INSTALLATION OF PIPEWORK

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 61 00 Common Product Requirements

.2 Section 01 74 00 Cleaning

.3 Section 22 11 16 – Domestic Water Piping

.4 Section 22 13 17 – Drainage Waste & Vent – CI, CU

.5 Section 22 13 18 – Drainage Waste & Vent - Plastic

.6 Section 23 05 29 – Pipe Hangers & Supports for HVAC Equipment & Piping

.7 Section 23 05 53.01 – Mechanical Identification

.8 Section 23 51 00 – Breeching, Chimneys & Stacks

.9 Section 23 54 16 – Fuel-Fired Furnaces

.10 Section 23 74 00 – Packaged Air Handling Units – Gas

.11 Section 23 82 39 – Unit Heaters

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

.3 National Fire Code of Canada (NFCC 2005)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers, and Coating: in accordance with manufacturer's recommendations for surface conditions.

.2 Fire Stopping: in accordance with ULC assembly standards consistent with the penetration application.

Part 3 EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer, National Fire Code of Canada and CSA B51.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain.

.4 Discharge to be visible.

.5 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install manual air vents to at high points in piping systems.

.2 Install isolating ball valve at each manual air vent valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 DIELECTRIC CONNECTIONS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating flanges or bronze valves no dielectric couplings permitted.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 .1 Install pipework to CSA B51.

.2 The non-natural gas pipe works related to this project are deemed to be minor and generally related to making any required service tie-ins and or minor relocations to accommodate HVAC equipment installations as such the Contractor shall fully investigate existing piping systems and generally match these existing systems with respect to pipe class and material specifications when performing any pipe Works.

.3 Screwed fittings jointed with Teflon tape.

.4 Protect openings against entry of foreign material.

.5 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.6 Assemble piping using fittings manufactured to ANSI standards.

.7 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.8 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.9 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.10 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.11 Install, except where indicated, to permit separate thermal insulation of each pipe.

.12 Group piping wherever possible.

.13 Ream pipes, remove scale and other foreign material before assembly.

.14 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.15 Provide for thermal expansion as indicated.

.16 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Install globe valves in bypass around control valves.
- .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
- .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .8 Install ball valves for glycol service.
- .9 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.17 Check Valves:

- .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe, painted.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

- .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
- .2 Other floors: terminate 25 mm above finished floor.
- .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.3 Provide space for firestopping.

.4 Maintain fire rating integrity.

.5 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.6 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with ULC assembly instructions for the application.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush systems with clean water and or by air blowing as applicable for a period of time and velocity to ensure all installation debris is removed from piping systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Contract Administrator or The City's representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Contract Administrator.

.2 Request written approval by Contract Administrator 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.14 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

COMMON MOTOR REQUIREMENTS – HVAC EQUIPMENT

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 45 00 Quality Control

.4 Section 01 74 11 Cleaning

.5 Section 01 78 00 Closeout Submittals

.6 Section 23 34 00 Fans General

.7 Section 23 74 00 Packaged Air Handling Units - Gas

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.

.2 Product Data:

.1 Supplier of packaged equipment that includes an electric motor shall as part of the equipment shop drawing submission submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings: submit drawings in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality Control: in accordance with Section 01 45 00 - Quality Control.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 GENERAL

.1 Motors: high efficiency, in accordance with Manitoba Hydro high efficiency standards and to ASHRAE 90.1.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified in respective equipment Sections.

.2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, totally-enclosed-fan-cooled-non-sparking (TEFC NS), ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, insulation values consistent with inverter-duty ratings, inverter duty rated where noted unless otherwise indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Contract Administrator for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates complete with jacking bolts to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS (for exposed motor drives)

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

.1 Expanded metal 316L stainless steel screen welded to stainless steel frame.
.2 Minimum 1.2 mm thick sheet metal tops and bottoms.
.3 38 mm dia holes on both shaft centres for insertion of tachometer.
.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place. Extended grease lines to be stainless steel; standard of acceptance Swagelok.

.4 Install belt guards to allow movement of motors for adjusting belt tension. -

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick stainless steel; 316L.
.2 Securely fasten in place.
.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, stainless steel, 19 mm mesh.
.2 Net free area of guard: not less than 80% of fan openings.
.3 Securely fasten in place.
.4 Removable for servicing.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions (applies to complete piece of equipment, i.e. not just motor).

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PIPE HANGERS & SUPPORTS FOR HVAC EQUIPMENT & PIPING

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 78 00 Closeout Submittals

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 45 00 Quality Control

.4 Section 01 74 11 Cleaning

.5 Section 03 33 00 Cast-in-Place Concrete

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1, Power Piping, B31.3 Process Piping, B31.9 Building Services Piping.

.2 ASTM International

.1 ASTM A 125, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A 193, Standard Specification for Alloy Steel and Stainless Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A 194, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP 69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.4 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.5 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Manufacturers' Instructions:

.7 Provide manufacturer's installation instructions.

.1 Contractor will make available 1 copy of systems supplier's installation instructions..

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP 58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports, fasteners and anchors: 316L stainless steel.

.2 Ensure stainless steel hangers in contact with copper piping are epoxy coated or rubber gasketted.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.2 Rod: 13 mm.

.3 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with retaining clip, tie rod, double nutted or lock nut and washers, to MSS-SP 58 and MSS-SP 69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP 69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and double nut.

.4 Upper attachment to concrete:

.1 Ceiling: stainless steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged stainless steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: stainless steel, 316L, wedge shaped body with knockout protector plate to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies: Unistrut or approved equal in accordance with B6.

.2 Stainless steel brackets: Unistrut or approved equal in accordance with B6.

.6 Hanger rods: threaded rod stainless steel material to MSS SP 58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.7 Pipe attachments: material to MSS SP 58:

.1 Attachments for steel piping: stainless steel; 316L.

.2 Use insulation shields for hot pipework.

.3 Oversize pipe hangers and supports.

.8 Adjustable clevis: material stainless steel to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: stainless steel yoke, rod and nuts with cast iron roll, to MSS SP 69.

.10 U-bolts: stainless steel to MSS SP 69 with 2 nuts at each end.

.1 Finishes for steel pipework: stainless steel.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.4 RISER CLAMPS

.1 Steel pipe: stainless carbon steel to MSS SP 58, type 42.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 193 Alloy Steel.

.4 Nuts: to ASTM A 194 Alloy Steel.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.6 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings for equipment supports not detailed on drawings.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

.2 Where anchor bolts are not provided by equipment supplier provide all neccessary anchor bolts, sleeves, etc. for equipment setting.

2.8 PLATFORMS AND CATWALKS

.1 In accordance with specifications on drawings.

2.9 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.10 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop drawings.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 2 minimum concrete inserts, one at each diagonal corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.7 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance. Secure position with double nut.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

VIBRATION CONTROL FOR HVAC EQUIPMENT

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components for their installation.

.2 It is expected that vibration isolation systems be provided by the manufacturer of the packaged HVAC equipment including all air handling units and supply and exhaust fans. Preference shall be made to achieve the necessary vibration control in air handling units through internal isolation of the rotating equipment.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 03 33 00 Cast-in-Place Concrete

.4 Section 01 74 11 Cleaning

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 National Building Code of Canada (NBC) - 1995

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Provide system shop drawings complete with performance and product data.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Contractor's COR Safety Program and requirements of authority-having-jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.

.2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.

.3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.

.4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for outdoor and high humidity installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.7 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail and jacking bolts.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 100 mm minimum.

2.8 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gussetted height-saving brackets welded to frame; and clear housekeeping pads by 100 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

MECHANICAL IDENTIFICATION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 22 11 16 Domestic Water Piping

.5 Section 22 13 17 – Drainage Waste & Vent – CI, CU

.6 Section 22 13 18 – Drainage Waste & Vent – Plastic

.7 Section 22 15 00 – General Service Compressed Air

.8 Section 23 05 05 – Installation of Pipework

.9 Section 23 11 23 – Facility Natural Gas Piping

.10 Section 23 31 13.01 – Metal Ducts to 750 Pa

.11 Section 23 54 16 – Fuel-Fired Furnaces

.12 Section 23 74 00 – Packaged Air Handling Units – Gas

.13 Section 23 82 39 – Unit Heaters

1.3 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.4 SUBMITTALS

.1 Product Data:

.2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.5 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Contractor's COR Safety Program and requirements of authority-having-jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Dispose of unused paint and coating material at official hazardous material collections site approved by Authorities having Jurisdiction.

.2 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size #	mm Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.3 Locations:

.4 Terminal cabinets, control panels: use size # 5.

.5 Equipment in Mechanical Rooms: use size # 9..

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour	Legend marking
City water	Green	CITY WATER (POTABLE)
Treated water	Dark Green	SECONDARY EFFLUENT WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
High temp HW Htg. supply	Yellow	HTHW HTG. SUPPLY++
High temp HW Htg. return	Yellow	HTHW HTG. RETURN++
Make-up water	Yellow	MAKE-UP WTR
Chilled drinking water	Green	CH. DRINK WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Storm water	Green	STORM
Sanitary	Green	SAN

MECHANICAL IDENTIFICATION

Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Distilled water	Green	DISTILL. WTR
Compressed air (<700kPa)	Green	COMP. AIR
Instrument air	Green	INSTRUMENT AIR

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

.1 Provide identification only after painting has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

TESTING ADJUSTING & BALANCING

Part 1 GENERAL

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC systems.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Contract Administrator within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

TESTING ADJUSTING & BALANCING

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.9 START OF TAB

.1 Notify Contract Administrator 7 days prior to start of TAB for each individual system.

.2 Start TAB when system is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.
.2 Air systems:
.3 Filters in place, clean.
.4 Duct systems clean.
.5 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.6 Correct fan rotation.
.7 Fire, smoke, volume control dampers installed and open.
.8 Coil fins combed, clean.
.9 Access doors, installed, closed.
.10 Outlets installed, volume control dampers open.

.8 Liquid systems:

.1 Flushed, filled, vented.
.2 Correct pump rotation.
.3 Strainers in place, baskets clean.
.4 Isolating and balancing valves installed, open.
.5 Calibrated balancing valves installed, at factory settings.
.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.15 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.
.2 System schematics.
.3 System schematics to also highlight the location and results of operational checks of existing and new fire dampers.

.3 Submit 6 copies of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Contract Administrator.

.2 Provide personnel and instrumentation to verify and rebalance up to 25% of reported results.

.3 Number and location of verified results as directed by Contract Administrator.

.4 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC.

.2 Do TAB of systems, equipment, components, controls specified in Division 23.

.3 Qualifications: personnel performing TAB current member in good standing of AABC.

.4 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration, location and operational check of existing and new fire dampers.

.6 Locations of equipment measurements: to include as appropriate:

.7 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.8 At controllers, controlled device.

.9 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Schematically represent the location, size and confirm operational status of any existing or new fire dampers located within the systems subject to TAB.

.2 Qualifications of TAB personnel: as for air systems specified this section.

.3 Quality assurance: as for air systems specified this section.

.4 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.

.5 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with systems in every possible combinations of normal operating modes.

Part 2 PRODUCTS

2.1 NOT USED

.1 Not used.

Part 3 EXECUTION

3.1 Not used.

END OF SECTION

DUCT INSULATION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 61 00 Common Product Requirements

.2 Section 01 74 11 Cleaning

.3 Section 23 05 29 Pipe Hangers & Supports for HVAC Equipment and Piping

.4 Section 23 31 13.01 – Metal Ducts to 750 Pa

.5 Section 23 33 00 – Air Duct Accessories

.6 Section 23 33 14 – Dampers – Balancing

.7 Section 23 33 15 – Dampers – Operating

.8 Section 23 33 14 – Fire & Smoke Dampers

.9 Section 23 51 00 – Breeching, Chimneys & Stacks

1.2 REFERENCES

.1 Definitions:

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

.3 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B 209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C 547, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C 553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C 612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Shop Drawings:

.1 Provide drawings in accordance with Section 01 33 00 Submittal Procedures.

.4 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations, and special handling criteria, installation sequence, cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C 553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C 553.

2.3 JACKETS

.1 Lagging adhesive: compatible with insulation.

.2 Stainless steel:

.1 Type: 316.

.2 Thickness: 0.25 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.3 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.4 Contact adhesive: quick-setting.

.5 Tie wire: 1.5 mm stainless steel.

.6 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.7 Fasteners: 2 mm diameter pins with 35 mm square clips, length to suit thickness of insulation.

Part 3 EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witnessed and certified.

.2 Ensure surfaces are clean, dry and free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)	Jacketed
Supply, return and exhaust ducts exposed in space being	none	N/A	N/A	N/A

served				
Supply, return and exhaust ducts in mechanical service rooms	C-1	yes	25	yes
Outside air ducts to mixing plenum or equip intake	C-1	yes	50	yes
Mixing plenums	C-1	yes	25	yes
Exhaust duct between dampers and outside air louvres	C-1	yes	25	yes
Exhaust duct within 4.0 m of building envelope penetration	C-1	yes	25	yes
Round intake air/ Exhaust air ducts Misc small (<300 mm)	C-2	yes	50	no

3.5 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

THERMAL INSULATION FOR PIPING

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for insulated piping and piping accessories affected by construction and new pipe sections as indicated on drawings.

.2 Thermal insulation for refrigerant piping.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

1.3 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B 209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C 533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C 547, Mineral Fiber Pipe Insulation.

.7 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.4 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIACs:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.5 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing work of this Section, and have at least 7 years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Place excess or unused insulation and insulation accessory materials in designated containers.

.2 Divert unused metal materials from landfill to metal recycling facility.

.3 Dispose of unused adhesive material at official hazardous material collections site.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.

.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.

.5 TIAC Code C-2: mineral fibre blanket faced with without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.

.6 TIAC Code A-6: flexible unicellular tubular elastomer. ..

.1 Jacket: to CGSB 51-GP-52Ma.

.2 Maximum "k" factor:.

.3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C 533.

.2 Maximum "k" factor: to.

.3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Special requirements:

.1 Indoor: none.

.2 Outdoor: UV rated material at least 0.5 mm thick.

.2 Stainless steel:

.1 Type: 304.

.2 Thickness: 0.25 mm.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Outdoor rated silicone caulking.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer's instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1 for insulated pipe encountered during construction requiring relocation and/or if existing insulation systems are affected.

.1 Securements: SS wire Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H

.4 Jacket: PVC

.3 TIAC Code: A-6 for refrigerant piping.

.1 Insulation securements: per manufacturer's recommendations.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Jacket for outdoor piping only; stainless steel.

.4 Thickness of insulation as listed in following table.

.1 For A-1 systems match existing.

.2 For A-6 systems, 25 mm.

.5 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof SS jacket.

.6 Finish attachments: SS screws orbands, at 150 mm on centre. Seals: closed.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

FACILITY NATURAL GAS PIPING

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 45 00 Quality Control

.3 Section 01 78 00 Closeout Submittals

.4 Section 23 05 01 - Installation of Pipework

.5 Section 23 05 53.01 – Mechanical Identification

.6 Section 23 54 16 – Fuel-Fired Furnaces

.7 Section 23 74 00 – Packaged Air Handling Units - Gas

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5, Pipe Flanges and Flanged Fittings.
.2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
.3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
.4 ASME B18.2.1, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A 47/A 47M, Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A 53/A 53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
.3 ASTM B 75M, Standard Specification for Seamless Copper Tube.
.4 ASTM B 837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.5 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB, Natural Gas and Propane Installation Code

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturers catalogue literature following: valves, regulators.

.3 Submit WHMIS MSDS in accordance with Section and Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports and CGA certification: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting three week prior to beginning work of this Section in accordance with D14.

.1 Verify project requirements and tie-in to existing system requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.5 Consult with authority having jurisdiction and obtain all required permits and co-ordinate inspections, pay fees.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A 53/A 53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.
.2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B 837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

.4 Brazing: to ASTM B 837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.
.2 Steel pipe flanges and flanged fittings: to ASME B16.5.
.3 Welding: butt-welding fittings.
.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A 47/A 47M.
.5 Bolts and nuts: to ASME B18.2.1.
.6 Nipples: schedule 40, to ASTM A 53/A 53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.
.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug or ball type.

2.5 REGULTORS

.1 Provincial code approved for service regulator duty, sized to suit application.

.2 CGA approved and complete with all required identification/verification stickers.

2.6 ROOF PIPING – SUPPORTS

.1 Approved product: C-Port or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Comply with requirements of local AUTHORITY HAVING JURISDICTION.

3.2 PIPING

.1 Install in accordance with Section 23 05 01 - Installation of Pipework, CAN/CSA B149.1, and AUTHORITY HAVING JURISDICTION, supplemented as specified.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

.3 Co-ordinate all tie-ins and service disruptions with Contract Administrator and The City. Make tie-ins at times to minimize disruption to The City's operations.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 REGULATORS

.1 Assume all existing equipment service regulators require replacement, install to code and adjust to suit equipment manufacturer's pressure requirements.

.2 Existing natural gas service distribution piping is a "5-psig" service.

.3 Field run regulator vents in accordance with code, terminate above roof complete with Contract Administrator approved roof penetration, curbing and flashing, (basis of acceptance Canadian Roofing Association (CRA) standard roof penetration details).

3.5 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.6 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

.3 Be responsible for purging and restoration of service to all equipment affected by service disruptions; confirm all existing equipment operations upon restoration of service.

3.7 CLEANING

.1 Cleaning: in accordance with CAN/CSA B149.1, supplemented as specified.

.2 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.3 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

REFRIGERANT PIPING

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for copper tubing and fittings for refrigerant systems.

.2 Pressure test and evacuation services testing of refrigerant piping systems including supply and installation of any necessary refrigerant charge.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 23 05 01 - Installation of Pipework.

.5 Section 23 54 16 – Fuel Fired Furnaces

.6 Section 23 07 15 – Thermal Insulation for Piping

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting three weeks prior to beginning work of this Section in accordance with Construction Progress Schedule - Critical Path Method specified in D14.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with applicable codes and regulations.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Divert unused metal materials from landfill to metal.

Part 2 PRODUCTS

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B 280, type ACR B.

.2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

.1 Service: design pressure 2758 kPa and temperature 121 degrees C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A 307, heavy series.

.4 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and un-insulated pipe or between sleeve and insulation.

2.4 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

2.5 REFRIGERANT

.1 Consistent with equipment specified and meeting manufacturer’s specific refrigerant specifications for the equipment supplied.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:

.1 Soft annealed copper tubing: bend without crimping or constriction Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively or as dictated by equipment manufacturer’s recommended instructions.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa absolute and hold for 4 h.

.2 Break vacuum with refrigerant to 14 kPa.

.3 Final to 5 Pa absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit test results to Contract Administrator.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report measurements to Contract Administrator.

3.7 CLEANING

.1 Perform cleaning operations as specified in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

METAL DUCTS TO 750 Pa

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of low-and medium pressure metallic ductwork, joints and accessories.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures
.2 Section 23 05 29 – Pipe Hangers and Supports for HVAC Piping & Equipment
.3 Section 23 07 13 – Duct Insulation
.4 Section 23 33 00 – Air Duct Accessories
.5 Section 23 33 14 – Dampers – Balancing
.6 Section 23 33 15 – Dampers – Operating
.7 Section 23 33 16 – Fire & Smoke Dampers
.8 Section 23 33 46 – Flexible Ducts
.9 Section 23 34 00 – Fans General
.10 Section 23 37 13 – Diffusers, Registers and Grilles
.11 Section 23 37 20 – Louvres, Intakes and Vents
.12 Section 23 44 00 – HVAC Air Filtration
.13 Section 23 51 00 – Breeching, Chimneys and Stacks
.14 Section 23 54 16 – Fuel-Fired Furnaces
.15 Section 23 74 00 – Packaged Air Handling Units - Gas

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A 480/A 480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
.2 ASTM A 635/A 635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
.3 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition and Addendum No. 1.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1st Edition.

.3 IAQ Guideline for Occupied Buildings Under Construction, 1st Edition.

.6 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

1.5 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards..

.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

1.7 SITE INVESTIGATIONS, TIE-IN ALLOWANCES

.1 The Contractor is advised that detailed site investigations are to be carried out prior to fabrication and construction of duct and duct components; verify the size, orientation, location and supports required for, duct to equipment transitions and new duct to existing duct connections.

.2 Drawings and equipment specifications are based on the best information available at time of Bid Opportunity and are subject to revision based on reviewed shop drawings received during the project submittals process.

.3 Contractors shall include all necessary allowances in their bid price for minor changes that adjust tie-in locations and duct sizes to meet equipment shop drawing requirements and as-found conditions.

.4 The following allowances shall be considered minor and incidental to the price bid. No claims for extra will be considered by the Contract Administrator for modifications required to accommodate these minor changes,

.1 Duct diameter or duct rectangular dimensions, ± 50 mm.

.2 Tie-in locations to existing ductwork, ± 3.0 m in all directions,

.3 Duct routing, deviation from duct centreline shown, ± 2.0 m in all directions,

.4 Fittings additional to that shown on drawings,

.5 Fittings required to achieve temporary, partial, operation of an air moving system in accordance with the stated phased construction implementation schedule.

Part 2 PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
750	A
500	B
125	C
125	Unsealed

.2 Seal classification:

.1 Class A: transverse joints, duct wall penetrations and connections made airtight with gaskets, and/or sealant and tape.

.2 Class B: transverse joints and connections made airtight with sealant and tape.

.3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows.

.1 Rectangular: Centreline radius: 1.5 times width of duct unless noted otherwise.

.2 Round: Smooth radius. Centreline radius: 1.5 times diameter unless. noted otherwise.

.3 Mitred elbows, rectangular:

.1 To 400 mm: with double thickness turning vanes.

.2 Over 400 mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45 degrees entry on branch.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 45 degrees maximum included angle.

.2 Converging: 45degrees maximum included angle.

.6 Offsets:

.1 As indicated.

.2 Obstruction deflectors: maintain full cross-sectional area.

.3 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL (Admin Bldg Only)

.1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.8 STAINLESS STEEL (All except Admin Bldg)

.1 Process Exhaust Air Streams for, Primary and Secondary Clarifiers, Headworks -All, ODS-All, Utilities – Tunnels: To ASTM A 480/A 480M, Type 316L.

.2 Process 100 % Make-up Air Outside Air Streams and Re-circulating Ventilation Systems: To ASTM A 480/A 480M, Type 304L.

.3 Finish: No. 3B – Cold rolled, bright finish.

.4 Thickness, fabrication and reinforcement: to SMACNA Industrial Duct Construction 15d, Rectangular Industrial Duct Construction Standard, Round Industrial Duct Construction Standard.

.5 Joints: to SMACNA for SMACNA Industrial Duct Construction 15d, Rectangular Industrial Duct Construction Standard, Round Industrial Duct Construction Standard.

2.9 FASTENERS

.1 Nuts: Stainless steel, 316L to ASTM A194.

.2 Bolts: Stainless steel, 316L to ASTM A193.

.*3* Sheet Metal Screws, self-tapping, *only permitted in low pressure duct in Administration Building.*

2.10 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: stainless steel angle, type to match duct material, with stainless steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured stainless steel drilled concrete inserts.

.2 For steel joist: manufactured stainless steel joist clamp.

.3 For steel beams: manufactured stainless steel beam clamps:

Part 3 EXECUTION

3.1 GENERAL

.1 Do work in accordance with, ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Insulate strap hangers 100 mm beyond insulated duct.

.4 Support risers in accordance with SMACNA.

.5 Install breakaway joints in ductwork on sides of fire separation.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.7 Provide surface buffing and cleaning as necessary to provide surface finish consistent with that specified.

.8 At welded connections or other areas where the corrosion resistance properties of stainless steel are affected provide surface buffing and/or chemical passivating that restores the corrosion resistance properties of stainless steel.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers and/or double nutted and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Form bottom of horizontal duct without longitudinal seams.

.3 Weld joints of bottom and side sheets.

.4 Seal other joints with duct sealer.

.5 Fit base of riser with a drain pan extending 100 mm from all sides of duct. Drain piping routed to nearest trench located at floor level.

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Do not install additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.

.6 Complete test before performance insulation or concealment Work.

END OF SECTION

AIR DUCT ACCESSORIES

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 45 00 Quality Control

.3 Section 01 78 00 Closeout Submittals

.4 Section 23 31 13.01 – Metal Duct to 750 Pa

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.2 Submit WHMIS MSDS in accordance with this Section. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting three weeks prior to beginning work of this Section in accordance with Construction Progress Schedules - Bar (GANTT) Chart specified in D14.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Divert unused metal materials from landfill to metal recycling facility.

Part 2 PRODUCTS

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: stainless steel metal frame 6 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.

.2 301 to 450 mm: four sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum two handle type oeprators.

.4 Doors over 1000 mm: piano hinge and two handle type operators operable from both sides.

.5 Hold open devices.

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 1200 x 600 mm for person size entry.

.2 450 x 450 mm for servicing entry.

.3 300 x 200 mm for viewing.

.4 As indicated.

.3 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.4 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.2 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Contract Administrator.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.5 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS BALANCING

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 23 31 13.01 – Metal Duct to 750 Pa

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.2 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

Part 2 PRODUCTS

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 MULTI-BLADED DAMPERS (PROCESS AREAS)

.1 Stainless steel, factory manufactured.

.2 Opposed blade: double skin air foil design, 1.6 mm thick 316 stainless steel to 1200 mm length, 2 mm thick to 1500 mm length.

.3 Axle: minimum 19 mm diameter stainless steel rod.

.4 Maximum blade height: 100 mm.

.5 Bearings: stainless steel sleeve pressed into cast housing bolted to the damper frame.

.6 Linkage: located in jamb out of airstream and constructed of minimum 3.5 mm stainless steel double clevis arms with 4.8 x 19 stainless steel tie bars pivoting on 9.5 mm diameter stainless steel pivot pins with lock type retainers.

.7 Seals: silicone blade seals shall be mechanically attached to blade. Jamb seals shall be flexible stainless steel located between blade edge and jamb for maximum sealing compression.

.8 Channel frame: minimum 200 mm deep x 50 mm flanged, 2.8 mm 316 stainless steel.

.9 Maximum leakage: 0.22% at 250 Pa.

.10 Acceptable Materials: Ruskin CD80AF3, Greenheck HCD230 for rectangular applications Ruskin CDR92, Greenheck HCDR for round applications as noted or approved equal in accordance with B6.

2.3 SINGLE BLADE BUTTERFLY DAMPERS (ADMIN BLDG)

.1 Galvanized steel, manufactured to SMACNA standards.

.2 Single blade: one sheet metal thickness higher than duct.

.3 Axle: minimum 6 mm diameter galvanized steel rod.

.4 Maximum blade height: 300 mm.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Make corrections and adjustments as directed by Contract Administrator.

3.3 FIELD QUALITY CONTROL

.1 Tests:

.2 Tests to cover period of not less than days and demonstrate that system is functioning as specified.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS OPERATING

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Operating dampers for mechanical forced air ventilation systems in process areas where dampers complete with actuators are not provided with packaged equipment.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 23 33 00 Air Duct Accessories

.5 Section 23 31 13.01 – Metal Duct to 750 Pa

1.3 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Performance data.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 MULTI-BLADE DAMPERS

.1 Stainless steel, factory manufactured to AMCA Std 99-2408 Class II pressure class.

.2 Parallel blade: double skin air foil design, 1.6 mm thick 316 stainless steel to 1200 mm length, 2 mm thick to 1500 mm length. Insulated blade on outdoor dampers.

.3 Axle: minimum 19 mm diameter stainless steel rod.

.4 Maximum blade height: 150 mm.

.5 Bearings: stainless steel outboard bearings with shaft seals pressed into cast housing bolted to the damper frame.

.6 Linkage: located in jamb out of airstream and constructed of minimum 3.5 mm stainless steel double clevis arms with 4.8 x 19 stainless steel tie bars pivoting on 9.5 mm diameter stainless steel pivot pins with lock type retainers.

.7 Seals: low temperature-low leakage, silicone blade seals shall be mechanically attached to blade. Jamb seals shall be flexible stainless steel located between blade edge and jamb for maximum sealing compression.

.8 Channel frame: minimum 200 mm deep x 50 mm flanged, 2.8 mm 316 stainless steel.

.9 Performance:

.1 Leakage: in closed position less than 2% of rated air-flow at 500 Pa differential across damper.

.2 Pressure drop: at full open position less than Pa differential across damper at m/s.

.10 Acceptable Products: Ruskin CD80AF3, Greenheck HCD230 for rectangular applications Ruskin CDR92, Greenheck HCDR for round applications as noted or approved equal in accordance with B6.

.11 Damper Actuator:

.1 Direct coupled, 2-postion, spring return for damper operation.

.2 Self centered shaft adaptor.

.3 Fully opened and fully closed integral end-limit switches.

.4 Spring return direction field selectable.

.5 Torque ratings 125% (minimum) of breaking torque to initiate opening/closing at maximum pressure differential.

.6 Voltage feedback signal; 2-10Vdc.

.7 Operating voltage actuator motor and limit switches, 115Vac.

.8 Outdoor located damper actuator with thermostatic electric heater.

.9 Acceptable Products: Honeywell MS Series, Belimo or approved equal in accordance with B6.

2.2 GRAVITY WEIGHTED RELIEF DAMPERS

.1 Stainless steel, factory manufactured to AMCA Std 99-2408 Class II pressure class.

.2 Parallel blade: double skin air foil design, 1.6 mm thick 316 stainless steel to 1200 mm length, 2 mm thick to 1500 mm length.

.3 Axle: minimum 19 mm diameter stainless steel rod.

.4 Maximum blade height: 150 mm.

.5 Bearings: stainless steel outboard bearings with shaft seals pressed into cast housing bolted to the damper frame.

.6 Linkage: located in jamb out of airstream and constructed of minimum 3.5 mm stainless steel double clevis arms with 4.8 x 19 stainless steel tie bars pivoting on 9.5 mm diameter stainless steel pivot pins with lock type retainers.

.7 Seals: low temperature-low leakage, silicone blade seals shall be mechanically attached to blade. Jamb seals shall be flexible stainless steel located between blade edge and jamb for maximum sealing compression.

.8 Channel frame: minimum 200 mm deep x 50 mm flanged, 2.8 mm 316 stainless steel.

.9 Performance:

.1 Automatic multi-blade damper with ball bearing centre pivoted and counter-weights set to open at 300 Pa static pressure, (adjustable).

.10 Acceptable Products: Greenheck HPR-120 for rectangular applications or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

FIRE & SMOKE DAMPERS

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Fire and smoke dampers, and fire stop flaps.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 23 33 00 Air Duct Accessories

.5 Section 23 31 13.01 – Metal Duct to 750 Pa

1.3 1.2 REFERENCES

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505, Fusible Links for Fire Protection Service.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 Fire dampers.

.2 Smoke dampers.

.3 Fire stop flaps.

.4 Operators.

.5 Fusible links.

.6 Design details of break-away joints.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section01 78 00 - Closeout Submittals.

1.5 QUALITYASSURANCE

.1 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide following:

.1 6 fusible links of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type C, listed and bear label of ULC, meet requirements of city fire authority, and ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Stainless steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Top hinged: offset, round or square; guillotine type; sized to maintain full duct cross section as indicated.

.4 Fusible link actuated to 74 ^{o}C, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm retaining angle stainless steel frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Equip fire dampers with stainless steel sleeve or frame installed disruption ductwork or impair damper operation.

.6 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.7 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.8 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PROJECT SCOPE

.1 The intent of this project is to only change the fire dampers that are directly affected by the construction; existing fire dampers located within existing ductwork that is not being altered by the construction do not require replacement.

3.3 INSTALLATION

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

FLEXIBLE DUCTS

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of flexible ductwork, joints and accessories.

.2 Note this technical specification only has application in the Administration Building.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 23 31 13.01 – Metal Duct to 750 Pa

.3 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.3 National Fire Protection Association (NFPA).

.1 NFPA 90A-02, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-02, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible,(Addendum No.1, November 1997).

.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.5 Underwriters' Laboratories Inc. (UL).

.1 UL 181-96, Standard for Factory-Made Air Ducts and Air Connectors.

.6 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS.

.1 Thermal properties.

.2 Friction loss.

.3 Acoustical loss.

.4 Leakage.

.5 Fire rating.

.3 Samples: submit samples with product data of different types of flexible duct being used in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

Part 2 PRODUCTS

2.1 GENERAL

.1 Factory fabricated to CAN/ULC-S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

.1 Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws of bolts at 150 mm intervals.

.2 Performance:

.1 Factory tested to 500 Pa without leakage.

.2 Maximum relative pressure drop coefficient: 3.

Part 3 EXECUTION

3.1 DUCT INSTALLATION

.1 Install in accordance with: NFPA 90A and SMACNA.

END OF SECTION

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 78 00 Closeout Submittals

.3 Section 01 61 00 Common Product Requirements

.4 Section 01 74 11 Cleaning

.5 Section 23 05 13 – Common Motor Requirements for HVAC Equipment

.6 Section 23 05 29 – Pipe Hangers and Supports for HVAC Piping & Equipment

.7 Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment

.8 Section 23 31 13.01 – Metal Duct to 750 Pa

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99, Standards Handbook.

.2 AMCA Standard 99-2408-69 Operating Limits for Centrifugal Fans.

.3 AMCA Standard 210 Laboratory Methods for Testing Fans for Aerodynamic Performance Rating.

.4 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.

.5 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99-2408-69 Class II minimum standards.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide:

.1 Fan performance curves showing point of operation, kW and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with variable speed controllers.

.5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE

.1 Extra Materials:

.2 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.1 Spare parts to include:

.1 Matched sets of belts.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 FANS GENERAL

.1 Pressure Class: AMCA 99-2408-69 Class II minimum regardless of operating pressure.

.2 Wheel Design Characteristics: backward inclined or airfoil.

.3 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers, as appropriate.

.3 Sizes; refer to fan schedules.

.4 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment. Outlet dampers and vanes as indicated.

.5 Scroll casing drains: as indicated.

.6 Bearing lubrication systems with stainless steel extension lubrication tubes.

.7 Vibration isolation: to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.

.8 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

.9 Refer to fan schedules for detailed acceptable product listings, performance and detailed materials of construction.

.10 Approved manufacturer’s: Twin City, Northern Blower or approved equal in accordance with B6.

2.2 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Welded stainless steel construction.

.2 Maximum operating speed of centrifugal fans not more than 40 50 % of first critical speed.

.3 Backward inclined or airfoil blades, as indicated.

.2 Bearings: heavy duty flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.

.3 Shaft seals on exhaust fans:

.1 Single labryinth seals.

.4 Housings:

.1 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.2 Provide latched airtight access doors with handles.

2.3 AXIAL FLOW FANS (TUBE-AXIAL OR VANE-AXIAL)

.1 Casings: welded stainless steel with welded motor support.

.2 Blade material: 316 stainless steel. Hub material: 316 stainless steel.

.3 Supports:

.1 Floor mounted units: reinforced legs.

.2 Ceiling suspended units: support brackets welded to side of casing. Extend grease lubrication facilities to outside of casing using stainless steel tubing Swagelok or equivalent.

.4 Bearings: ball or roller with stainless steel extension tubes to outside of casing, Swagelok or equivalent.

.1 Adjustable blades for varying range of volume and pressure. Provide permanent pitch angle indication vernier scale on hub where noted on schedules.

.5 Belt drive:

.1 Drive blades by externally mounted motors through V-belt drive. Provide internal belt fairing, external belt guards and adjustable motor mounts.

.2 Adjust blades for varying range of volume and pressure. Hubs to facilitate indexing of blade angle. Provide manual adjustment stops to avoid overloading motor.

2.4 IN-LINE CENTRIFUGAL FANS

.1 Fan Wheels

.1 Welded stainless steel construction.

.2 Maximum operating speed of centrifugal fans not more than 40 50 % of first critical speed.

.3 Airfoil blades, as indicated.

.2 Bearings: heavy duty flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.

.3 Shaft seals on exhaust fans:

.1 Single labyrinth seals.

.4 Housings:

.1 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.

.2 Provide latched airtight access doors with handles.

.5 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and belt drive.

.6 Provide AMCA arrangements as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.5 PROPELLER FANS

.1 Fabricate multi-bladed propellers of sheet steel within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketted edges.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size and provide anchor bolts for floor mounted fans.

3.4 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DIFFUSERS REGISTERS & GRILLES

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 78 00 Closeout Submittals

.4 Section 23 31 13.01 – Metal Ducts to 750 Pa

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.2 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include:

.3 Keys for volume control adjustment.

.4 Keys for air flow pattern adjustment.

Part 2 PRODUCTS

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board and as specified.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Contract Administrator

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

.1 General: with opposed blade dampers.

.2 Type SA-1: 32 mm border, double deflection spaced 19 mm on center The front set of blades shall run parallel to the long dimension of the register. Register complete with integral opposed blade, stainless steel volume control damper. The damper shall be operable from the register face. See drawings for sizes.

Acceptable Product: PRICE model 720DSS/F/L/A or approved equal in accordance with B6.

.3 Type SA-2: 32 mm border, double deflection spaced 19 mm on center The front set of blades shall run parallel to the long dimension of the grille. See drawings for sizes.

Acceptable Product: PRICE model 720/F/L/A or approved equal in accordance with B6.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

.1 Type EA-1: Grilles shall have fixed, zero degree blades spaced 6 mm on center. The outlet core shall have 304 stainless steel receiving bar. Blades shall run parallel to the long dimension of the grille. The grille border shall be heavy duty 304 stainless steel construction with precise factory mitered corners and reinforcing support bars for extra support for the core receiving bar. The support and receiving bars shall not exceed 200 mm on center. The core shall be held into the border with removable core clips allowing the removal of the core without special tools.

Acceptable Product: PRICE model LBPH15A or approved equal in accordance with B6.

.2 Type EA-2: 32 mm border, zero degree deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parallel to the long dimension of the register. Register complete with integral opposed blade, stainless steel volume control damper. The damper shall be operable from the register face. See drawings for sizes.

Acceptable Product: PRICE model 710ZDSS/F/L/A or approved equal in accordance with B6.

.3 Type EA-3: 32 mm border, 45° deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parallel to the long dimension of the register. Register complete with integral opposed blade, stainless steel volume control damper. The damper shall be operable from the register face. See drawings for sizes.

Acceptable Product: PRICE model 730ZDSS/F/L/A or approved equal in accordance with B6.

.4 Type RA-1: 32 mm border, 45° deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parallel to the long dimension of the grille. See drawings for sizes.

Acceptable Product: PRICE model 530/F/L/A or approved equal in accordance with B6.

.5 Type RA-2: 32 mm border, zero degree deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parallel to the long dimension of the register. Register complete with integral opposed blade, stainless steel volume control damper. The damper shall be operable from the register face. See drawings for sizes.

Acceptable Product: PRICE model 710ZDSS/F/L/A or approved equal in accordance with B6.

.6 Type RA-3: 32 mm border, 45° deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parallel to the long dimension of the register. Register complete with integral opposed blade, stainless steel volume control damper. The damper shall be operable from the register face. See drawings for sizes.

.7 Acceptable Product: PRICE model 730ZDSS/F/L/A or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Install with stainless steel screws in countersunk holes where fastenings are visible.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

LOUVRES INTAKES & VENTS

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

.2 Custom fabrication of removable-seasonal bug screens as indicated on drawing schedules.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 07 92 00 Joint Sealants

.5 Section 23 31 13.01 – Metal Ducts to 750 Pa

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.4 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90.

1.6 MOCK-UPS

.1 Submit a mock-up of the fabricated removable bug screen shown on the drawings. For review and approval by Contract Administrator prior to final fabrication of bug screens.

.2 Submit in accordance with 01 45 00 Quality Control.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured SS.

.1 Complete with integral birdscreen of 2.7 mm diameter ss wire.

.2 Maximum throat velocity: 3.3 m/s intake.

.3 Maximum velocity through damper area: 1.5 m/s.

.4 Shape: as indicated.

.2 Birdscreens:

.1 Complete with integral birdscreen of 2.7 mm diameter ss wire. Use 19 mm mesh on exhaust 30 mm mesh on intake.

2.2 GOOSENECK HOODS

.1 Thickness: to ASHRAE and SMACNA.

.2 Fabrication: to ASHRAE and SMACNA.

.3 Joints: to ASHRAE and SMACNA and or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7 2.7 mm diameter ss wire. Use 19 mm mesh on exhaust 30 mm mesh on intake.

2.3 FIXED LOUVRES - STAINLESS STEEL

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: Formed 304 stainless steel, 2B finish.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 100 mm deep formed 304 stainless steel, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on interior face of louvers in formed U-frame.

.8 Finish: 2B; Colour: to Contract Administrator’s approval.

.9 Approved manufacturer: EH Price Airolite 638C1004X or approved equal in accordance with B6.

2.4 PENTHOUSES - STAINLESS STEEL

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: 1.4 mm thickness, formed 304 stainless steel.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.

.4 Frame, head, sill and jamb: 100 mm deep formed 304 stainless steel, minimum 3 mm thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centres.

.6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on exterior face of louvres in formed U-frame.

.8 Finish: 2B; Colour: to Contract Administrator’s approval.

.9 Approved manufacturer: EH Price or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening.

.4 Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

HVAC AIR FILTRATION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Air filters for various types of mechanical air handling equipment.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 78 00 Closeout Submittals

.3 Section 01 74 11 HVAC Air Filtration

.4 Section 23 31 13.01 – Metal Ducts to 750 Pa

1.3 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.1, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11, Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12, Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.13, Filter Media, Automatic Roll.

.5 CAN/CGSB-115.14, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.6 CAN/CGSB-115.15, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.7 CAN/CGSB-115.16, Activated Carbon for Odor Removal from Ventilating Systems.

.8 CAN/CGSB-115.18, Filter, Air, Extended Area Panel Type, Medium Efficiency.

.9 CAN/CGSB-115.20, Polarized Media Air Filter.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Underwriters' Laboratories of Canada

.1 ULC -S111, Standard Method of Fire Tests for Air Filter Units.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 PRODUCTS

2.1 GENERAL

.1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.

.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

.1 Holding frames: permanent "T" section or channel section construction of same material as casing/hood, 1.6 mm thick, except where specified.

.2 Seals: to ensure leakproof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank.

2.3 FIBROUS GLASS PANEL FILTERS

.1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

.2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.

.3 Performance: minimum average synthetic dust weight arrestance 90> % to ASHRAE 52.1, MERV 7.

.4 Fire rated: to ULC -S111, Class 2.

.5 Nominal thickness: 50 mm.

.6 Acceptable product: AAF PerfectPleat (plant standard) or approved equal in accordance with B6.

2.4 ACTIVATED CARBON TYPE FILTERS

.1 Media:

.1 Panel media pads with granular activated carbon and potassium permanganate impregnated on substrate at a density of 300 grams per square foot.

.2 Holding frame: removable, non-disposable, plastic or corrosion resistant stainless steel.

.3 Filter housing: corrosion resistant stainless steel.

.4 Test element:

.1 Detachable, to indicate extent of saturation of actual installation.

.2 1 per bank.

.5 Acceptable product: AAF AmAir/C+SAAFOxi or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 ACTIVATED CARBON TYPE FILTERS

.1 During testing, adjusting and balancing, install substitute media.

.2 Install permanent media only after painting is completed.

3.4 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

BREECHING CHIMNEYS & STACKS

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials, accessories and installation for breechings, chimneys and stacks.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 61 00 Common Product Requirements

.3 Section 01 74 11 Cleaning

.4 Section 03 33 00 Cast-in-Place Concrete

.5 Section 23 05 13 – Pipe Hangers and Supports for HVAC Piping & Equipment

.6 Section 23 07 13 – Duct Insulation

.7 Section 23 31 13.01 – Metal Ducts to 750 Pa

.8 Section 23 34 00 – Fans General

.9 Section 23 54 16 – Fuel-Fired Furnaces

.10 Section 23 74 00 – Packaged Air Handling Units - Gas

1.3 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of thimbles.

.4 Bases/Foundations.

.5 Supports.

.6 Guy details.

.7 Rain caps.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

.1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with Province of Manitoba Department of Labour Mechanical & Engineering Branch Gas & Oil Program and applicable City regulations.

.2 Certificates:

.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

Part 2 PRODUCTS

2.1 FUELS: PRESSURE CHIMNEY AND BREECHING

.1 ULC labelled, 760 degrees C rated.

.2 In-direct-Fired Air Handling Units: Sectional, prefabricated, double wall with mineral fibre, 25 mm with mated fittings and couplings.

.1 Liner: type 316 stainless steel, AL294C stainless steel for condensing appliance applications.

.2 Shell: mm thick, type 316 stainless steel.

.3 Outer seals between sections: to suit application.

.4 Inner seals between sections: to suit application.

2.2 TYPE B GAS VENT

.1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only for unit heaters.

.2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.3 PVC GAS VENT

.1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only.

.1 Unit shall accommodate vent pipe, fittings, cements and primers listed to ULC S636. Vent sizing must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction.

.2 Approved vent system: IPEX System 636, PVC/CPVC Primer, Purple Violet for Flue Gas Venting rated Class IIA, 65 ^{o}C or approved equal in accordance with B6.

2.4 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching, as indicated.

.2 Barometric dampers: single double acting, 70% of full size of breeching area.

.3 Hangers and supports: in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) and manufacturer’s instructions.

.4 Rain cap for non condensing applications, velocity cone for condensing appliance applciations.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 1.5 m centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated, follow guy wire recommendations of manufacturer.

.4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated.

.6 Install rain caps and cleanouts, as indicated and as required by regulatory authorities.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

FUEL FIRED FURNACES

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 61 00 Common Product Requirements

.2 Section 01 74 11 Cleaning

1.2 REFERENCES

.1 American National Standards Institute (ANSI) / American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 52.1, Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

.2 American National Standards Institute (ANSI) / Canadian Standards Association (CSA International)

.1 ANSI Z21.47/ CSA 2.3A, Gas-Fired Central Furnaces.

.2 ANSI Z83.8/CSA 2.6, CSA Standard for Gas Unit Heaters and Gas-Fired Duct Furnaces.

.3 Canadian Electrical Code

.4 Canadian Standards Association (CSA International) / Canadian Gas Association (CGA)

.1 CGA 3.2, Industrial and Commercial Gas-Fired Package Furnaces.

.5 Canadian Standards Association (CSA International)

.1 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.

.2 CSA C22.2 No. 24-93, Temperature-Indicating and Regulating Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for furnace units and furnace parts, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit manufacturer's written recommendations.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Parts:

.1 Spare filters: in addition to filters installed immediately prior to acceptance by Contract Administrator, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 MAKE-UP AIR FURNACE (100%)

.1 General: Provide CSA approved, packaged factory assembled unit consisting of cabinet, fan, fan motor, intake/exhaust assembly, heat exchanger, combustion chamber, burner, controls, air filter.

.1 Mid efficiency level range: 78% to 81%

.2 Certification of components and construction of factory assembled gas-fired unit: to ANSI Z21.47/CSA 2.3A for forced air central furnace.

.2 Capacity: See unit schedules for details.

.3 Type: See unit schedules for details.

.4 Cabinet: 1.0 mm thick satin coated sheet metal with baked enamel finish.

.1 Welded steel base for floor type.

.2 Easily removed and secured access doors for components requiring service

.3 Cabinet to be lined with 13 mm foil backed fiberglass insulation. Balance of cabinetry for make-up air applications, lined with 13 mm neoprene coated insulation.

.5 Heat Exchanger:

.1 Primary: stainless steel tube with stainless steel fins; maximum temperature rise of 55.6°C.

.2 Warranty: non-prorated 10 years.

.6 Combustion Chamber: to manufacturers standard.

.7 Circulation Blower Motor Assembly:

.1 Centrifugal type blower.

.2 Statically and dynamically balanced.

.3 Rubber mounted.

.4 Speed adjustment: direct-drive, 3-speed adjustable PSC motor.

.5 Motor: direct-drive PSC motor, overload protection, adjustable mounts; see unit schedules for motor capacity.

.8 Air Filters: 20 mm thick throwaway, arranged for ease of service..

.9 Heater Burner:

.1 General: to bear CSA and ULC labels.

.2 Gas burner: Electronic intermittent ignition combustion type gas burner.

.10 Intake and Vent Assembly:

.1 Unit shall accomodate "B" type venting. "B" vent sizing must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction.

.11 Controls:

.1 General: conform to CSA C22.2 No.24.

.2 Gas firing:

.1 Operating controls:

.1 Heating-cooling 7-day programmable thermostat.

.2 Electronic pilot ignition.

.3 Manual main shut-off valve, automatic safety pilot, automatic electric valve and gas pressure regulator.

.4 Fan operating control switch with adjustable set points and continuous operating switch.

.2 Safety controls:

.1 Electronic combustion control relay with flame rectification sensor to detect and supervise flame by shutting off fuel upon flame failure or safety interlock signal within seconds, in sequence pre-purge-pilot ignition, supervision-main valve opening-pilot cut-off-burner operation and roll out switch.

.2 Blocked vent shut-off switch or control system.

.3 Limit control to shut down furnace if heat exchanger temperature exceeds limit setting. Combination fan and limit control to be spiral wound.

.4 Door interlock switch on fan compartment access panel to shut down furnace when panel is removed.

.5 Electronic board built-in diagnostics.

2.2 HIGH EFFICIENCY FURNACE

.1 General: Provide CSA approved, packaged factory assembled unit consisting of cabinet, fan, fan motor, intake/exhaust assembly, heat exchanger, combustion chamber, burner, controls, air filter, condensate drain.

.1 High efficiency level range: 90% to 96%

.2 Certification of components and construction of factory assembled gas-fired unit: to ANSI Z21.47/CSA 2.3A for forced air central furnace.

.2 Capacity: See unit schedules for details.

.3 Type: See unit schedules for details.

.4 Cabinet: 0.76 mm thickness minimum, pre-painted galvanized steel.

.1 Welded steel base for floor type.

.2 Easily removed and secured access doors for components requiring service

.3 Thermally insulated cabinet.

.5 Heat Exchanger:

.1 Primary: Primary heat exchangers shall be 3-pass 0.91 mm corrosion resistant aluminized steel of fold-and-crimp sectional design, which operates under negative pressure.

.2 Secondary: Secondary heat exchangers shall be of a flow-through design having a patented interior laminate coating of polypropylene for greater corrosion resistance with fold-and-crimp design, which operates under negative pressure.

.3 Warranty: non-prorated 10 years.

.6 Combustion Chamber: Power vent, forced draft; to manufacturers standard.

.7 Circulation Blower Motor Assembly:

.1 Centrifugal type blower.

.2 Statically and dynamically balanced.

.3 Rubber mounted.

.4 Speed adjustment: multiple-speed direct drive PSC motor.

.5 Motor: multi-speed, PSC, overload protection, adjustable mounts; see unit schedules for motor capacity.

.8 Air Filters: 20 mm thick throwaway, arranged for ease of service.

.9 Heater Burner:

.1 General: to bear CSA and ULC labels.

.2 Gas burner: Hot surface ignition combustion type gas burner.

.10 Intake and Vent Assembly:

.1 Unit shall accommodate vent pipe, fittings, cements and primers listed to ULC S636. Vent sizing must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction.

.2 Approved vent system: IPEX System 636, PVC/CPVC Primer, Purple Violet for Flue Gas Venting rated Class IIA, 65 ^{o}C or approved equal in accordance with B6.

.11 Condensate Drain: Provide PVC condensate drain trap.

.12 Controls:

.1 General: conform to CSA C22.2 No.24.

.2 Gas firing:

.1 Operating controls:

.1 Heating-cooling programmable 7-day thermostat.

.2 Intermittent ignition.

.3 Manual main shut-off valve, automatic safety pilot, automatic electric valve and gas pressure regulator.

.4 Fan operating control switch with adjustable set points and continuous operating switch.

.2 Safety controls:

.1 Electronic combustion control relay with flame rectification sensor to detect and supervise flame by shutting off fuel upon flame failure or safety interlock signal within seconds, in sequence pre-purge-pilot ignition, supervision-main valve opening-pilot cut-off-burner operation and roll out switch.

.2 Blocked vent shut-off switch or control system.

.3 Limit control to shut down furnace if heat exchanger temperature exceeds limit setting. Combination fan and limit control to be spiral wound.

.4 Door interlock switch on fan compartment access panel to shut down furnace when panel is removed.

.5 Electronic board built-in diagnostics.

.6 Internal float switch to shut off furnace if condensate does not drain properly.

2.3 DX (Direct Expansion) Cooling Coil

.1 Vertical N-type design for use with R-410A refrigerant; factory painted.

.2 Coil shall be furnished with a corrosion resistant condensate drain pan with two 19 mm female threaded brass insert connections, sweat connections for refrigerant piping, thermostatic expansion valve (TXV), protective tube sheets and a teflon ring installed inside the liquid line connection at the TXV.

.3 Coils shall be capable of 2100 psi minimum.

.4 Limited five (5) year warranty on parts; additional extended warranties available.

2.4 Condenser

.1 Cabinet: constructed of galvanized steel, bonderized, and coated with a powder coat paint; provided with a dense grille.

.2 Fan: direct drive, propeller type, upward discharge. Totally enclosed, single-phase type with class B insulation and permanently lubricated bearings. Shafts will be corrosion resistant. Fan blades to be statically and dynamically balanced. Condenser fan openings will be equipped with coated steel wire safety guards.

.3 Compressor: to be hermetically sealed; mounted on rubber vibration isolators.

.4 Condenser coil: constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed; air cooled.

.5 Refrigeration components: circuit components will include liquid-line shutoff valve with sweat connections, vapour-line shutoff valve with sweat connections, system charge of R-

410A refrigerant, and compressor oil. Unit will be equipped with high-pressure switch, low pressure switch and filter drier for refrigerant.

Part 3 EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions, regulations of authorities having jurisdiction and to CAN/CSA-B149.1.

.2 Install split system air conditioning to manufacturer's instructions.

.3 Provide Contract Administrator written report of test results.

.4 Bacharach smoke density number not to exceed #1.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 11 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PACKAGED AIR HANDLING UNITS - GAS

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for self-contained single zone, non-circulating direct gas fired and circulating indirect gas fired, packaged industrial air handling units.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 45 00 Quality Control

.3 Section 01 78 00 Closeout Submittals

.4 Section 01 91 13 Commissioning Requirements

.5 Section 23 05 13 – Common Motor Requirements for HVAC Equipment

.6 Section 23 05 29 – Pipe Hangers and Supports for HVAC Piping and Equipment

.7 Section 23 11 23 – Facility Natural Gas Piping

.8 Section 23 31 13.01 – Metal Ducts to 750 Pa

.9 Section 23 33 15 – Dampers – Operating

.10 Section 23 33 46 – Flexible Ducts

.11 Section 23 51 00 – Breeching, Chimneys & Stacks

1.3 REFERENCES

.1 ANSI/UL 1995 B, Standard for Heating and Cooling Equipment.

.2 Canadian Standards Association (CSA International)

.1 CGA 3.2 Standard for Industrial and Commercial Gas Fired Package Furnaces.

.2 CSA 3.7, 3.7a, 3.7b (ANSI Z83), Non-circulating, Direct Gas Fired, Industrial Air Heaters.

.3 CSA C22.1 HB-02, Canadian Electrical Code Handbook.

.4 CSA/CGA B149.1 Natural Gas and Propane Installation Code.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association

.1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

.5 AMCA

.1 Standard 99-2408-69 Operating Limits for Centrifugal Fans.

.2 Standard 210 Laboratory Methods for Testing Fans for Aerodynamic Performance Rating.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for packaged, custom fabricated air handling units.

.3 Submit WHMIS MSDS in accordance with Section 02 81 01 - Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.4 Shop Drawings:

.1 Submit shop drawings to indicate project layout and dimensions; indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Complete internal panel and wiring, both as schematics and as actually assembled.

.5 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.6 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.7 Fan performance curves.

.8 Details of vibration isolation.

.9 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.6 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.7 Instructions: submit manufacturer's installation instructions.

.8 Manufacturer's Field Reports: manufacturer's field reports specified.

.9 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:

.1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.5 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting three weeks prior to beginning work of this Section in accordance with Construction Progress Schedules - Bar (GANTT) Chart specified in D14.

.1 Verify project requirements.

.2 Review installation conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Handle and dispose of hazardous materials in accordance with Authorities Having Jurisdiction regulations.

1.7 WARRANTY

.1 Contractor hereby warrants that packaged air handling units will function and operate in accordance with the General Conditions, technical specifications and drawings for a period of 12-months from the date of project substantial completion or 24 months of delivery to site whichever period is longer.

Part 2 PRODUCTS

2.1 GENERAL

.1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedules attached.

.2 Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal in accordance with B6" or "alternate in accordance with B6" must address these factors.

.3 Unless stated otherwise in the air handling unit schedules, air-handling units are to be shipped to the job in one piece, factory assembled. Where indicated in the Air Handling Unit Schedules some units are required to be capable of being knocked down to assist in

their transport to the unit location in the building. Modify the construction of these units to facilitate a modular installation that does not affect the units certification or ratings.

.4 All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as $_{C}$ETL, ETL$_{US}$, UL, CSA prior to shipment.

.5 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code, Canadian Gas Association, Canadian Standards Association and any labelling requirements of the local authority-having-jurisdiction.

.6 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.7 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.1 Approved manufacturer's for this project; EngAir, ICE or approved equal in accordance with B6.

.8 Units to consist of cabinet and frame, supply fan, heat exchanger or direct fired heating section, burner, controls, air filter, fan and motorized, outside air, return air and relief air damper as applicable.

.9 Pre-fabricated steel mounting frame integral to the air handling unit construction.

2.2 CABINET

.1 Unit casing shall be of minimum 16 gauge (1.6mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.2 All high pressure 1250Pa to 2250 Pa wc fan sections shall be constructed of 14 gauge (2.0mm) metal. Continuous high pressure sealant shall be provided between all panels.

.3 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.4 The interior of the unit shall be provided with a 22 gauge (0.85mm) solid, 304 stainless steel metal liner over insulated areas.

.5 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Access through screwed wall panels is not acceptable.

.6 Access Doors:

.1 Hinged access doors, with extruded neoprene gasket, fully lined, and a minimum of two leverlok handles, operable from both sides for all units.

.2 Doors to open outwards on all sections for air handling units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

.3 Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label and safety chain must be affixed.

.4 Hinged access doors shall be provided with tie back clips.

.7 Provide a 120V duplex, outdoor, convenience receptacle in control cabinet enclosure (powered from unit power supply).

2.3 INSULATION

.1 All units shall be internally insulated with 25mm thick nominal 24 kg/m^3 density acoustic insulation.

.2 24 kg/m^3 insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 400mm on-centre. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.3 Provide reinforcing channels under floor to minimize deflection.

2.4 FANS

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Centrifugal airfoil or backward inclined, statically and dynamically balanced, AMCA 99-2408-69 Class II (minimum) rating. Multi V-belt drive with adjustable variable pitch motor pulley, rubber spring isolated hinge mounted motor fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators: 95 % efficiency

.3 Fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings. Extended stainless steel grease lines (Swagelok basis of acceptance) shall be provided to the main fan section access door area to facilitate bearing lubrication without having to enter the unit.

.4 Drives shall be adjustable on fans with motors 7-1/2 HP (5.6 kW) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.5 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where

required. Motor mounting shall be adjustable to allow for variations in belt tension and drive alignment. Provide jacking bolts on fan-motor base support for alignment and tensioning adjustment.

.6 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 230mm to 380mm diameters fans. All other fans shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 25mm static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.7 Fan motors shall be TEFC (totally enclosed fan cooled), super high efficiency type.

2.5 AIR FILTERS

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 For units with filter banks up to 1825mm high, the filter modules shall be designed to slide out of the unit. Side removal 50mm filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 50mm Replaceable Media Filters: Disposable glass fibre media type enclosed in permanent galvanized metal frames with metal retainers on both sides. The filter media shall have a minimum efficiency of 20-25% on ASHRAE Standard 52.1-92, and a minimum of MERV 7 per ASHRAE 52.2. ULc Class 2 rating.

.4 To meet NFPA 90A, air filter requirements type Class 2.

.5 Approved product: AAF PerfectPleat (plant standard) or approved equal in accordance with B6.

2.6 DAMPERS

.1 Stainless steel, factory manufactured to AMCA Std 99-2408 Class II pressure class.

.2 Parallel blade: double skin air foil design, 1.6 mm thick 316 stainless steel to 1200 mm length, 2 mm thick to 1500 mm length. Insulated blade on outdoor dampers.

.3 Axle: minimum 19 mm diameter stainless steel rod.

.4 Maximum blade height: 150 mm.

.5 Bearings: stainless steel outboard bearings with shaft seals pressed into cast housing bolted to the damper frame.

.6 Linkage: located in jamb out of airstream and constructed of minimum 3.5 mm stainless steel double clevis arms with 4.8 x 19 stainless steel tie bars pivoting on 9.5 mm diameter stainless steel pivot pins with lock type retainers.

.7 Seals: low temperature-low leakage, silicone blade seals shall be mechanically attached to blade. Jamb seals shall be flexible stainless steel located between blade edge and jamb for maximum sealing compression.

.8 Channel frame: minimum 200 mm deep x 50 mm flanged, 2.8 mm 316 stainless steel.

.9 Performance:

.1 Leakage: in closed position less than 2% of rated air-flow at 500 Pa differential across damper.

.2 Pressure drop: at full open position to unit manufacturer's standard.

.10 Acceptable Products: Ruskin CD80AF3, Greenheck HCD230 or approved equal in accordance with B6.

.11 Damper Actuator:

.1 Direct coupled, 2-postion, spring return for damper operation.

.2 Self centered shaft adaptor.

.3 Fully opened and fully closed integral end-limit switches. Number of limit-switches required shall be determined from Process & Instrumentation Diagrams.

.4 Spring return direction field selectable.

.5 Torque ratings 125% (minimum) of breaking torque to initiate opening/closing at maximum pressure differential.

.6 Voltage feedback signal; 2-10Vdc.

.7 Control circuit and status operating voltage, 24Vdc.

.8 Operating voltage; actuator motor 24Vdc.

.9 Outdoor located damper actuator with thermostatic electric heater.

.10 Acceptable Products: Honeywell MS Series, Belimo or approved equal in accordance with B6.

2.7 BURNERS – DIRECT FIRED

.1 Make-up air units where indicated in the Air Handling Unit Schedules shall have a direct fired heating section and be $_{C}$ETL, ETL$_{US}$ approved as a complete package including accessories and controls.

.2 Operating natural gas pressure at unit(s) manifold shall be 1750 Pa.

.3 Burner

.1 Burner assembly shall be a line type capable of modulating turn down ratio of 25:1. The assembly shall be constructed in a draw through arrangement. Outside air is drawn across the burner section at a constant velocity within the allowable limits of the burner design. Design preference shall be made to have the unit operating without a bypass damper, i.e. bypass damper shall only be implemented on units with multiple operating points where the velocity profile required for efficient combustion cannot otherwise be maintained.

.2 All burner combustion air openings shall be located in stainless steel burner plates to maintain design combustion air requirements at all inputs. Combustion air

openings in burner castings are not acceptable due to potential blockage from corrosion. Gas orifices shall be a maximum of 13 mm apart and gas burner connection size shall be 38mm minimum in order to ensure full turndown performance.

.3 Burner assembly and piping to include modulating flow ratio valve, fail-safe shut off valve(s), main and pilot pressure regulators, manual shut off valves and electric pilot valve. Flame surveillance shall be with a solid-state programmed flame relay complete with flame rod. The gas train shall be in a cabinet enclosure. Insulation on indoor units shall be 25mm thick, 24 kg/m^3 neoprene faced on inlet section.

.4 Controls

.1 Refer to the P&ID drawings and control narratives appended to these technical specifications for the detailed sequence of operations required for each direct-fired air handling unit/system.

.2 Unit shall start from exhaust system interlock (by others) wired to unit control terminal strip as indicated on bid opportunity drawings. Unit discharge air temperature shall be maintained constant by a discharge air sensor which shall modulate the main flow ratio gas valve.

.3 Reverse interlock shall provide necessary controls (relays and current sensing devices for proof of airflow for MUA equipment; current sensing relays for exhaust fans by Others) to ensure that should exhaust fan(s) interlocked with the make-up air unit fail, the direct-fired burner will immediately shutdown. Also, should the direct-fired unit fail, the exhaust fan(s) will stop immediately. On dual capacity units, interlock shall be for a sequenced, start.

.4 Refer to the Air Handling Unit Schedules, Control Narratives and Process & Instrumentation Drawings for a complete description of unit control interfacing requirements to operating system.

.5 HE series direct fired burners shall be equipped with a programmed logic controller or microprocessor controller to provide discharge air temperature control and burner management functions.

.6 Controllers shall as a minimum accommodate the following standard features:

.1 A built in discharge air setpoint adjustment to allow discharge air setpoint between 8°C and 52°C

.2 Self-checking of discharge air sensor to identify out of range or fault conditions

.3 Built in auto by-pass low limit with alarm contact

.4 Flame relay monitoring

.5 Air sensor self test

.6 Air flow monitoring

.7 Optical isolation on BMS input

.8 Five LED indicator lights for status indication of 20 different status functions including: burner status, flame status, fan status, low limit and operation status.

.9 Output to third party PLC: the air handling unit controller shall be capable of communicating to a programmable logic controller (PLC) via Modbus\TCP protocol or an Ethernet network.

.7 Two Level Temperature Control: AHU controller together with single stage, stainless steel RTD sensor to allow unit operation at two distinct discharge air temperature set points. A space RTD (by Others) shall be located in a representative location in the space and will communicate through the third party PLC to the AHU controller.

.8 (Parallel Unit Operation) Provide automatic position profile plate damper and operator wired and controlled by two exhaust systems as detailed on P&ID drawings. The make-up air units shall operate at high air volumes while both exhaust systems are on and shall operate at low air volume when only one exhaust system is on. The profile plate damper shall only be required if deemed necessary to ensure trouble free burner(s) operation. The operating hours for parallel unit operation are expected to be less than 24-hours per year.

.9 Provide a RTD, in the intake air stream that locks out the air handling unit burner function at an outdoor temperature above 15°C (adjustable).

.2 Factory testing of direct fired gas heating section.

.1 Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.

.2 Burner shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold to match the flow rate to the application.

.3 The blower flow rate shall be set to the design airflow conditions.

.4 Controls shall be checked and set to ensure proper operation as per unit order.

.5 A copy of the test report shall be provided.

2.8 GAS HEAT SECTION – INDIRECT FIRED

.1 General

.1 Heating units shall be indirect natural gas fired. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.

.2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold shall be 1750 Pa.

.4 Gas fired units shall be approved for operation in -40°C locations.

.2 Heat Exchanger/Burner Assembly

.1 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 25mm of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger.

.2 The heat exchanger/burner assembly shall be a blow through positive pressure type.

.3 Unit pilot shall have an interrupted pilot ignition system.

.4 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

.5 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.

.3 Factory testing of indirect fired gas heating section.

.1 Tests shall be performed after complete final unit assembly, just prior to shipping to job site. The tests shall be performed in accordance with the equipment standard that the gas heating section is certified.

.1 Heat exchanger shall be clocked with a dedicated calibrated gas meter to insure proper set up of the gas manifold.

.2 High and Low input flue gas combustion analysis using a calibrated combustion analyzer including O_2 and CO to provide proper air fuel ratio throughout the entire operating range.

.3 A copy of the combustion test report shall be provided to the Contract Administrator.

.4 Venting

.1 Installation and venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction. PS venting is required on indoor units.

.5 Controls

.1 Modulating fuel with modulating combustion air complete with proportional and integral control with discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. Combustion blower RPM shall be proved using a hall effect speed sensor.

.2 Combustion efficiency of standard efficiency heat exchangers shall increase 1-2% from high fire to low fire on units incorporating 15:1 high turndown burner. Heat exchangers with input ranges above 117 kW shall provide a minimum of 80% efficiency throughout the entire operating range. Heat exchangers with input

ranges 117 kW and lower shall provide a minimum of 80% efficiency throughout the entire operating range.

.3 Controllers for heating only units incorporating shall include the following standard features:

.1 Service analyzer with diagnostic lights for ease of set-up and service

.2 Linear gas and combustion air flow obtained via a built in solid-state linear algorithm

.3 -40°C minimum operating ambient temperature

.4 Four air change pre-purge on units with over 400 MBH (117kW) input

.5 Maintained purge to decrease temperature cycles

.6 Post purge

.7 Interrupted pilot

.8 Self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances

.9 Low fire start

.10 Controlled burner start-up and shut down

.11 Blower contactor that starts fan after burner pre-purge

.12 Economizer enable control

.13 Damper contact that allows fan to start after damper opens, damper to close after fan stops, and damper to close on flame failure

.14 Non-recycling auto by-pass low limit with alarm contacts and built-in sensor checking

.15 Separate gas and air actuators independently controlled to give the correct air to fuel ratio though out the entire firing range.

.4 Heating control function shall be modulating discharge air complete with stainless steel sensor and integral selector with adjustable ambient reset thermostat.

.5 Provide a make-up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

.6 Output to third party PLC: the air handling unit controller shall be capable of communicating to a programmable logic controller (PLC) via Modbus\TCP protocol or an Ethernet network.

2.9 PACKAGED CONTROLS/WIRING – GENERAL REQUIREMENTS

.1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.2 Gas fired units shall also include high limit and combustion airflow switch.

.3 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, minimum enclosure requirements NEMA 12.

.4 A discharge air low limit equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit.

.5 Power and control wiring methods to remote devices in accordance with Section 25 30 02 Field Control Devices and 26 05 21 Wires and Cables.

2.10 CAPACITY

.1 As indicated on attached Air Handling Unit Schedules:

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

.1 Install as per manufacturers' instructions as indicated.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Run drain line from heating section condensate drain to closest floor drain.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Upon completion of work, after cleaning is carried out.

.2 Obtain reports within 3 days of review and submit immediately to Contract Administrator.

.3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, sensors, electrical disconnects.

.4 Verify accessibility, cleanability, drainage of condensate drains.

.5 Performance Verification:

.1 General:

.1 In accordance with Section 01 91 13 Commissioning Requirements and as supplemented and specified herein.

.2 Air Handling Units:

.1 Check for smooth, vibration less correct rotation of supply fan impeller.

.2 Measure supply fan capacity.

.3 Adjust impeller speed as necessary and repeat measurement of fan capacity.

.4 Measure pressure drop each component of air handling unit.

.5 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.

.6 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.

.7 OAD: verify for proper stroking, interlock with RAD.

.8 Measure DBT, WBT of SA, RA, EA.

.9 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.

.10 Simulate maximum heating load and:

.1 Verify temperature rise across heat exchanger.

.2 Perform flue gas analysis. Adjust for peak efficiency.

.3 Verify combustion air flow to heat exchanger.

.4 Simulate minimum heating load and repeat measurements.

.11 Verify operating control strategies, including:

.1 Heat exchanger operating and high limit.

.2 Freeze protection.

.3 Economizer cycle operation, temperature of change-over.

.4 Alarms.

.5 Voltage drop across thermostat wiring.

.12 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.

.13 Check capacity of heating unit.

.14 Refer to other sections of these specifications for PV procedures for other components.

.6 Commissioning Reports:

.1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports supplemented as specified herein. Include:

.1 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

3.4 DEMONSTRATION

.1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.5 CLEANING

.1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

UNIT HEATERS

Part 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures

.2 Section 01 78 00 Closeout Submittals.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 33 00 Submittal Procedures.

.3 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.
.2 Performance criteria.
.3 Mounting methods.
.4 Physical size.
.5 kW rating, voltage, phase.
.6 Cabinet material thicknesses.
.7 Limitations.
.8 Colour and finish.

1.3 1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate:

.1 Equipment, capacity and piping connections.
.2 Dimensions, internal and external construction details, recommended method of installation with proposed support, sizes and location of mounting bolt holes.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

Part 2 PRODUCTS

2.1 HORIZONTAL UNIT HEATERS – HOT WATER (GLYCOL)

.1 Casing: 1.2 mm thick cold rolled steel, treated to prevent corrosion and painted with a corrosion resistant, baked, polyester powdercoat gray-green finish, with threaded connections for hanger rods.

.2 Coils: DLP-type copper tubes with aluminum fins mechanically bonded to tubing; malleable iron supply and return connections. Warranted for operation at 190°C and 1 MPa maximums.

.3 Fan: direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

.4 Motor: continuous duty, built-in overload protection, and resilient motor supports.

.5 Air outlet: one-way adjustable louvres.

.6 Control room thermostat: electric, low voltage.

.7 Acceptable manufacturers:

.1 Modine model HSB-165-S-01 or approved equal in accordance with B6.

2.2 INFRARED TYPE UNIT HEATERS

.1 General: Vertically hung, natural gas fired, heat treated aluminized steel heat exchanger.

.2 Venting: Concentric 100 mm combustion air intake and 50 mm flue. Unit heater factory supplied with 2400 mm horizontal venting kit.

.3 Control room thermostat: electric, line voltage, plastic cover.

.4 Acceptable manufacturers:

.1 Superior Radiant Products model GR-45 or approved equal in accordance with B6.

Part 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Provide double swing pipe joints as indicated.

.3 Check final location with Contract Administrator if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

.4 Hot water units: for each unit, install ball valve on inlet and balancing valve on outlet of each unit. Install drain valve at low point.

.1 Install manual air vent at high point.

.5 Clean finned tubes and comb straight.

.6 Provide supplementary suspension steel as required.

.7 Install thermostats in locations indicated.

.8 Before acceptance, set discharge patterns and fan speeds to suit requirements.

END OF SECTION

APPENDICES

SCHEDULES

Specification Reference	Title	No. of Pages
23 74 00	Packaged Air Handling Units Gas	26
23 34 00	Exhaust Air Fans	24
23 34 00	Supply Air Fans	2
23 34 00	Relief Air Fans	1
23 54 16	Fuel Fired Furnaces	12

CONTROL NARRATIVES - PROCESS AREAS

	Title	No. of Pages
	Area H Headworks	23
	Area U Mechanical Bay	18
	Area P Primary Clarifiers	17
	Area S Secondary Clarifiers	15
	Area U Tunnels	12
	Area S Odour Dispersion System (ODS)	11

END OF SECTION