Insulation blocks to be applied with edges tightly butted and joints staggered. Fasten with 1.6mm (#16 ga.) galv. annealed steel wire for small areas and 2.5mm (#12 ga.) annealed steel wire, or, 12mm (1/2") x .38mm (.015") galv. steel bands on 300mm (12") maximum centres, for large areas. Where required, provide welded steel studs, clips or angle as anchors for wires and bands.
- .2 Over insulation, stretch 25mm (1") hexagonal mesh wire in place and secure by wiring to anchors with edges tied together. Finish with insulating cement, applied 12mm (1/2") thick in two (2) coats. First coat to be left rough and allowed to dry before applying second coat, which shall be mixed 4 to 1 by weight with Portland Cement and trowelled to smooth, hard finish.
- .3 Over insulating cement, install 0.4mm thick embossed aluminum jacket in strict accordance with manufacturer's published recommendations.
- .4 Insulation on silencer must be installed to allow for expansion. Temperature of diesel exhaust will be 593 deg. C. (1100 deg. F.). All adhesives used on this system shall be suitable for temperatures involved.
- .5 Where required, provide welded steel studs, clips or angle as anchors for wires and bands.
- .6 Over insulation, stretch 25mm (1") hexagonal mesh wire in place and secure by wiring to anchors with edges tied together. Finish with insulating cement, applied 12mm (1/2") thick in two (2) coats. First coat to be left rough and allowed to dry before applying second coat, which shall be mixed 4 to 1 by weight with Portland Cement and trowelled to smooth, hard finish.
- .7 Over insulating cement, 230 g. (8 oz) canvas adhered with Fintguard No. 120 white fire retardant lagging adhesive. Finish with brush coat of same adhesive.

### **3.4 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 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.

**END OF SECTION**

**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.

**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 15900 Controls/Instrumentation  
.4 Section 16010 Electrical General Provisions

**Part 2 Products**

**2.1 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.  
.2 Support vertical ducts with angle iron collars sized to provide proper bearing.  
.3 To Wooden Ceilings and Beams: Grinnell Fig. 153 Pipe Hanger Flange or Fig. 156 or equal.

**2.2 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<br>(25" to 30")  | 25mm (1") x 25mm (1") x 3.2mm (1/8") angle,<br>1.2mm (4'0") from joint. |
| .1 Gauge: .60mm (24 USSG)          |   |
| .3 785mm to 1000mm<br>(31" to 40") | 25mm (1") x 25mm (1") x 3.2mm (1/8") angle,<br>1.2mm (4'0") from joint. |
| .1 Gauge: .80mm (22 USSG)          |   |

<u>Max. Side</u>		<u>Bracing</u>
.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 3.2mm (1/8") diagonal angles or 37.5mm (1-1/2") x 37.5mm (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 Ductwork to be galvanized steel unless noted otherwise.

### **2.3 FLEXIBLE DUCTWORK CONNECTORS**

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

### **2.4 MOTORIZED DAMPERS**

- .1 Supplied by Section 15900 for installation by Section 15800, with exception of those supplied with factory assembled.

### **2.5 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.

### **2.6 LOUVRES AND WALL OPENINGS**

- .1 Provide 12mm (1/2") square mesh, 1.6mm (16 ga.) steel birdscreen galv. after weaving, on inside face of louvres and in all outside openings not having louvres.

## **Part 3 Execution**

### **3.1 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 The Contract Administrator's approval.
- .2 Concrete Inserts (where applicable)
- .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.

### **3.2 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 Single thickness partitions between ducts not accepted.
  - .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.
- .4 Provide openings for thermostats and controllers by Section 15900.
- .5 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 The Contract Administrator before installation.
- .6 If ductwork is not adequately braced and/or supported to provide good installation, additional bracing and/or supports to be provided at no extra cost to The City. The Contract Administrator to interpret.
- .7 Assemble round duct sections using beaded couplings attached with sheet metal screws.

### **3.3 FLEXIBLE DUCTWORK CONNECTORS**

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

### **3.4 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.

### **3.5 LOUVRES AND WALL OPENINGS**

- .1 Flash and make all openings around the louvres and wall openings weathertight. Slope ductwork down to louver. Drill drain holes in bottom blade of louver. Seal ductwork with Duro-Dyne S-2 until watertight.

### **3.6 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.

**END OF SECTION**

**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.

**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.

**1.3 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Section 15010 Mechanical General Provisions
- .2 Section 15800 Air Distribution
- .3 Section 16010 Electrical

**1.4 WORK BY OTHER SECTIONS**

- .1 Section 15800 to distribute and mount all motorized dampers, etc. in their respective locations, as supervised by Section 15900.
- .2 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.

**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 sub-trade acceptable to The Contract Administrator to supply and 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 As a minimum, provide separate, dedicated conduit system for each of following.  
Conduit to be minimum 19mm EMT.
  - .1 All wiring connected to an electronic control system including sensor and control wiring associated with DDC panels.
  - .2 Sensor and control wiring for stand-alone electric control systems.
- .9 If approved by system manufacturer, cable up to 30 Volts may be installed in extra-low voltage communication cable tray.
- .10 Refer to Section 16150 for conduit and cable identification requirements.

## **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, convactor 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 The Contract Administrator and The City. Include copy of approved lamacoid list in each Maintenance/Operating Manual.

### **2.2 ULTRA-TIGHT CONTROL DAMPERS - EMERGENCY GENERATOR**

- .1 Blade Dampers
  - .1 Extruded aluminum (6063T5) damper frame shall not be less than 2.03mm thickness. Damper frame to be 101.6mm deep and shall be insulated with polystyrene on three sides if "Installed in Duct" type and on four sides if "Flanged to Duct" type.
  - .2 Blades to be extruded aluminum (6063T5), internally insulated with non-CFC, expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.

- .3 Blade gaskets shall be of extruded EPDM. Frame seals shall be of extruded TPE. Gaskets to be secured in an integral slot within aluminum extrusions.
- .4 Bearings to be comprised of a celcon inner bearing fixed to an 11.11mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in frame.
- .5 Linkage hardware shall be installed in frame side and be constructed of aluminum and corrosion resistant, zinc and nickel plated steel, complete with cup-point trunion screws for slip-proof grips.
- .6 Dampers to be designed for operation in temperatures ranging between -40F (-40C) and 212F (100C).
- .7 Damper shall be available with either opposed blade action or parallel blade action.
- .8 Air leakage through a 48" x 48" (1220mm x 1220mm) damper shall not exceed 4.12 cfm/sq.ft. (21 l/s/m) against 4" (1 kPa) w.g. differential static pressure @ standard air. Standard air leakage data to be certified under the AMCA certified ratings program.
- .9 Pressure drop of a fully open 48" x 48" (1220mm x 1220mm) damper shall not exceed .03"(.007kPa) w.g. at 1000fpm(5.08 m/s).
- .10 Dampers shall be made to size required without blanking off free area.
- .11 Installation of dampers shall be in accordance with manufacturer's installation guidelines. Provide damper actuator arm extensions as required to allow actuator installation outside of airstream in warm space.
- .12 Acceptable product shall be TAMCO SERIES 9000 SC (Severe Cold) Thermally Insulated Damper.

### **2.3 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.

### **2.4 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 heavy duty plastic guard.

### **2.5 GENERATOR ROOM VENTILATION - SEQUENCE OF OPERATION**

- .1 Controls shall operate only when generator set runs.
- .2 On generator start-up O.A. damper shall open to preset (adjustable) minimum position to allow combustion air for the genset to come in.

- .3 Room thermostat shall modulate O.A., R.A. and exhaust air dampers to maintain space temp.
- .4 When generator shuts down, O.A., and exhaust air dampers shall close and R.A. dampers shall open.

## **2.6 SHOP DRAWINGS**

- .1 Include following with submission:
  - .1 Control drawings, indicating electrics, bill or materials, etc.
  - .2 Prior to commissioning, submit as-built information and drawings for each of above items, for use by The City during commissioning.

## **2.7 REDUNDANT SERVICES AND EQUIPMENT**

- .1 Remove existing controls, control air tubing, equipment etc. which are not necessary for revised systems. The City 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 During tender period visit jobsite 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'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.

- .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'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'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 The Contract Administrator's approval. Make all adjustments in collaboration with field the Contract Administrator responsible for balancing air and water system.
- .2 If within one year from date of completion as interpreted by The 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.
- .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 with three days prior notice before inspection is to take place so The City can arrange to have his representative present during full inspection. Following each inspection an itemized report shall be forwarded to The City. 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 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 that this work has been done.

### **3.7 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.

**END OF SECTION**