

## **1. SECTION 21, 22, & 23 GENERAL PROVISIONS**

### **1.1 Intent**

- .1 Contractor to provide tender price as a single lump sum
- .2 Intent of project is to demolish existing glycol heating system and replace with electric heat pump/electric duct heater for office areas and electric heat pump/gas fired furnace for shop area. The office and shop area will each have their own air sourced heat pump.
- .3 Contractor to demolish existing heating and cooling coils of AH-5. Provide new electric heating coil and allow required sheet metal scope of work to replace existing cooling coil space in the air handling unit.
- .4 Install individual duct heaters for each room and provide a thermostat for each duct heater
- .5 Contractor to service/clean AH-5 as part of mechanical scope of work.
- .6 Rebalance AH-5 and diffusers to specified airflows.
- .7 Demolish and dispose of all equipment, piping and valving attached to the existing steam heater.
- .8 Demolish existing unit heaters serving workshop area and entrance heaters. Provide replacement unit as noted above in 1.1.1. Replace entrance heater as shown on drawings.
- .9 The contractor shall provide a complete, fully tested and fully operating mechanical system in accordance with all applicable codes. The Mechanical Contractor shall make provisions for all labour, material, and equipment necessary to complete the mechanical work.
- .10 Any clarification of scope, intent or specification information or otherwise required to complete the project shall be questioned during the tender process prior to the last addendum.
- .11 Contract documents are diagrammatic only. They are to establish scope, material and quality. They are not detailed installation drawings. Minor details usually not shown or specified and any incidental accessories required for proper installation of the system are to be included in the work.
- .12 Contractor is to ensure that all intended equipment will fit within given spaces. Make reference to the electrical, mechanical, architectural and structural drawings, when setting out work and before ordering equipment.
- .13 The Contractor shall visit the site prior to tender and verify existing conditions. New piping, ductwork and insulation standards shall at least match the existing installation or be higher if specified herein.

### **1.2 Code Compliance**

- .1 All work shall conform to current editions of National, Provincial and Municipal Codes, Standards and Acts; and will meet the requirements of Authorities having jurisdiction.

### **1.3 Liability**

- .1 Assume responsibility for layout of work; and for any damage caused to the Owner or others by improper execution of work.
- .2 Protect finished and unfinished work from damage.
- .3 Take responsibility for condition of materials and equipment supplied and protect until work is completed and accepted. Coordinate deliveries with the general contractor.

### **1.4 Certificates**

- .1 Give notices, obtain permits and approvals, and pay fees so work specified may be carried out. Furnish certificates if requested, as evidence that work conforms to laws and regulations of the authorities having jurisdiction.

### **1.5 Cutting and Patching**

- .1 All work shall be coordinated with other trades especially that related to cutting and patching of required openings; and locations and installation of sleeves, inserts, support, curbs, frames and access doors.
- .2 Obtain approval from structural and electrical engineers before drilling and coring of existing structure.

### **1.6 Compliance with Energy By-Law**

- .1 All equipment installed on this project shall comply with the performance requirements as noted by the latest edition of the BC Building Code.

### **1.7 Alternative Materials and Equipment**

- .1 Contract price shall be based on materials and equipment specified. Approval by Consultant of equipment submitted by the mechanical trade as equal to that specified does not relieve the mechanical trade of any responsibility.
- .2 Revisions required to adapt accepted equals and alternatives shall be included in the contract price. No increase in the contract price will be considered to accommodate the use of equipment other than that specified.
- .3 Certain items of equipment and items of work (such as balancing, water treatment) may not have an approved equal due to the need to have a consistent type or source of maintenance. Refer to specific clauses in this specification.

### **1.8 Tender Price Breakdown**

- .1 Submit a tender price breakdown within thirty (30) days of tender closing and before first progress claim, in a format agreed to with the Consultant.
- .2 As a minimum, include the following in the tender price breakdown:
  - .1 Site Services: Materials, labour
  - .2 Mechanical: Equipment, materials, labour

.3 Sheet Metal: Equipment, materials, labour

.4 Controls: Equipment, materials, labour

#### **1.9 Progress Claims**

- .1 Submit a Progress Summary and a Detailed Price Breakdown with each Progress Claim. The Summary and Breakdown shall include all Change Orders issued.
- .2 Progress claims shall not be processed past 95% of the overall Mechanical Contract until the final commissioning has been completed. This will allow for sufficient deficiency holdbacks for problems identified during commissioning.

#### **1.10 Shop Drawings**

- .1 Submit four (4) sets of shop drawings to Consultant for all equipment specified in the specification or drawings for review. Do not order equipment or materials until Consultant has reviewed shop drawings.

#### **1.11 Guarantee**

- .1 Provide the Owner with a written guarantee that the equipment installed and work performed shall remain in serviceable condition for a period of one (1) year from the date of final acceptance by the Owner. The warranty shall cover material as well as labour.

#### **1.12 Standard Of Materials And Workmanship**

- .1 Make and quality of materials used are subject to approval by the Consultant. Remove unacceptable materials and install suitable materials in their place.
- .2 Materials shall be new and of uniform pattern throughout, unless noted otherwise.
- .3 Employ only tradesmen properly licensed to perform the specific work. The Consultant may perform spot checks for trade tickets and accreditation.

#### **1.13 Demolition**

- .1 Contractor to include all costs for disposal of all materials to be demolished and removed as indicated in these documents including appropriate disposal of all glycol.

#### **1.14 Record Drawings**

- .1 Keep on site an extra set of white prints and specifications, recording changes and deviations daily. These drawings shall be made available on a weekly basis for review by the Consultant.
- .2 Upon completion of work, submit final record drawings to the Consultant. These must be submitted within two (2) weeks after acceptance of work. Failure to submit drawings will result in the work being done by the Owner and the cost deducted from the final payment.
- .3 The final record drawings shall be prepared by the contractor.

### **1.15 Substantial Completion Inspection**

- .1 Advise Consultant five (5) days prior to the date inspection is desired. All systems to be fully operational and any deficiencies should be noted to the Consultant.
- .2 All deficiencies shall be completed within two (2) weeks after substantial completion and letter submitted to Consultant within that time advising that the work is complete. Failure to complete work will result in work being done by the Owner and the costs deducted from final payment.
- .3 The following shall be an outline checklist of the minimum requirements to be met by the contractor prior to the Consultants' Substantial Performance by the contractor.

Inspection:

- .1 Complete Balancing Reports
- .2 Complete Commissioning Checklists
- .3 Final Gas Inspection Certificate from local gas inspector
- .4 Controls Commissioning, Checklist and 15 day trend logs for all major equipment (AHUs)
- .5 Fire stopping and Fire Damper test letter
- .6 Seismic Engineers inspection of all Seismic restraints and schedule C letters of assurance
- .7 Major equipment – suppliers start-up test sheets and letters certifying start up. (packaged equipment)
- .8 Final As-Built Drawings ready for review
- .9 Maintenance and operation manuals, ready for review

### **1.16 Examination of Work**

- .1 This project involves renovations to existing building, therefore, examine the site and local conditions to determine the difficulties in carrying out the work indicated and specified prior to submitting final price. Extras will not be considered based on the grounds of differences on site.

### **1.17 Coordination with Electrical Division**

- .1 Contractor to co-ordinate electrical design-build as part of overall project scope

### **1.18 Coordination of Services**

- .1 Coordinate with proper utilities for services such as water, sewer, natural gas, and assume all charges.
- .2 Coordinate with the owner to shutdown, disconnect, reroute, or make connection to existing services. Provide written 24 hour notice for all service shutdowns.

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**1.19 Performance Tests**

- .1 Operate each mechanical system after mechanical and electrical work has been completed, to demonstrate that each system fulfills the requirements of the contract and operates satisfactorily. These are performance tests and must be completed before work can be finally accepted. Coordinate with packaged equipment suppliers and the commissioning agent.

**1.20 Operation and Maintenance Manuals**

- .1 Provide four (4) copies of manuals prepared by qualified and experienced personnel for use by Owner. Manuals form part of the contract and must be delivered to the Consultant before work will be considered complete. Each manual shall provide the following:
  - .2 Layman's description of all mechanical systems including operating maintenance and lubrication instructions,
  - .3 Certification of all equipment where required by local codes and authorities,
  - .4 Shop drawings and maintenance bulletins,
  - .5 List address and telephone numbers of all equipment suppliers and contractors.
  - .6 Performance details for all equipment including curves for fans and pumps with actual operating points noted.
  - .7 Provide this maintenance manual in electronic format documents, scanned drawings, AutoCAD files, Microsoft PowerPoint, etc.

**1.21 Balancing**

- .1 The approved balancing agencies are: Western Mechanical; K.D. Engineering.
- .2 Balance terminal boxes, exhaust fans, and air outlets to air quantities indicated on the drawings and in this specification. Where outlet quantities are not indicated, divide box capacity equally among all outlets.
- .3 Submit two (2) copies of the report to Engineer within two (2) weeks after substantial completion. Failure to submit the report within the specified time will result in the work being done by the Owner and the costs deducted from final payment.
- .4 Balancing shall be performed to the following accuracies:

Air-Terminal Outlets	±10%
Air-Central Equipment	± 5%
Hydronic-Pumps and Central Equipment	± 5%
- .5 Provide a drop test of all fire dampers and a letter/certificate attesting to this work.

**1.22 Cooperate with the Balancing Agency as follows**

- .1 Make any corrections as required by Balancing Agency.

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- .2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings and specifications for their use.
- .3 Operate automatic control system and verify set points during balancing.
- .4 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to Owner.
- .5 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to Owner.

### 1.23 Painting and Identification

- .1 Identify piping with labels and flow arrows. Provide identification at **15 m** maximum intervals, before and after pipes passing through walls, at all sides of tees, behind access doors. Use Brady B-500 vinyl cloth labels for non-insulated pipes and B-350 for insulated pipes.
- .2 Identify electric starting switches, thermostats controlling motors and equipment supplied under this division with lamacoid plates having **6 mm** minimum letter size.

### 1.24 Fire-Stopping

- .1 Fire-stop all pipe and duct penetrations through floors and walls, designated as fire and/or smoke separations.
- .2 Fire-stopping materials to meet ULC CAN 2S115. Acceptable Materials: by "Tremco" or "National Firestopping".
- .3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per manufacturer's instructions.

### 1.25 Flashing and Roof Curbs

- .1 Provide curbs, flash and counter flash where mechanical equipment passes through weather or waterproofed walls, floors and roofs.

### 1.26 Seismic Control

- .1 Provide seismic restraint on all piping, ductwork and equipment to satisfy all codes and authorities having jurisdiction.
- .2 Submit shop drawings of all seismic restraint details prepared and sealed by a professional engineer. Prior to substantial completion, this professional engineer for seismic design shall visit the site to verify seismic restraint installation and provide a letter of conformance in accordance with the applicable Building Code.
- .3 Piping ductwork and equipment shall be restrained in accordance with the latest edition of the Seismic Restraints Manual for Mechanical Systems produced by SMACNA, and the latest edition of the ASHRAE Application Handbook Chapter 49, Seismic Restraints.
- .4 Where equipment is mounted on spring or R.I.S. mounts for vibration isolation it shall be the responsibility of the manufacturer of the mount to incorporate seismic restraint. These restraints shall be multi-directional as described in the guidelines specified above. Provide

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steel frame bases where necessary to achieve this and also avoid overturning. The manufacturer shall supply certificates, signed by a Professional Engineer registered within the jurisdiction, verifying the design of the seismic restraints in accordance with this section.

- .5 Where equipment is located without vibration isolation fittings all such equipment shall be rigidly fixed with holding down bolts of sufficient strength to restrain seismic action. Holding down bolts shall be packed within slots to prevent movement prior to restraint commencing. Bolts shall be of sufficient strength to withstand overturning of the equipment during seismic disturbance.

**1.27 Metric Conversion**

- .1 All units in this division are expressed in SI units. Soft metric conversions are used throughout.
- .2 Equivalent Nominal Diameters of Pipes - Metric and Imperial.
- .3 Where pipes are specified with metric dimensions and only Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.
- .4 When CSA approved SI Metric pipes are available and are provided, the contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings and equipment.

EQUIVALENT NOMINAL DIAMETERS OF PIPE

mm	Inches	mm	Inches	mm	Inches
3	1/8	65	2½	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
12	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8		
30	1¼	250	10		
40	1½	300	12		
50	2				

- .5 The metric duct sizes are expressed as 25 mm = 1 inch.

**2. DUCTWORK AND ACCESSORIES**

**2.1 General**

- .1 Fabricate ductwork in accordance with SMACNA Duct Manual and ASHRAE Handbooks. Ductwork shall meet the requirements of NFPA 90A and 90B and conform to applicable codes.

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- .2 Prior to fabrication of ductwork, check all ceiling spaces and heights and conflicts with other trades.
- .3 Duct sizes indicated are inside clear dimensions. For acoustically lined or internally insulated ducts maintains size inside ducts.
- .4 Provide fire dampers where ducts cross fire separations. Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S112 "Fire Dampers". Fusible links shall be constructed to ULC Standard S505.
- .5 Provide balancing dampers where indicated on drawings and at points on low pressure supply, return and exhaust ducts where branches are taken from larger ducts.
- .6 Provide return air openings and/or insulated sound traps where indicated.
- .7 Provide acoustical seal around ducts and sound traps at penetration through sound baffles.
- .8 Modify ceiling system where required to accommodate grilles and diffusers.
- .9 Size round ducts, installed in place of rectangular ducts, from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by permission from Engineer.
- .10 Exposed round ductwork to be spiral lock seam type only.
- .11 Provide duct hangers and supports in accordance with SMACNA manuals.
- .12 Identify ductwork as per the base building standards. Confirm these prior to submitting tender.

### 2.2 Low Velocity Ductwork

- .1 Ductwork shall be galvanized steel. The minimum sheet metal thickness for ducts including fittings, access doors, and other accessories shall be as per SMACNA duct manual for Low Velocity Ductwork.
- .2 Low velocity insulated flexible ductwork shall be equal to Thermaflex Type M-KC.
- .3 Connect diffusers or troffer boots to low pressure ducts with **900 mm** maximum length of stretched flexible duct. Hold in place with caulking compound and strap or clamp. Do not use flexible duct to change directions.
- .4 Where low pressure ducts are connected to fan equipment, terminal boxes or any other apparatus, a screwed or bolted flexible gasketed joint shall be provided between the ductwork and the equipment, minimum **50mm** wide.

### 2.3 Medium and High Velocity Ductwork

- .1 Ductwork shall be galvanized steel. The minimum sheet metal thickness for medium and high pressure ducts including fittings, access doors and other accessories shall be as per SMACNA manual for Medium and High Velocity Ductwork.
- .2 Continuously welded round ducts shall have **100 mm** cemented slip joints, brazed or electric welded.



- .3 Where flexible air ducts are used to connect terminal units to metal ducts, the flexible air ducts shall be rated for **30.5 m/s** velocity and **3.98 kPa**. Maximum stretched length of flexible air duct shall be **300 mm**. Do not use flexible duct to change direction. Where flexible air ducts are attached to metal insulated duct, furnish flexible air ducts with fiberglass wool insulation and metalized jacket such as Thermaflex M-KC.

## **2.4 Duct Sealing**

- .1 All supply, return and exhaust duct joints, longitudinal as well as transverse, shall be sealed using,
- .1 Low Pressure Ductwork:
- .1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds **1.5 mm** use heavy mastic type sealant.
- .2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.
- .3 Other Joints: Heavy mastic type sealant.
- .2 Medium and High Pressure Ductwork: Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.
- .2 Duct tapes as sealing method are not permitted
- .3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.
- .4 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application, by the Consultant.

## **3. PIPING**

### **3.1 Pipe Material**

- .1 Service: Natural Gas; Propane.  
Material: Steel Schedule 40, A53 Grade B.
- .2 Service: Refrigerant.  
Material: ACR Copper.
- .3 Service: Condensate; Pumped Condensate.  
Material: Steel Schedule 80, A120.
- .4 Service: Equipment drains and overflows.  
Material: Steel Schedule 40, Galvanized, A120.

### 3.2 Pipe Connections

- .1 Screwed joint steel piping up to and including **40 mm**. Weld piping **65 mm** and larger including branch connections. Screw **50 mm** piping for liquid systems, weld **50 mm** piping for air or gas systems. Use dielectric type couplings when joining dissimilar metal pipes.

### 3.3 Pipe Hangers and Supports

- .1 All piping shall be firmly supported and securely braced. Provide copper plated hangers and supports for copper piping and galvanized hangers and supports for galvanized piping.
- .2 Use of perforated straps is not permitted for pipe hangers.
- .3 Provide ring type hangers for piping up to **40 mm** and clevis type hangers for piping over **40 mm**.

### 3.4 Pipe Support Spacing

Pipe Size (mm)	Rod Diameter (mm)	Spacing (m)
12	9	1.8
20-40	9	2.4
50-65	9	3.0
75-100	16	3.6
150-300	22	4.3

### 3.5 Gas Distribution Piping

- .1 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs at condensation collection points. Where gas piping is run in concealed space provide ventilation grilles, as required.

## 4. INSULATION

### 4.1 Duct and Breeching Insulation

- .1 Exposed Rectangular Ducts: Rigid fibrous glass insulation, 'K' value at **24°C** maximum **0.035 w/m°C** with factory applied reinforced aluminum foil vapour barrier.
- .2 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, 'K' value **24°C** maximum **0.035 w/m°C** with factory applied reinforced aluminum foil vapour barrier.
- .3 Acoustic Lining: Fibrous insulation with 'K' value at **24°C** maximum **0.035 w/m°C** absolute roughness of exposed surface not to exceed **0.58 mm** coated to prevent fibre erosion at air velocities up to **254 m/s**, **24 kg/m<sup>3</sup>** minimum density for ductwork and **75 kg/m<sup>3</sup>** for plenums.
- .4 Breeching Insulation: Semi-rigid mineral fibre, insulation with glass mat, 'K' value **0.035 w/m°C** maximum at **24°C**. Service temperature **65°C to 450°C**.
- .5 Recovery Jackets: ULC labelled thermocanvas.
- .6 Ensure surface and insulation is clean and dry prior to and during installation.

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- .7 Ensure insulation is continuous through inside partitions.
- .8 Finish and seal insulation neatly at hangers, supports, access doors, fire dampers and other protrusions.
- .9 Recover all insulation except in ceiling spaces, crawl spaces, and mechanical shafts.
- .10 Insulation Installation Thickness Schedule

<b>Duct &amp; Equipment</b>	<b>Insulation Thickness</b> <i>mm</i>
Outside Air Intake, Combustion Air, and Relief Duct Exhaust Ducts within <b>3000mm</b> of Exterior Walls or Openings	<b>25</b>
Supply Ducts	<b>25</b>
Acoustic Lining (where indicated)	<b>25</b>
Breeching for Boilers, Domestic Hot Water Heaters, Gas Furnaces, Unit Heaters (atmospheric gas burners)	<b>25</b>
Breeching for Boilers, Domestic Water Heaters, Gas Furnaces, Unit Heaters (forced air burners)	<b>50</b>

**4.2 Piping Insulation**

<b>Piping to be Insulated</b>	<b>Pipe Size</b>	<b>Insulation Thickness</b> <i>(mm)</i>
Refrigeration Suction	All Sizes	<b>25</b>
Vents within <b>3 linear metres</b> and Roof Outlet	All Sizes	<b>25</b>
Condensate drains from indoor air conditioning and heat pump units	All sizes	<b>12</b>

**5. PLUMBING**

**5.1 Plumbing General**

- .1 Check invert elevations prior to sanitary and drainage connections.
- .2 Grade drainage lines 2% per foot, unless noted otherwise.

## **6. CONTROLS**

### **6.1 Examination of Existing Systems**

- .1 This project involves renovation to an existing control system. The contractor shall inspect the system prior to tender close and include in his bid all control components required to provide a fully operational system including replacement of existing defective components where noted in the project documents.

### **6.2 Thermostats**

- .1 Relocate and reconnect existing thermostats as shown the drawings.
- .2 Provide new thermostats where indicated of building standard type. Ensure operating characteristics are compatible with control components (ie direct/reverse acting).
- .3 All thermostats to be wall or column mounted at normal mounting height unless specifically noted otherwise.
- .4 All thermostats, existing and new, are to be calibrated prior to air balancing. Contact building owner if an existing thermostat needs replacing.
- .5 Contractor to review with owner's maintenance staff thermostat connections to equipment and control air lines.

### **6.3 Control Components**

- .1 Control valves and dampers shall be equal to base building standard type unless noted otherwise.

### **6.4 Sequence of operations**

- .1 AH-5 – Unit to provide heating and cooling for the office spaces. HPC-1 is the primary heating source and will supply air at 21°C when outdoor conditions permit. When outdoor conditions fall below the operating conditions of HP-1, EHC-1 to supplement HP-1 to condition air to 21°C. Zone duct heaters (DH-typical) to further temper air and meet wall mounted thermostat setpoints. When one DH zone goes into cooling, supply air to ramp down until DH zone is met. Zone thermostats to be tied into HPC-1 controller and have setting for lowest zone heating and blended zone temperatures. Zone duct heaters will temper the air to zones requiring heat during mixed heating/cooling system conditions. Zone duct heaters (DH-typical) to be completed with SCR controllers which will tie into building control system. AH-5 to be constant volume but can be programmed to setback temperatures as determined by users for unoccupied hours.
- .2 HPC-2/F-1 – Unit to provide heating and cooling for the shop space. HPC-2 to be primary heating source and will supply air at appropriate conditions to match the setpoints as described by the wall mounted thermostat. When HPC-2 cannot match the room setpoint F-1 gas section to engage and provide supplemental heating for shop space. When space switches to cooling mode F-1 gas section to shutoff and cooling is provided by HPC-2. F-1 to provide constant volume air to the space but be programmable to allow setback temperatures as determined by the use during unoccupied hours.
- .3 EH-1 – Unit to provide heat to storm lobby as dictated by existing thermostat located in lobby.

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**END OF SECTION**