PART 1 - GENERAL

1.1 Submittals

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

.2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licenced in one of the Provinces of Canada.

.3 Shop drawings to show:
- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.4 Shop drawings and product data accompanied by:
- .1 Detailed drawings of bases, supports and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 Closeout Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Operation and maintenance manual approved by and final copies deposited with, Departmental Representative before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for system including environmental controls.
  - .2 Description of each system and its controls.
  - .3 Description of operation of system at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for systems and component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data shall include:
  - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

1.1 Submittals (Cont'd)

.5 (Cont'd)

.4 (Cont'd)

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when needed for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Departmental Representative will provide one (1) set of reproducible mechanical drawings. Provide set of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information to reproductibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

1.1 Submittals (Cont'd)

.5 (Cont'd)

.9 (Cont'd)

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Departmental Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 Quality Assurance

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

1.3 Maintenance

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One head gasket set for each heat exchanger.

.4 One glass for each gauge glass.

.5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

PART 3 - EXECUTION

2.1 Painting Repairs and Restoration

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

2.2 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handing units.

2.3 Demonstration

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:
.1 ERU.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.4 Use operating and maintenance manual, as-built drawings and audio visual aids as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

2.4 Protection

.1 Protect equipment and systems openings from dirt, dust and other foreign materials with materials appropriate to system.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Electrical motors, drives and guards for mechanical equipment and systems.
.2 Supplier and installed responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Divisions 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 Electrical Equipment Manufacturers' Association Council (EEMAC).

1.3 Submittals

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

PART 2 - PRODUCTS

2.1 General

.1 Motors to be high efficiency.

2.2 Motors

.1 Provide motors for mechanical equipment as specified.

.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.

2.2 Motors (Cont'd)

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, 3 phase, V, unless otherwise specified or indicated.

2.3 Temporary Motors

.1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative 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 specified.

.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 Correct size of sheave to be determined during commissioning.

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

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

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

2.5 Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;
.1 Expanded metal screen welded to 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.

2.5 Drive Guards (Cont'd)

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.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 galvanized mild steel.
.2 Securely fasten in place.
.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:
.1 Wire or expanded metal screen, galvanized, 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 Application

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

3.2 Installation

.1 Fasten securely in place.

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

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose (Inch).
.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International
.1 ASTM A 276-08, Standard Specification for Stainless Steel Bars and Shapes.
.2 ASTM B 62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
.3 ASTM B 283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
.4 ASTM B 505/B 505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
.1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
.3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

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 equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.3 Shop Drawings:

1.3 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)

.3 (Cont'd)
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province Territory of Canada.
.2 Submit data for valves specified in this Section.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:
.1 Furnish following spare parts:
.1 Valve seats: one for every 10 valves each size, minimum 1.
.2 Discs: one for every 10 valves, each size. Minimum 1.
.3 Stem packing: one for every 10 valves, each size. Minimum 1.
.4 Valve handles: 2 of each size.

1.6 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 MATERIALS

.1 Sustainable Requirements:
.1.

.2 Valves:
.1 Except for specialty valves, to be single manufacturer.
.2 Products to have CRN registration numbers.

.3 End Connections:
.1 Connection into adjacent piping/tubing:
.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

2.1 MATERIALS (Cont'd)

.3 (Cont'd)
.1 (Cont'd)
.2 Copper tube systems: solder ends grooved ends to ANSI/ASME B16.18.

.4 Lockshield Keys:
.1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.5 Gate Valves:
.1 Requirements common to gate valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Bonnet: union with hexagonal shoulders.
.3 Connections: screwed with hexagonal shoulders.
.4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Packing: non-asbestos.
.6 Handwheel: non-ferrous.
.7 Handwheel Nut: bronze to ASTM B 62.
.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
.1 Body: with long disc guides, screwed bonnet with stem retaining nut.
.2 Operator: Handwheel.
.3 NPS 2 and under, rising stem, split wedge disc, Class 125:
.1 Body: with long disc guides, screwed bonnet.
.2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
.3 Operator: handwheel lockshield.

.6 Globe Valves:
.1 Requirements common to globe valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Bonnet: union with hexagonal shoulders.
.3 Connections: screwed with hexagonal shoulders.
.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
.6 Handwheel: non-ferrous.
.7 Handwheel Nut: bronze to ASTM B 62.
.2 NPS 2 and under, composition disc, Class 125:
.1 Body and bonnet: screwed bonnet.

2.1 MATERIALS (Cont'd)

.6 (Cont'd)
.2 (Cont'd)
.2 Disc and seat: renewable rotating PTFE disccomposition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
.3 Operator: handwheel lockshield.

.7 Check Valves:
.1 Requirements common to check valves, unless specified otherwise:
.1 Standard specification: MSS SP-80.
.2 Connections: screwed with hexagonal shoulders.
.2 NPS 2 and under, swing type, bronze disc, Class 125:
.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.8 Ball Valves:
.1 NPS 2 and under:
.1 Body and cap: cast high tensile bronze to ASTM B 62.
.2 Pressure rating: Class125 2760-kPa CWP 4140-kPa CWP, 860 kPa steam.
.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI.
.4 Stem: tamperproof ball drive.
.5 Stem packing nut: external to body.
.6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.
.7 Stem seal: TFE with external packing nut.
.8 Operator: removable lever handle.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section includes:
.1 Hangers and supports for mechanical piping, ducting and equipment.

.2 Related Section:
.1 Section 23 72 00 - Air to Air Energy Recovery Equipment.
.2 Unit heaters equipment.
.3 Exhaust system Nederman.
.4 Dryer exhaust.

1.2 References

.1 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.2 Underwriter's Laboratories of Canada (ULC)

1.3 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 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
.3 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
.4 Provide for vertical adjustments after erection and during commissioning.

PART 2 - PRODUCTS

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

2.2 Pipe Hangers

.1 Finishes:
.1 Pipe hangers and supports: carbon steel.
.2 Ensure steel hangers in contact with copper piping are copper plated.

.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.
.1 Rod: 9 mm, UL listed.

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

.4 Upper attachment to concrete.
.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
.2 Concrete inserts: wedge shaped body with knockout protector plate, UL listed.

.5 Hanger rods: threaded rod material to MSS SP58.
.1 Ensure that hanger rods are subject to tensile loading only.

.6 Pipe attachments: material to MSS SP58.
.1 Attachments for steel piping: carbon steel black.
.2 Attachments for copper piping: copper plated black steel.
.3 Use insulation shields for hot pipework.
.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, 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.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

2.2 Pipe Hangers (Cont'd)

.9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A 563.

.1 Finishes for steel pipework: black.

2.3 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, 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 SP69.

2.4 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

2.5 Equipment Anchor Bolts and Templates

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

2.6 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 Application

.1 Manufacturer's Instructions:

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

3.2 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

3.3 Hanger Spacing

.1 Plumbing piping: to Canadian Plumbing Code, Provincial Code and authority having jurisdiction.

.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, but not less than one hanger at joints.

.6 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m

.7 Pipework greater than NPS 12: to MSS SP69.

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.
.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.

END OF SECTION

PART 1 - GENERAL

1.1 General

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

.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 be Departmental Representative.

.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-1-2002.
.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environment Systems-1998.
.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.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.

1.2 Qualifications of TAB Personnel (Cont'd)

.8 (Cont'd)

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

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 so as 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 be 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 so as 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 confirm adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 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.

1.8 Operation of Systems During TAB

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

1.9 Start of TAB

.1 Notify Departmental Representative prior to start of TAB.

.2 Start TAB when building is essentially completed.

.3 Provisions for TAB installed and operational.

.4 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:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 10%, minus 10%.

1.11 Accuracy Tolerances

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

1.12 Instruments

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

.2 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 TAB Report

.1 Format to be 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 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.14 Verification

.1 Reported results subject to verification by Departmental Representative.

.2 Provide manpower and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.15 Settings

.1 After TAB is completed to satisfaction of Departmental Representative, 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.

1.16 Completion of TAB

.1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.17 Air Systems

.1 Standard: TAB to be to most stringent of TAB standards of AABC or ASHRAE.

.2 Do TAB of following systems, equipment, components, controls:
- .1 Supply air and return.
- .2 Energy recovery ventilator.
- .3 Fresh air supply and exhaust.
- .4 Mini split system.
- .5 Unit heaters.
- .6 Exhaust system - Nederman.
- .7 Dryer exhaust system.

.3 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.

.4 Locations of equipment measurements: To include, as appropriate:
- .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .2 At controllers, controlled device.

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

END OF SECTION

1 GENERAL

1.01 REFERENCES

.1 Definitions
  .1 For purposes of this section:
    .1 "CONCEALED" - insulated mechanical services and equipment suspended ceilings and non-accessible chases and furred-i spaces.
    .2 "EXPOSED" - means "not concealed" as previously defined.
    .3 Insulation systems - insulation material, fasteners, jack and other accessories.
  .2 TIAC Codes:
    .1 CRD: Code Round Ductwork.
    .2 CRF: Code Rectangular Finish.

.2 Reference Standards:
  .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
  .2 ASTM International Inc.
    .1 ASTM C 547-07e1, Standard Specification for Mineral Fiber P Insulation.
    .2 ASTM C 553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  .3 Canadian General Standards Board (CGSB)
    .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Mater for Pipe, Duct and Equipment Thermal Insulation.
  .4 Thermal Insulation Association of Canada (TIAC): National Insulat Standards (2005).
  .5 Underwriters Laboratories of Canada (ULC)
    .1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
    .2 CAN/ULC-S701-05, Standard for Thermal Insulation Polystyre Boards and Pipe Covering.

2 PRODUCTS

2.01 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:
  .1 Maximum flame spread rating: 25.
  .2 Maximum smoke developed rating: 50.

2.02 INSULATION

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

.2 Thermal conductivity ("k" factor) not to exceed specified values at 2 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.

2.03 JACKETS

.1 Canvas:
.1 220 gm/mý cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

2.04 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

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

.4 ULC Listed Canvas Jacket:
.1 220 gm/mý cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

3 EXECUTION

3.01 APPLICATION

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

3.02 PRE-INSTALLATION REQUIREMENTS

.1 Ensure surfaces are clean, dry, free from foreign material.

3.03 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jac and finishes.

.1 Ensure hangers, supports to be outside vapour retarder jacket.

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

.5 Fasteners: install at 300 mm on centre in horizontal and vertical directio minimum two (2) rows each side.

3.04 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	25
Round cold and dual temperature supply air ducts	C-2	yes	25
Outside air air ducts to mixing plenum	C-1	yes	50
Exhaust duct between dampers and louvres	C-1	no	25

.2 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: Conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS .1.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE 90.1-04-SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.
.1 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.2 ASTM C 449/C 449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
.3 ASTM C 533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
.4 ASTM C 547-07, Standard Specification for Mineral Fiber Pipe Insulation.
.5 ASTM C 553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
.6 ASTM C 612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
.7 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
.8 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
.2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

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

.5 Underwriters Laboratories of Canada (ULC)

1.2 REFERENCES (Cont'd)

.5 (Cont'd)
.1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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 insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
.2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements 01 35 43 - Environmental Procedures.

.3 Manufacturer's Instructions:
.1 Include procedures to be used and installation standards to be achieved.

.4 Qualifications:
.1 Installer to be 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 of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section01 61 00 - Common Product Requirements.

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

.3 Store at temperatures and conditions recommended by manufacturer.

PART 2 - PRODUCTS

2.1 COMPONENTS

.1 Sustainable Requirements:
.1 Materials and products in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

2.2 FIRE AND SMOKE RATING

.1 Fire and smoke ratings to CAN/ULC-S102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre: 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: ASTM C 547.
.2 Maximum "k" factor: ASTM C 547.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C 547.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C 547.

.5 TIAC Code C-1: rigid mineral fibre board, unfaced.
.1 Mineral fibre: ASTM C 612.
.2 Maximum "k" factor: ASTM C 612.

.6 TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
.1 Mineral fibre: ASTM C 612.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C 612.

.7 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
.1 Mineral fibre: ASTM C 553.
.2 Jacket: to CGSB 51-GP-52MA.
.3 Maximum "k" factor: ASTM C 553.

.8 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
.1 Insulation: ASTM C 533.
.2 Maximum "k" factor: ASTM C 533.
.3 Design to permit periodic removal and re-installation.

2.4 CEMENT

.1 Thermal insulating and finish
.1 To: ASTM C 449/C 449M.
.2 Hydraulic setting or Air drying on mineral wool, to ASTM C 449.

2.5 JACKETS

.1 Polyvinyl Chloride (PVC):
.1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
.2 Minimum service temperatures: -20 degrees C.
.3 Maximum service temperature: 65 degrees C.
.4 Moisture vapour transmission: 0.02 perm.
.5 Thickness: mm.
.6 Fastenings:
.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
.2 Tacks.
.3 Pressure sensitive vinyl tape of matching colour.
.7 Covering adhesive: compatible with insulation.

.2 Canvas:
.1 220 and 120 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
.2 Lagging adhesive: compatible with insulation.

2.6 INSULATION SECUREMENTS

.1 Tape: self-adhesive, aluminum, plain 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.

.6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face both faces of insulation on one face of insulation with expanded metal lath on other face.

2.6 INSULATION SECUREMENTS (Cont'd)

.7 Fasteners: 2 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.

2.7 VAPOUR RETARDER LAP ADHESIVE

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

2.8 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with 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 testing of equipment and adjacent piping systems complete, witnessed and certified.

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

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards
.1 Hot equipment: To TIAC code 1503-H.
.2 Cold equipment: to TIAC code 1503-C.

.2 Elastomeric Insulation:to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.

.3 Provide vapour retarder as recommended by manufacturer.

.4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.

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

3.3 INSTALLATION (Cont'd)

.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports outside vapour retarder jacket.

.7 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 valves, primary flow measuring elements flanges and unions at equipment.

.2 Installation to permit periodic removal and replacement without damage to adjacent insulation.

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

PART 1 - GENERAL

1.1 SUMMARY

.1 Related Sections: .1.

1.2 REFERENCES

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

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 POTABLE WATER SYSTEMS

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 23.

.2 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.5 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: refer to Section 22 42 00 - Plumbing Fixtures.

PART 2 - PRODUCTS

2.1 NOT USED .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

.2 Related Sections:
.1 Section 23 33 14 - Dampers - Balancing.
.2 Section 23 37 13 - Diffusers, Registers and Grilles.
.3 Section 23 55 01 - Duct Heaters.
.4 Section 23 72 00 - Air-to-Air Energy Recovery Equipment.

1.2 References

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

.2 American Society for Testing and Materials (ASTM)
.1 ASTM A 480/A480M-03c, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
.2 ASTM A 635/A635M-02, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
.3 ASTM A 653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 National Fire Protection Agency (NFPA)
.1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.
.2 NFPA 90B-02, Standard for the 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, 2nd Edition 1995 and Addendum No. 1, 1997.
.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
.3 IAQ Guidelines for Occupied Buildings Under Construction (1995, 1st Edition).

PART 2 - PRODUCTS

2.1 Seal

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

.2 Seal classification:
.1 Class C: transverse joints and connections made air tight with sealant tape or combination thereof. Longitudinal seams unsealed.

2.2 Sealant

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°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 Duct Leakage Test Manual.

2.5 Fittings

.1 Fabrication: to SMACNA.

.2 Radiused elbows:
.1 Rectangular: standard radius. Centreline radius: 1.5 times width of duct.
.2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
.1 To 400 mm: with single thickness turning vanes.

.4 Branches:
.1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.
.2 Round main and branch: enter main duct at 45° with conical connection.
.3 Provide volume control damper in branch duct near connection to main duct.

2.5 Fittings (Cont'd)

.4 (Cont'd)
.4 Main duct branches: with splitter damper.

.5 Transitions:
.1 Diverging: 20° maximum included angle.
.2 Converging: 30° maximum included angle.

.6 Offsets:
.1 Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 Firestopping

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

.2 Firestopping material and installation must not distort duct.

2.7 Galvanized Steel

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

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.8 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
.1 Maximum size duct supported by strap hanger: 500 mm.
.2 Hanger configuration: to SMACNA.
.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6

.2 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.2 For steel joist: manufactured joist clamp.

2.8 Hangers and Supports (Cont'd)

.2 (Cont'd)
.3 For steel beams: manufactured beam clamps.

PART 3 - EXECUTION

3.1 General

.1 Do work in accordance with NFPA 90A, NFPA 90B, SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.

.3 Support risers in accordance with SMACNA.

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

3.2 Hangers

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with ASHRAE SMACNA.

3.3 Watertight Duct

.1 Provide watertight duct for:
.1 Fresh air intake.

.2 Form bottom of horizontal duct without longitudinal seams.
.1 Solder joints of bottom and side sheets.
.2 Seal other joints with duct sealer.

.3 Slope horizontal ductwork down towards louvre.

3.4 Sealing and Taping

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

3.4 Sealing and Taping (Cont'd)	.2	Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
.2 Sustainable requirements for construction and verification.

.2 Related Section:
.1 Section 23 31 13 - Metal Ducts - Low Pressure to 500 Pa.

1.2 References

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

1.3 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.
.2 Flexible connections.
.3 Duct access doors.
.4 Turning vanes.

PART 2 - PRODUCTS

2.1 General

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

2.2 Flexible Connections

.1 Frame: galvanized sheet metal frame 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°C to plus 90°C, density of 1.3 kg/m^2.

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.

2.4 Turning Vanes

.1 Factory or shop fabricated single thickness to recommendations of SMACNA.

PART 3 - EXECUTION

3.1 Application

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

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: 75mm.
.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:
.1 300 x 300 mm for servicing entry.

3.2 Installation (Cont'd)

.2 (Cont'd)
.1 (Cont'd)
.2 Locations:
.1 Fire and smoke dampers.
.2 Control dampers.
.3 Devices requiring maintenance.
.4 Required by code.
.5 Reheat coils.
.6 Elsewhere as indicated.

.3 Turning vanes:
.1 Install in accordance with recommendcations of SMACNA and as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 References

.1 Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible- 1985.

PART 2 - PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Splitter Dampers

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Single thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 Single Blade Dampers

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 Multi-Bladed Dampers

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 - EXECUTION

3.1 Application

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

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 Corrections and adjustments conducted by Departmental Representative.

3.3 Cleaning .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM A 653/A 653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

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 the following:
.1 Performance data.
.2.

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

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

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

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

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 MULTI-LEAF DAMPERS

.1 Opposed and or parallel blade type as indicated.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Operator: to Section 23 09 43 - Pneumatic Control System for HVAC.

.6 Performance:
.1 Leakage: in closed position less than 2% of rated air flow.
.2 Pressure drop: as indicated.

.7 Insulated aluminum dampers:
.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.2 BACK DRAFT DAMPERS

.1 Automatic gravity operated, single leaf, aluminum or steel construction with nylon bearings, centre pivoted spring assisted.

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. S.e 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

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Materials and installation of flexible ductwork, joints and accessories.

.2 Related Sections:
.1 Section 23 37 13 - Diffusers, Registers and Grilles.

1.2 References

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

.2 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 the Installation of Warm Air Heating and Air Conditioning Systems.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 95 and Addendum No.1 November 1997.
.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.4 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULC-S110-1986(R2001), Fire Tests for Air Ducts.

1.3 Submittals

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

.2 Indicate the following:
.1 Thermal properties.
.2 Friction loss.
.3 Acoustical loss.
.4 Leakage.
.5 Fire rating.

.3 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 Indoor Air Quality (IAQ) Management Plan

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

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 Metallic - Uninsulated

.1 Type 1: spiral wound flexible stainless steel, as indicated.

.2 Performance:
.1 Factory tested to 2.5 kPa without leakage.
.2 Maximum relative pressure drop coefficient: 3.

2.3 Non-metallic - Insulated

.1 Type 4: non-collapsible, coated mineral base fabric, aluminum foil mylar, type mechanically bonded to, and helically supported by, external steel wire with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket.

.2 Performance:
.1 Factory tested to 2.5 kPa without leakage.
.2 Maximum relative pressure drop coefficient: 3.

PART 3 - EXECUTION

3.1 Duct Installation

.1 Install in accordance with: CAN/ULC-S110 NFPA 90A, NFPA 90B SMACNA.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 System Description

.1 Performance Requirements:
.1 Catalogued or published ratingsfor 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 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 Indicate the following:
.1 Capacity.
.2 Throw and terminal velocity.
.3 Noise criteria.
.4 Pressure drop.
.5 Neck velocity.

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 at all locations.
.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Departmental Representative.

2.2 Manufactured Units	.1	Grilles, registers and diffusers of same generic type to be product of one manufacturer.
2.3 Supply Grilles and Registers	.1	General: see Schedule on drawings.
2.4 Return and Exhaust Grilles and Registers	.1	General: see Schedule on drawings.

PART 3 - EXECUTION

3.1 Application	.1	Manufacturer's Instructions: .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.
3.2 Installation	.1	Install in accordance with manufacturers instructions.
	.2	Install with secure fasteners.
	.3	Bolt grilles, registers and diffusers, in place.
3.3 Cleaning	.1	Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Mechanical louvres, intakes, vents and reinforcement and bracing for air vents, intakes and gooseneck hoods.

1.2 References

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
.1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

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

.3 Society of Automotive Engineers (SAE).

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.

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.

.2 Indicate the following:
.1 Pressure drop.
.2 Face area.
.3 Free area.

PART 2 - PRODUCTS

2.1 GOOSENECK HOODS

.1 Thickness: to ASHREA and SMACNA.
.1 to ASHRAE SMACNA

2.1 GOOSENECK HOODS (Cont'd)

.2 Fabrication: to ASHREA and SMACNA.
.1 to ASHREA SMACNA

.3 Joints: to ASHREA and SMACNA and or proprietary manufactured duct joint. Proprietary manufactrured flanged duct jointconsidered class A seal.

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 2.7mm diameter copper aluminum ss wire. Use 12mm mesh on exhaust 19mm mesh on intake.

PART 3 - EXECUTION

3.1 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

3.2 Cleaning

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

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Materials and application of hot water duct heaters.
.2 Sustainable requirements for construction and verification.

.2 Related Sections:
.1 Section 23 31 13 - Metal Ducts - Low Pressure to 500 Pa.

1.2 Submittals

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

.2 Submit product data and include:
.1 Element support details.
.2 Heater total kW rating, voltage, phase.
.3 EWT: 82.2 degrees celcius.
.4 WTD: 71 degrees celcius
.5 WPD: 13.8 degrees celcius.
.6 APD: 16.0 degrees celcius.
.7 Heater element watt/density and maximum sheath temperature.
.8 Maximum discharge temperature.
.9 Physical size.
.10 Unit support.
.11 Clearance from combustible materials.
.12 Minimum operating air flow.
.13 Pressure drop minimum air flow.

PART 2 - PRODUCTS

2.1 Duct Heaters

.1 Duct heaters: insert type.

.2 Elements:
.1 Finned tubular.

.3 Maximum temperature at discharge: 71°C.

.4 Controls: Discharge air temperature control by DDC.
.1 Where heater is mounted ductwork, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
.2 Factory mounted and wired in control box use terminal blocks for power and control wiring to thermostat and sail switch.

2.1 Duct Heaters (Cont'd)

.4 (Cont'd)
.3 Controls mounted in a CSA type enclosure and to include:
.1 Magnetic Mercury contractors.

PART 3 - EXECUTION

3.1 Installation

.1 Make power and control connections in accordance with CSA C22.2 No.46.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements and Section 26 05 00 - Common Work Results - Electrical.

.2 Perform tests in presence of Departmental Representative.

.3 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.

.4 Where controls are mounted in heater, exercise care in mounting contractors to minimize switching noise transmission through ductwork.

.5 High temperature cutout and air proving switch.

.6 Electrical:
.1 Duct heater kw.
.2 208V voltage.
.3 Phase

.7 Main isolation disconnect switch.

END OF SECTION

PART 1 - GENERAL

1.1 Summary

.1 Section Includes:
.1 Materials, components and installation for heat reclaim devices.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ASHRAE 84-1991, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).

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.

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

.3 Certificates:
.1 Catalogued or published ratings obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
.2 Provide confirmation of testing.

1.4 Maintenance

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include: such as bearings and
.1 Bearings and seals.
.2 Address of suppliers.
.3 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 - PRODUCTS

2.1 General

.1 Certified by ARI Standard 1060.

.2 NFPA 90A and NFPA 90B requirements.

2.2 Static Plate Type

.1 Capacity: as indicated on drawings.

.2 The energy recovery core shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished through molecular transport by hydroscopic resin.

.3 The energy recovery core shall perform without the occurrence of condensation or frosting under normal operating conditions (defined as outside temperature above -10°F and inside relative humidity below 40%). Occasional extreme conditions shall not affect the usual function or performance of the energy recovery core.

.4 Exhaust and fresh airstreams shall be at times travel in separate passages, and airstreams shall not mix. The exhaust air transfer ratio (EATR) shall be ARI-1060 certified as 0% at balanced pressure.

.5 Airflow through the energy recovery core shall be laminar, avoiding deposition of particulates on the interior of the exchange plate material.

.6 The energy recovery core shall be of static plate, cross-flow construction, with no moving parts.

.7 The unit shall be capable of operating in winter and summer conditions without generating condensate. No condensate pan or drain shall be required.

.8 The unit cabinet shall be constructed of galvanized, 20-gauge steel, with lapped corners.

.9 The unit shall have single-point power connection.

.10 Flange components shall be provided suitable for connection of ductwork.

2.2 Static Plate Type (Cont'd)

.11 The exhaust and fresh air streams shall both be protected by MERV 8 rated, 2 inch pleated, disposable filters positioned before the ERV core.

PART 3 - EXECUTION

3.1 Application

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

3.2 Installation

.1 Install in accordance with manufacturer's recommendations.

.2 Support independently of adjacent ductwork with flexible connections.

.3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories for access to coils, dampers.

3.3 Cleaning

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

END OF SECTION