1.0 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 licensed in Province of Manitoba, 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 reviewed by, and final copies deposited with, Contract Administrator before final site review.
  .3 Operation data to include:
    .1 Control schematics for systems including environmental controls.
    .2 Description of systems and their controls.
    .3 Description of operation of systems 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.
  .4 Maintenance data to include:
    .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    .2 Data to include schedules of tasks, frequency, tools required and task time.
  .5 Performance data to include:
    .1 Equipment manufacturer's performance datasheets 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 Manuals:
    .1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for review. Submission of individual data will not be accepted unless directed by Contract Administrator.
    .2 Make changes as required and re-submit as directed by Contract Administrator.
  .7 Additional data:
    .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  .8 Site records:
    .1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets 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 weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes.

.9 As-built drawings:

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

.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 Contract Administrator for review 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.

.2 Health and Safety Requirements: in accordance with Part D - Supplemental Conditions.

1.3 MAINTENANCE

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

.1 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.

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.

.2 Waste Management and Disposal:

.1 Dispose of waste materials in accordance with Section 01 73 00 - Execution.

2.0 Products

2.1 NOT USED

.1 Not used.

3.0 Execution

3.1 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.

3.2 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.
.3 Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct site tests in accordance with Section 01 45 00 - Quality Control and submit report to Contract Administrator for review.
.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 to Contract Administrator for review.
  .2 Provide manufacturer's field services consisting of product use recommendations and periodic site reviews of product installation in accordance with manufacturer's instructions.
  .3 Schedule site reviews of Work in accordance with Section 01 45 00 - Quality Control.

3.4 DEMONSTRATION

.1 Contract Administrator 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 all equipment and systems.
.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 operation 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.
.6 Contract Administrator may record these demonstrations on video tape for future reference.

3.5 PROTECTION

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

END OF SECTION

1.0 General

1.1 SUMMARY

.1 Section Includes:
- .1 Electrical motors, drives and guards for mechanical equipment and systems.
- .2 Supplier and installer 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 Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

.1 The most current edition of the following:

.2 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).

.3 Electrical Equipment Manufacturers' Association Council (EEMAC)

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

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.

.2 Waste Management and Disposal:
- .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GENERAL

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

2.2 MOTORS

.1 Provide motors for mechanical equipment as indicated.

.2 Motors under 1/2 HP : speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.

.4 All motors to be inverted duty rated for use with variable frequency drives unless

otherwise indicated.

.5 Direct drive DC motors:
- .1 Motor shall be brushless DC type specifically designed for fan applications with heavy duty ball bearings and electronic commutation.
- .2 Shall contain internal circuitry that converts 115 volt single phase power to a DC signal.
- .3 Motor shall be speed controllable down to 20% of full speed. Speed control is achieved through either a potentiometer dial mounted on the exterior of the motor housing, or a 0-10 volt control signal input through the pre-wired controls wires.
- .4 Motor shall be a minimum of 85% efficient at all speeds.

.6 Two speed motors:
- .1 Where indicated provide motors with two sets of windings or equal in accordance with Part B - Bidding Procedures.
- .2 Accepted equivalents to two speed motors:
  - .1 Variable frequency drives.
  - .2 Speed controllable direct drive DC motors.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor reviewed 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 10 HP : 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 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 23 05 00 - Common Work Results for HVAC.

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 centers for insertion of tachometer.
- .4 Removable for servicing.

.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.

3.0 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 site tests in accordance with Section 23 05 00 - Common Work Results For HVAC and submit report to Contract Administrator for review.
.2 Manufacturer's Field Services: in accordance with Section 23 05 00 - Common Work Results For HVAC.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 REFERENCES

.1 The most current edition of the following:
.2 American Society of Mechanical Engineers (ASME)
  .1 ASME B31.1, Power Piping.
.3 ASTM International
  .1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.
  .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  .3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
.4 Factory Mutual (FM)
.5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  .2 MSS SP69, Pipe Hangers and Supports - Selection and Application.
  .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.
.6 Underwriter's Laboratories of Canada (ULC)

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results for HVAC.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 23 05 00 - Common Work Results for HVAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results for HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results for HVAC.

2.0 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 SP58.
  .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 SP58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 In accordance with CAN/CSA B149.1.

2.4 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications. Submit calculations with shop drawings.

2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.6 PLATFORMS AND CATWALKS

.1 To Section 05 50 00 - Metal Fabrications.

2.7 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 50 00 - Metal Fabrications.
.2 Submit structural calculations with shop drawings.

3.0 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 as indicated.
.3 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
.4 Use constant support type hangers where:
  .1 Transfer of load to adjacent hangers or connected equipment is not permitted.
.5 Use variable support spring hangers where:
  .1 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Natural Gas: to CAN/CSA B149.1.

3.4 HANGER INSTALLATION

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

3.5 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
  .1 Equalize loads.

3.6 FIELD QUALITY CONTROL

.1 Site Tests: conduct site tests in accordance with Section 23 05 00 - Common Work Results For HVAC and submit report to Contract Administrator for review.
.2 Manufacturer's Field Services: in accordance with Section 23 05 00 - Common Work Results For HVAC.

3.7 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

.1 Section Includes:
  .1 Vibration isolation materials and components, and their installation.

1.2 REFERENCES

.1 The most current edition of the following:
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).
.3 National Fire Protection Association (NFPA)
  .1 NFPA 13, Standard for the Installation of Sprinkler Systems.
.4 National Building Code of Canada (NBC)

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GENERAL

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

2.2 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 leveling devices.
.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
.3 Cadmium plate for 100% relative humidity installations.
.4 Colour code springs.

2.3 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; leveling 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.

.6 Performance: as indicated.

2.4 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.

.6 Performance: as indicated.

2.5 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 where indicated.

.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 25 mm minimum.

3.0 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 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
  .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
    .1 After delivery and storage of Products.
    .2 After preparatory work is complete but before installation commences.
    .3 Twice during the installation, at 25% and 60% completion stages.
    .4 Upon completion of installation.
  .3 Submit manufacturer's reports to Contract Administrator within 3 days of manufacturer representative's review.
  .4 Make adjustments and corrections in accordance with written report.
.2 Review and Certification:
  .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  .2 Take vibration measurements for equipment as indicated.
  .3 Provide Contract Administrator with notice 24 h in advance of commencement of tests.
  .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
  .5 Submit complete report of test results including sound curves.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 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 REFERENCES

.1 The most current edition of the following:
.2 Canadian Gas Association (CGA)
  .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.
.3 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  .2 CAN/CGSB-24.3, Identification of Piping Systems.
.4 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.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 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 laminated plastic, 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.
.4 Locations:
.1 Terminal cabinets, control panels: use size # 5.
.2 Equipment in Mechanical Rooms: use size # 9.
.5 Identification for PWGSC Preventive Maintenance Support System (PMSS):
.1 Use arrangement of Main identifier, Source identifier, Destination identifier.
.2 Equipment in Mechanical Room:
.1 Main identifier: size #9.
.2 Source and Destination identifiers: size #6.
.3 Terminal cabinets, control panels: size #5.
.3 Equipment elsewhere: sizes as appropriate.

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 acceptance 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 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.

2.6 LANGUAGE

.1 Identification in English and French.
.2 Use one nameplate and label for both languages.

3.0 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

3.2 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.

3.3 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.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 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.

.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 the most current edition of the standard under which TAB Firm's qualifications are accepted:

- .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.

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 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 days prior to start of TAB.
.2 Start TAB when building 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:
        .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 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:
  .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for review 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 Submit 6 copies of TAB Report to Contract Administrator for verification and review, 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 up to 30% 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 reviewed by Contract Administrator.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of TAB standards of AABC.
.2 Do TAB of systems, equipment, components, controls specified Division 23.
.3 Qualifications: personnel performing TAB qualified to standards of AABC.
.4 Quality assurance: perform TAB under direction of supervisor qualified by 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.

.6 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.

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

.8 Coordinate with Section 23 09 33 - Electric and Electronic Control System for HVAC and Section 23 73 11 - Air Handling Units - Packaged to set low speed of make-up air unit (MUA-1) to match low speed of exhaust fans (EF-1 & EF-2) to within 10% of negative space pressure to neutral space pressure.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:
  .1 Qualifications of TAB personnel: as for air systems specified this section.
  .2 Quality assurance: as for air systems specified this section.

.2 Fume hoods:
  .1 Standard: Canada Labour Code, state applicable Provincial or other standard.
  .2 TAB procedures: as described in standard.

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

.4 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.

.5 Measurement of noise and vibration from equipment specified in Division 23.

.6 Measurement of spatial noise and vibration.

2.0 Products

2.1 NOT USED

.1 Not used.

3.0 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

1.0 General

1.1 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 previouslydefined.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Code Round Ductwork,
  - .2 CRF: Code Rectangular Finish.

.2 The most current edition of the following:
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International Inc.
  - .1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C921, 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 Green Seal Environmental Standards (GSES)
  - .1 Standard GS-36, Commercial Adhesives.
- .5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .6 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.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.3 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 of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 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 fiber: as specified includes glass fiber, 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 C335.
.3 TIAC Code C-1: Rigid mineral fiber board to ASTM C612, 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 fiber blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  .1 Mineral fiber: to ASTM C553.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:
  .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.2 Lagging adhesive: compatible with insulation.
  .1 Maximum VOC limit 50 g/L to GSES GS-36.
.3 Aluminum:
  .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
  .2 Thickness: 0.50 mm sheet.
  .3 Finish: Smooth.
  .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.
.4 Stainless steel:
  .1 Type: 304.
  .2 Thickness: 0.25 mm sheet.
  .3 Finish: Smooth.
  .4 Jacket banding and mechanical seals: 12 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.
    .1 Maximum VOC limit 50 g/L to GSES GS-36.
.2 Indoor Vapour Retarder Finish:
  .1 Vinyl emulsion type acrylic, compatible with insulation.
.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
.4 ULC Listed Canvas Jacket:
  .1 220 gm/m2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
.5 Outdoor Vapour Retarder Mastic:
  .1 Vinyl emulsion type acrylic, compatible with insulation.
  .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m2.
.6 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
.7 Contact adhesive: quick-setting
  .1 Maximum VOC limit 50 g/L to GSES GS-36.
.8 Canvas adhesive: washable.
  .1 Maximum VOC limit 50 g/L to GSES GS-36.
.9 Tie wire: 1.5 mm stainless steel.
.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
.11 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face of insulation.
.12 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

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

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.
.2 Apply materials in accordance with manufacturers 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)
Rectangular cold and dual temperature supply air duct	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served	C-1	no	25
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none	no	25

.1 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
.1 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
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

.1 Section Includes:
  .1 Materials and installation procedures for electric heating and ventilation controls.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.3 QUALITY ASSURANCE

.1 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 SEQUENCING

.1 Sequencing of operations for systems as follows:
  .1 Meter Shop Ventilation:
    .1 HRV-1: Unit shall start and operate to maintain the air quality set-point of a space carbon dioxide (CO2) sensor or from a manual override switch.
      .1 Initial adjustable air quality set-point shall be:
        .1 700 ppm of CO2.
    .2 EDH-1: Unit shall operate through an electronic SCR controller to maintain supply air temperature set-point of -6 degrees C.
  .2 Hydrant Shop Ventilation:
    .1 EF-6: Unit shall start and operate on low speed to maintain the air quality set-point of a space carbon dioxide (CO2) sensor or from a manual override switch. Unit shall start and operate on high speed to maintain the air quality set-point of space carbon monoxide (CO) and nitrogen dioxide (NO2) sensors.
      .1 Initial adjustable air quality set-points shall be:
        .1 700 ppm of CO2.
        .2 12 ppm of CO.
        .3 0.72 ppm of NO2.
    .2 AHU-1: Unit fan shall start and operate through direct interlock to exhaust fan EF-6 at a constant air volume regardless of EF-6 fan speed. Unit electric heating coil shall operate through an electronic SCR controller to maintain air temperature set-point of 12 degrees C. Unit outdoor air inlet damper shall open to minimum setting when exhaust fan EF-6 operates at low speed, and open to 100% when exhaust fan EF-6 operates at high speed.
    .3 Air Quality Alarm: The carbon monoxide (CO) and nitrogen dioxide (NO2) sensor control panel shall emit an audible alarm when air contaminant concentrations exceed the following set-points:
      .1 25 ppm of CO.

.2 2 ppm of NO2.

.3 Wastewater Services Garage Ventilation:

.1 EF-1 & EF-2: Units shall start and operate on low speed to maintain the air quality set-point of space carbon dioxide (CO2) sensors or from a space de-humidistat or from a manual override switch. Unit shall start and operate on high speed to maintain the air quality set-point of space carbon monoxide (CO) and nitrogen dioxide (NO2) sensors.

.1 Initial adjustable air quality set-points shall be:

.1 700 ppm of CO2.

.2 12 ppm of CO.

.3 0.72 ppm of NO2.

.2 Initial adjustable humidity set-point for de-humidification shall be:

.1 55% RH.

.2 MUA-1: Unit shall start and operate at low speed through direct interlock to exhaust fans EF-1 & EF-2. Unit indirect gas-fired heat exchanger shall operate through proportional and integral control to maintain air temperature set-point of 12 degrees C. Unit speed drive shall modulate unit operation to maintain differential pressure set-point.

.1 Initial adjustable differential pressure set-point shall be:

.1 0 Pa to -10 Pa to maintain neutral to slight negative pressure in the building relative to the Hydrant Shop.

.3 Air Quality Alarm: The carbon monoxide (CO) and nitrogen dioxide (NO2) sensor control panel shall emit an audible alarm when air contaminant concentrations exceed the following set-points:

.1 25 ppm of CO.

.2 2 ppm of NO2.

.4 Wastewater Services Garage Welding Hood:

.1 EF-3: Unit shall start and operate from a wall mounted on/off switch.

.5 Wastewater Services Garage Parts Cleaning Exhaust Hood:

.1 EF-5: Unit shall start and operate from a wall mounted on/off switch.

.6 Wastewater Services Spaces Below Mezzanine:

.1 EF-4: Unit shall start and operate from the Locker Room light switch.

.2 F-1 & CU-1: Unit shall start and operate from a wall mounted heating and cooling thermostat mounted on the Break Room wall to maintain room temperature at the thermostat set-point.

2.0 Products

2.1 THERMOSTAT

.1 Low voltage fan coil heating-cooling thermostat with:

.1 For use on 24 V circuit at 1.5 A capacity.

.2 Four position fan switches for "Low- Medium-High-Off" fan switch.

.3 "Heat-Cool" switch and fan "Off" switch. Fan "Off" switch to break all circuits except heating.

.4 Two rocker switches for "Heat-Off-Cool" and "Low-Medium-High" fan switching. Isolate heating and cooling circuits. "Off" switch to break power to fan and thermostat.

.5 With heat anticipator adjustable 0.1 to 1.2 A.

.6 Temperature setting range: 10 degrees C to 25 degrees C.

.7 Without sub-base.

2.2 THERMOSTAT GUARDS

.1 Thermostat guards: lockable, opaque, cast metal. Slots for air circulation to thermostat.

2.3 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:
- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.4 AIR QUALITY SENSORS

.1 Transmitter:
- .1 Transmitter will be powered by the control panel power supply rated at 24 Vac. Fully addressable gas transmitter must be capable of communicating digitally with controller through an RS-485 communication port. Gas transmitters must be installed in a true daisy chain with an end of the line resistor on the last transmitter. The gas transmitter will incorporate an electrochemical cell for toxic gas monitoring and catalytic bead sensor for combustible gases. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
- .2 When placed in a network configuration the transmitter will be capable of transmitting gas concentrations through the controller. For local activation of fans or louvers (or other equipment) an on-board DPDT relay 5 A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable time delays) through the control panel. An LCD display will provide gas concentration readings.
- .3 Transmitter will be capable of operating within relative humidity ranges of 5-95% and temperature ranges of -20 degrees C to 40 degrees C.
- .4 Unit will be certified to ANSI/UL 61010-1 label and CAN/CSA-C22.2 No.61010-1. Transmitter must be manufactured in an ISO 9001-2000 production environment.
- .5 The transmitter should have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing.
- .6 For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 3 m.
- .7 Acceptable Material:
  - .1 Carbon Monoxide (CO) Transmitter: Honeywell Analytics model E3SMSCO or equal in accordance with Part B - Bidding Procedures.
  - .2 Nitrogen Dioxide (NO2) Transmitter: Honeywell Analytics model E3SM / E3NO2 or equal in accordance with Part B - Bidding Procedures.

.2 IAQPoint:
- .1 The equipment analog version shall be able to communicate a 4-20 mA signal through an RS485 interface either to a VA301C Controller or a BAS. The detection unit, digital version, shall be able to communicate with a BAS using a BACnet

MS/TP, Modbus or LON protocol. The detector shall use the Dual-Channel Non-Dispersive Infrared sensing technology (NDIR) and be able to monitor Carbon Dioxide (CO_2) concentration within two ranges: 0-2000 ppm or 0-10 000 ppm (user selectable). It shall have a response time of less than 60 seconds for a 90% step change.

.2 The detector shall also be able to simultaneously monitor the temperature (either in Celsius or Fahrenheit) and the Relative Humidity in addition to Carbon Dioxide. The temperature range shall be within -20 to 50 degrees C and the relative humidity range shall be within 0 to 95%. It shall have a footprint not larger than 99x63.5x30.5 mm. It shall be easily installed into an electrical box when wall-mounted and weighs no more than 200 g. It shall have a duct-mount version that weighs no more than 300 g and that allows an easy and simple insertion of the sampling tubes and.

.3 The detector's power requirements are 20 to 30 Vac or 18 to 30 Vdc, 0.5 A, 50/60 Hz. Its digital version shall be equipped standard with a graphic LCD 122 x 32 displays and be programmable by three buttons in the front panel. It shall allow a choice of communication baud rates among 4800, 9600, 38400 or 57600 Bd.

.4 The unit must mount directly onto drywall or other non-vibrating surfaces.

.5 Acceptable Material: Honeywell Analytics model IAQPT-SM-M-D or equal in accordance with Part B - Bidding Procedures.

.3 Controller:

.1 The control panel must be capable of communicating digitally with the networked transmitters and relay modules through three RS-485 Modbus communication buses. Each communication bus must be capable of accepting a combination of up to 32 addressable transmitters, relay modules, or annunciator panels at a maximum distance of 610 m. The power supply shall be of either 24 Vac or 24 Vdc

.2 The controller will manage four internal DPDT relays at fully programmable alarm levels (and within programmable time delays) and be capable of activating multiple relay modules of eight relays each. The relay rating will be no lower than 5 A, 30 Vdc or 250 Vac (resistive load).

.3 The controller must include a self-test function that allows for the activation/deactivation of all the programmed outputs by simulating a continuous 5% increase/decrease value until the maximum/minimum value is reached.

.4 The controller must include a real-time clock that enables operation of the outputs for a specific time frame.

.5 The controller must also include an energy saving feature that allows for output operation on alarms set at the max, min or average value of a specific group of transmitters. This feature must also allow for the activation of outputs upon a certain number of a specific group (3/4, 1/2, 1/3 and 1/4) of transmitters reaching their alarm levels. A total of 128 groups can be assigned.

.6 The controller will be capable of communicating with an annunciator panel that can serve as a remote display panel in a secondary control room.

.7 The controller will indicate the exact concentration of gas, the gas detected, and the location of the sensor by sweeping through the network and displaying the detected levels at each point on a graphic LCD display.

.8 Acceptable Material: Honeywell Analytics model VA301C or equal in accordance with Part B - Bidding Procedures.

.4 Accessories:

.1 Relay Modules:

.1 Relay module will be powered by the control panel's power output or by power transformer rated at 24 Volts AC or DC (always respect minimum voltage requirements at device).

.2 Module must be capable of communicating digitally with the controller through an RS-485/MODBUS communication port.
.3 Relay module will have eight relays rated at no lower than 5A, 30 Vdc or 250 Vac (resistive load).
.4 Acceptable Material: Honeywell Analytics model VA301R8 or equal in accordance with Part B - Bidding Procedures.

.2 Detector Guards:
.1 The guard is made of a 9-gauge steel wire.
.2 The guard must be designed to allow calibration without removing the guards.

2.5 DAMPER OPERATORS

.1 Dampers: in accordance with Section 23 33 15 - Dampers - Operating. Operators shall be factory mounted.
.2 Provide spring return for "fail safe" in normally open or normally closed position as indicated.
.4 Size operators to control dampers against maximum pressure or dynamic closing pressure, whichever is greater.
.5 Provide electric type operators with adjustable spring and stroke. Provide adjustable external stops to limit stroke in either direction.
.6 Where electronic damper operators are connected into fire alarm system, provide additional control devices to allow dampers to respond and go to required position upon signal in less than 15 seconds.

2.6 VARIABLE SPEED DRIVES

.1 Factory mounted on Make-up Air Unit by unit manufacturer.
.2 Coordinate with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC and Section 23 73 11 - Air Handling Units - Packaged to commission variable speed drives as specified.

2.7 HUMIDISTAT

.1 Line voltage, wall mounted humidistat, for dehumidifying with:
.1 Voltages: 24 VAC, 120 VAC, 240 VAC.
.2 Ratings:
.1 Full Load: 7.5 A at 120 V, 3.8 A at 240 V.
.2 Locked Rotor: 30 A at 120 V, 15 A at 240 V.
.3 Resistive: 12 A at 120 V, 6 A at 240 V.
.3 Humidity setting range: 20% to 80% RH.
.4 Differential: 4% to 6% RH.
.5 Environmental: 10 to 52 degrees C.
.6 Acceptable Materials: Honeywell model H46C or equal in accordance with Part B - Bidding Procedures.

2.8 WIRING

.1 In accordance with Sections 26 27 26 - Wiring Devices and 26 05 21 - Wires and Cables (0-1000 V).

3.0 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

3.2 INSTALLATION

.1 Install control devices.
.2 On outside wall, mount thermostats on insulated pad 25 mm from exterior wall.
.3 Install hazardous gas monitoring equipment including sensors, audible alarms, control panels as indicated, as recommended by manufacturer of equipment, and as required by authorities having jurisdiction.
.4 Install conduit and wiring from sensors to control panel and to the fan starters or HVAC control panel as recommended by manufacturer of equipment.

3.3 TESTING AND COMMISSIONING

.1 Calibrate and control systems for accuracy and performance.
.2 Provide complete testing and verification of all hazardous gas monitoring equipment, complete with reports to demonstrate operation of functions described above under sequence of operation by manufactures authorized certified service agent.
.3 Coordinate with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC and Section 23 54 16 - Fuel-Fired Furnaces to commission variable speed drives as specified.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 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.
.3 American Society for Testing and Materials International (ASTM)
  .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
  .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  .3 ASTM B75M, Standard Specification for Seamless Copper Tube Metric.
  .4 ASTM B837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
.4 Canadian Standards Association (CSA International)
  .1 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 Handbook.
  .2 CAN/CSA B149.2, Propane Storage and Handling Code.
.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meeting:
  .1 Convene pre-installation meeting one week prior to beginning work of this Section to:
    .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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 PIPE

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 B837.

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 A47/A47M.
  .5 Bolts and nuts: to ASME B18.2.1.
  .6 Nipples: schedule 40, to ASTM A53/A53M.
.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 compliant, lubricated plug type.

3.0 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 PIPING

.1 Install in accordance with CAN/CSA B149.1 and all applicable Provincial/Territorial Codes.
.2 Install drip points:
  .1 At low points in piping system.
  .2 At connections to equipment.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise indicated by Contract Administrator.
.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests:
  .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
.2 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 review 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 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to Contract Administrator.

.4 Performance Verification:

.1 Test performance of components.

3.5 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 accepted location, protected against blockage, damage.

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

3.6 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.3 American Society for Testing and Materials International, (ASTM).
  .1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  .2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
  .3 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
.4 Department of Justice Canada (Jus).
  .1 Canadian Environmental Protection Act (CEPA).
.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.6 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.
  .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.7 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.
  .3 IAQ Guideline for Occupied Buildings Under Construction.
.8 Transport Canada (TC).
  .1 Transportation of Dangerous Goods Act (TDGA).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 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 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.3 Indoor Air Quality (IAQ) Management Plan.
  .1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.

.2 Waste Management and Disposal:

.1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

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

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with gaskets. 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: standard radius.

.2 Round: smooth radius. Centreline radius: 1.5 times diameter.

.3 Mitered elbows, rectangular:

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

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

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct.

.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: 20 degrees maximum included angle.
.2 Converging: 30 degrees maximum included angle.

.6 Offsets:
.1 Full radiused elbows.

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

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, 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 duct.
.1 Maximum size duct supported by strap hanger: 500.
.2 Hanger configuration: to SMACNA.
.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and 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

.1 Upper hanger attachments:
.1 For concrete: manufactured concrete inserts.
.2 For steel joist: manufactured joist clamp.
.3 For steel beams: manufactured beam clamps.

3.0 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.
.2 Do not break continuity of insulation vapour barrier with hangers or rods.
.1 Insulate strap hangers 100 mm beyond insulated duct.
.2 Ensure diffuser is fully seated.
.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.
.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

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 SMACNA and as follows:

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

3.3 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.

3.4 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
.2 Complete test before performance insulation or concealment Work.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  .1 Material Safety Data Sheets (MSDS).
.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:
  .1 Convene pre-installation meeting one week prior to beginning work of this Section to:
    .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.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 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 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 fiber 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 sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.
.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated single 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.

3.0 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 As indicated.
.2 Locations:
.1 Fire and smoke dampers.
.2 Control dampers.
.3 Devices requiring maintenance.
.4 Required by code.
.5 Elsewhere as indicated.
.3 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.
.4 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 indicated 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.

.4 Turning vanes:
.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for review 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, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within 3 days of review, and submit, immediately, to Contract Administrator.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 Sheet Metal and Air Conditioning National Association (SMACNA)
  .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA, except maximum height as indicated.
.3 Locking quadrant with shaft extension to accommodate insulation thickness.
.4 Inside and outside nylon end bearings.
.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 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.

2.4 VOLUME EXTRACTOR DAMPERS

.1 For rectangular branch off rectangular main:
- .1 Adjustable gang operated curved blades to provide flow diversion and volume control at duct take-off.
- .2 Cold rolled blades and frame.
- .3 Blade spacing 51 mm on centre.
- .4 Blade orientation parallel to short duct dimension.
- .5 Manual control rod with locking device and position indicator.
- .6 Size: as indicated.
- .7 Acceptable Materials: E.H. Price model AE2 or equal in accordance with Part B - Bidding Procedures.

.2 For round branch duct off rectangular main:
- .1 Adjustable combination damper and equalizing grid to provide flow diversion and volume control at duct take-off.
- .2 Heavy cold rolled steel frame and extruded aluminum blades.
- .3 Individually adjustable louvre blades spring-tensioned to maintain setting.
- .4 Manual slotted operator control with locking device and position indicator.
- .5 Size: as indicated.
- .6 Acceptable Materials: E.H. Price model VCR or equal in accordance with Part B - Bidding Procedures.

3.0 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.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct site tests in accordance with Section 23 05 00 - Common Work Results For HVAC and submit report to Contract Administrator for review.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 American Society for Testing and Materials International (ASTM)
  .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.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: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 MULTI-LEAF DAMPERS

.1 Parallel blade type for all wall isolation applications. Opposed blade type for all mixed air applications.
.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 33 - Electric and Electronic Control System for HVAC.
.6 Performance:
  .1 Leakage: in closed position less than 15.2 L/s m2 of rated air flow at 0.25 Pa differential across damper.
  .2 Pressure drop: at full open position less than 0.007 Pa differential across damper at 5.08 m/s.
.7 Provide damper section with minimum of two (2) extended shafts, on either side, for mounting of operator.

2.2 THERMALLY INSULATED MULTI-LEAF DAMPERS

.1 Parallel blade type for all wall isolation applications. Opposed blade type for all mixed air applications.
.2 Dampers must be licensed to bear the AMCA seal.
.3 Dampers shall be 101 mm (4 inches) deep.
.4 Blades shall be extruded aluminum (6063-T5) not less than 1.60 mm (0.063 inches) thick, thermally broken with high density Polyurethane non-CFC injected foam insulation.
.5 Frame shall be extruded aluminum (6063-T5) not less than 2.03 mm (0.080 inches) thick, insulated with Polystyrene insulation.
.6 Axles shall be 9.53 mm (0.375 inch) extruded aluminum alloy 6063-T5.
.7 Bearings shall be either of the following:
  .1 Engineered thermo plastic (Acetal) rotating within a Polycarbonate outer bearing integral in frame.
  .2 A Celcon inner bearing fixed to a 11.11 mm (7/16") aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
.8 Blade and Jamb seals shall be Santoprene or extruded silicone.
.9 Operator: to Section 23 09 33 - Electric and Electronic Control System for HVAC and Section 23 73 11 - Air Handling Units - Packaged, accessories to air handling units, as applicable.
.10 Performance:
  .1 Leakage: in closed position less than 15.2 L/s m2 of rated air flow at 1.0 kPa static pressure at standard air (as per AMCA testing).
  .2 Pressure drop: at full open position less than 0.007 Pa differential across damper at 5.08 m/s.
  .3 Operating temperature: range shall be -40°C (-40°F) to 71°C (160°F).
.11 Dampers shall be made to size required without blanking off free area.
.12 Dampers shall be available as "Flanged to Duct" mounting type.
.13 Installation of dampers must be in accordance with current manufacturer's installation guidelines.
.14 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.
.15 Acceptable materials: Alumavent model 3961BF, TAMCO Series 9000 BF, or equal in accordance with Part B - Bidding Procedures.

3.0 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.
.6 Install damper operators outside of air stream.

3.3 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

.1 Section Includes:
  .1 Fans, motors, accessories and hardware for commercial use.

1.2 REFERENCES

.1 The most current edition of the following:
.2 Air Movement and Control Association (AMCA)
  .1 AMCA Publication 99, Standards Handbook.
  .2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.
  .3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
.3 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  .1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.4 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
.5 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, total static pressure, W, 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.
  .4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.
  .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Section 23 05 00 - Common Work Results For HVAC.
  .2 Furnish list of individual manufacturer's recommended spare parts for equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 -

Common Work Results For HVAC.

.2 Waste Management and Disposal:

.1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment supplemented as specified herein.

.2 For use with variable speed controllers.

.3 Sizes as indicated.

.2 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. Dampers and vanes and as indicated.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 UTILITY SETS

.1 General:

.1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Wheel:

.1 Forward curved centrifugal wheel.

.2 Constructed of heavy gauge steel with uniform stamped blades.

.3 Statically and dynamically balanced in accordance to AMCA Standard 204.

.4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

.5 Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

.3 Motors:

.1 Motor enclosures: Totally enclosed fan cooled.

.2 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.

.4 Housing:

.1 Discharge position specified on equipment schedule.

.2 Constructed of heavy gauge (galvanized) steel, with air tight lock formed seams.

.3 Shall be easily rotated in the field to any of the eight standard discharge positions.

.4 Housing and bearing supports shall be constructed of welded steel members to prevent vibration and to rigidly support the motor and wheel.

.5 Finishes:

.1 Types: Permatector, a thermal setting polyester urethane.

.6 Accessories:

.1 Dampers:

.1 Types: Motorized.

.2 Galvanized frames with prepunched mounting holes.
.3 Balanced for minimal resistance to flow.

.2 Shaft Seal:
.1 Shaft seal is an aluminum rub ring to seal the housing around the shaft.

.3 Isolation:
.1 Type: Spring Base Mounting Rails.
.2 Sized to match the weight of each fan.

2.3 IN-LINE CENTRIFUGAL FANS

.1 General:
.1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Wheel:
.1 Non-overloading, backward inclined centrifugal wheel.
.2 Constructed of aluminum.
.3 Statically and dynamically balanced in accordance to AMCA Standard 204.
.4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
.5 Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

.3 Motors:
.1 AC Induction Motor:
.1 Motor enclosures: Totally enclosed fan cooled.
.2 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.

.2 Electronically Commutated Motor:
.1 Motor enclosures: Open type.
.2 Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors.
.3 Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
.4 Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.

.4 Housing Construction:
.1 Construction material: Galvanized.
.2 Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
.3 Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

.5 Housing Supports and Drive Frame:
.1 Housing supports are constructed of structural steel with formed flanges.
.2 Drive frame is welded steel which supports the motor.

.6 Duct Collars:
.1 Square design to provide a large discharge area.
.2 Inlet and discharge collars provide easy duct connection.

.7 Access Panel:
.1 Two sided access panels, permit easy access to all internal components.
.2 Located perpendicular to the motor mounting panel.

.8 Disconnect Switch:

.1 NEMA rated: 4X.
.2 Positive electrical shut-off.
.3 Wired from fan motor to junction box.

.9 Accessories:
.1 Dampers:
.1 Type: Motorized.
.2 Prevents outside air from entering back into the building when fan is off.
.3 Balanced for minimal resistance to flow.
.4 Galvanized frames with prepunched mounting holes.
.2 Finishes: Permatector, a thermal setting polyester urethane.
.3 Isolation:
.1 Type: Neoprene/Rubber Mount.
.2 Sized to match the weight of fan.

2.4 PROPELLER FANS

.1 General:
.1 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Propeller:
.1 Propeller shall be aluminum blade riveted to steel hub.
.2 A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
.3 Statically and dynamically balanced in accordance with AMCA Standard 204.
.4 The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

.3 Motor:
.1 Motor enclosures: Open driproof.
.2 Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase.
.3 Accessible for maintenance.
.4 Provide motor with dual windings for two speeds as indicated.

.4 Drive Frame:
.1 Drive frame assemblies and fan panels shall be galvanized steel.
.2 Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one piece inlet venturi.

.5 Disconnect Switch:
.1 NEMA rated: 4X.
.2 Positive electrical shut-off.
.3 Wired from fan motor to junction box.

.6 Accessories:
.1 Dampers:
.1 Type: Motorized.
.2 Prevents outside air from entering back into the building when fan is off.
.3 Balanced for minimal resistance to flow.
.4 Galvanized frames with prepunched mounting holes.
.2 Finishes: Permatector, a thermal setting polyester urethane.
.3 Motor Side Guard:
.1 Guard type: OSHA Guard.
.2 Protective guard completely enclose the motor and drive side of the fan.
.3 Coated with Permatector, a thermal setting polyester urethane.
.4 Weatherhood:

.1 Shall shield wall opening and dampers from rain and snow.
.2 Material type: Galvanized.
.3 Turndown Angle: 90 degrees.
.4 Screen: Birdscreen.
.5 Finishes: None.

3.0 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 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 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 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 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 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 indicated.
  .3 Concealed fasteners.
.3 Concealed manual volume control damper operators.
.4 Colour: standard.

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES

.1 General: furnish and install supply grilles of the size and mounting types indicated.
.2 Type SG-1:
  .1 Steel, double deflection type with two sets of fully adjustable deflection blades spaced 19 mm on center. The front set of blades shall run parrallel to the long dimension of the grille, as indicated.
  .2 Finish: white powder coat.

.3 Model: as indicated.

.3 Type SG-2:

.1 Steel, double deflection type with two sets of fully adjustable deflection blades spaced 19 mm on center. The front set of blades shall run parrallel to the short dimension of the register, as indicated. The air-scoop shall be adjusted via the operator on the side frame.

.2 Finish: white powder coat to ASTM D1654, ASTM D610 and ASTM D714.

.3 Model: as indicated.

2.4 RETURN GRILLES

.1 General: furnish and install return grilles of the size and mounting types indicated.

.2 Type RG-1:

.1 45 degrees deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parrallel to the long dimension of the grille, as indicated.

.2 Finish: white powder coat to ASTM D1654, ASTM D610 and ASTM D714.

.3 Model: as indicated.

2.5 EXHAUST GRILLES

.1 General: furnish and install return grilles of the size and mounting types indicated.

.2 Type EG-1:

.1 45 degrees deflection fixed louver type with blades spaced 19 mm on center. The blades shall run parrallel to the long dimension of the grille, as indicated.

.2 Finish: white powder coat to ASTM D1654, ASTM D610 and ASTM D714.

.3 Model: as indicated.

3.0 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 manufacturers instructions.

.2 Install with flat head stainless steel screws in countersunk holes where fastenings are visible.

3.3 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.3 American Society for Testing and Materials International (ASTM)
  .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).
.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.6 Society of Automotive Engineers (SAE)

1.3 SUBMITTALS

.1 Submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GOOSENECK HOODS

.1 Thickness: to SMACNA.
.2 Fabrication: to SMACNA.
.3 Joints: to SMACNA.
.4 Supports: as indicated.
.5 Exhaust complete with integral bird screen of 2.7 mm diameter aluminum wire. Use 12 mm mesh.
.6 Intake complete with integral insect screen of 0.279 mm diameter aluminum wire.
.7 Dampers in accordance with Section 23 33 15 - Dampers - Operating as indicated.

2.2 FIXED LOUVRES - ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.
.2 Material: extruded aluminum alloy 6063-T5.
.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 one piece extruded aluminum, minimum 3 mm thick with caulking slot, integral to unit.

.5 Mullions: at 1500 mm maximum centers.
.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: 0.279 mm diameter wire aluminum insect screen on inside face of intake louvres in formed U-frame.
.8 Finish: anodized.

2.3 SIDEWALL WEATHER HOODS

.1 Thickness: to SMACNA.
.2 Fabrication: to SMACNA.
.3 Joints: to SMACNA.
.4 Supports: as indicated.
.5 Exhaust complete with integral bird screen of 2.7 mm diameter aluminum wire. Use 12 mm mesh.
.6 Intake complete with integral insect screen of 0.279 mm diameter aluminum wire.
.7 Dampers in accordance with Section 23 33 15 - Dampers - Operating as indicated.

3.0 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. Seal with caulking to ensure weather tightness.

3.3 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 REFERENCES

.1 The most current edition of the following:
.2 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.
.3 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.
.4 Canadian Electrical Code
.5 Canadian Standards Association (CSA International) / Canadian Gas Association (CGA)
  .1 CGA 3.2, Industrial and Commercial Gas-Fired Package Furnaces.
.6 Canadian Standards Association (CSA International)
  .1 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
  .2 CSA C22.2 No. 24, Temperature-Indicating and Regulating Equipment.
.7 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
.8 Underwriters' Laboratories of Canada (ULC)
.9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.3 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 23 05 00 - Common Work Results For HVAC.

1.4 QUALITY ASSURANCE

.1 Unit will be designed, tested and constructed to the current ANSI Z21.47/CSA 2.3 design standard for gas--fired central furnaces.
.2 Unit will be third party certified by CSA to the current ANSI Z21.47/CSA 2.3 design standard for gas-fired central furnaces. Unit will carry the CSA Blue StarR and Blue FlameR labels. Unit efficiency testing will be performed per the current DOE test procedure as listed in the Federal Register.
.3 Unit will be certified for capacity and efficiency and listed in the latest AHRI Consumer's Directory of Certified Efficiency Ratings.
.4 Unit will carry the current Federal Trade Commission Energy Guide efficiency label.

1.5 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.6 DELIVARY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GENERAL

.1 Provide CSA approved, packaged factory assembled unit consisting of cabinet, fan, induced fan, fan motor, intake/exhaust assembly, heat exchanger, combustion chamber, burner, controls, air filter, condensate drain, evaporator coil and condensing unit as indicated.
.2 Certification of components and construction of factory assembled gas-fired unit: to ANSI Z21,47/CSA 2.3A for forced air central furnace and to CGA 3.2 for commercial package furnace.

2.2 CAPACITY

.1 Output: as indicated.
.2 Air flow rate: as indicated.
.3 External static pressure: as indicated.
.4 Input: as indicated.
.5 Electrical characteristics: as indicated.

2.3 TYPE

.1 Upflow type 4-way multipoise gas-fired condensing furnace for use with natural gas.

2.4 CABINET

.1 0.030 mm thick minimum pre-painted galvanized steel.

2.5 HEAT EXCHANGER

.1 Primary: 3-Pass corrosion-resistant aluminized steel of fold-and-crimp sectional design and applied operating under negative pressure.
.2 Secondary: stainless steel flow-through of fin-and-tube design and applied to operating under negative pressure.

2.6 DRAFT INDUCER MOTOR

.1 Power vent, induced draft : to manufacturers standard.
.2 Sealed type: 100% outside air, to ANSI Z21.64.

2.7 CIRCULATION BLOWER MOTOR ASSEMBLY

.1 Blower:
  .1 Galvanized blower wheel shall be centrifugal type, statically and dynamically balanced.
.2 Motor:
  .1 Blower motor of PSC type shall be permanently lubricated with sleeve bearings.
  .2 Size: as indicated.

.3 Multiple speeds from 500-1150 RPM operating only when 115-VAC motor inputs are provided.
.4 Blower motor shall be direct drive and soft mounted to the blower scroll to reduce vibration transmission.

2.8 COILS

.1 Direct expansion (DX) evaporator coil:
.1 Refrigerant: R-410A.
.2 Capacity: as indicated.

2.9 CONDENSATE DRAIN

.1 Provide PVC condensate drain trap.
.2 Condensate filter/neutralizer kit.

2.10 AIR FILTERS

.1 25 mm thick, glass fiber, disposable type.

2.11 INTAKE AND VENT ASSEMBLY

.1 Provide manufacturer's standard combined concentric vent and intake complete with termination assembly for high efficiency gas (condensing) furnace.
.2 PVC schedule 40 plastic pipe.

2.12 CONTROLS

.1 General:
.1 Controls shall include a micro-processor-based integrated electronic control board with at least 16 service troubleshooting codes displayed via diagnostic flashing LED light on the control, a self-test feature that checks all major functions of the furnace, and a replaceable automotive-type circuit protection fuse.
.2 Multiple operational settings including blower speeds for heating, cooling, cooling and continuous fan.
.2 Operating controls:
.1 Heating-cooling thermostat in accordance with Section 23 09 33 - Electric and Electronic Control System for HVAC.

2.13 ACCESSORIES

.1 Air Cooled Condensing Unit:
.1 General: Factory assembled, single piece, air-cooled air conditioner unit complete with all factory wiring, piping, controls, compressor, refrigerant charge.
.2 Referigerant: R-410A.
.3 Capacity: as indicated.

3.0 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-B139.
.2 Co-ordinate with Concrete Division regarding concrete bases as indicated.

3.3 BREECHING, CHIMNEYS AND STACKS

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
.2 Suspend breeching at 1.5 m centers and at each joint.
.3 Support chimneys at bottom, roof and intermediate levels as indicated.
.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.

3.4 CLEANING

.1 Clean in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 SUMMARY

.1 Section Includes:
  .1 Materials and application of electric duct heaters.

1.2 REFERENCES

.1 The most current edition of the following:
.2 Canadian Standards Association (CSA International).
  .1 CSA C22.2 No.46, Electric Air-Heaters.
.3 Department of Justice Canada (Jus).
  .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
  .2 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 23 05 00 - Common Work Results for HVAC.
.2 Submit product data and include:
  .1 Element support details.
  .2 Heater: total kW rating, voltage, phase.
  .3 Number of stages.
  .4 Rating of stage: rating, voltage, phase.
  .5 Heater element watt/density and maximum sheath temperature.
  .6 Maximum discharge temperature.
  .7 Physical size.
  .8 Unit support.
  .9 Performance limitations.
  .10 Clearance from combustible materials.
  .11 Internal components wiring diagrams.
  .12 Minimum operating airflow.
  .13 Pressure drop operating airflow.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: in accordance with Section 23 05 00 - Common Work Results for HVAC.

2.0 Products

2.1 DUCT HEATERS

.1 Duct heaters: CSA (NRTL/C) approved open coil flanged round collar type.
.2 Construction:
  .1 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.
  .2 Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame.
  .3 Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
  .4 Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.Helical coils of nickel chrome alloy resistance wire.
.3 Safety Controls:

.1 Heaters shall be equipped with fail-safe automatic reset disc-type thermal cut-out (s) located in the top frame component above the heating elements.
.2 In addition to the automatic reset cut-out, heaters of 30 kW and less, rated for voltages below 300 volts shall be equipped with a fail-safe manual reset disc-type thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA.
.3 The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.
.4 Cut-outs shall de-energize the heater in case of insufficient air flow.
.5 For maintenance and safety purposes, the heater shall be equipped with a built-in disconnect to switch the power off at the heater location and protective screens on both sides.
.6 Load fuses shall be supplied as recommended by NEC (National Electrical Code).

.4 Air Flow:
.1 Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.
.2 Heaters shall be CSA approved for zero clearance in horizontal ducts.

.5 Mounting Method:
.1 Heaters shall be open coil flanged type, as indicated.
.2 Flanged heaters shall be suitable for attaching to matching flanges on the duct.
.3 Mounting flanges on both models shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

.6 Size and Capacity: as indicated.

.7 Internal Wiring:
.1 All internal wiring shall terminate on clearly identified terminal blocks.
.2 A wiring diagram shall be installed on the control box cover.
.3 Prior to shipping, heaters shall withstand tests as required by CSA.

.8 Built-in Controls:
.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.
.2 Controls to include:
.1 Magnetic contactor partial break.
.2 Control transformer.
.3 Duct thermostat.
.4 SCR controller.
.4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
.5 High temperature cutout and air proving switch.

.9 Main isolation disconnect switch.

3.0 Execution

3.1 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 01 73 00 - Execution and Section 26 05 00 - Common Work Results - for Electrical.

.2 Perform tests in presence of Contract Administrator.

.1 Provide test report and include copy with Operations and Maintenance Manuals.

END OF SECTION

1.0 General

1.1 SUMMARY

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

1.2 REFERENCES

.1 The most current edition of the following:
.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  .1 ASHRAE 84, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).
  .2 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI/ASHRAE approved).
.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Section 23 05 00 - Common Work Results For HVAC.
  .2 Furnish list of individual manufacturer's recommended spare parts for equipment.

2.0 Products

2.1 GENERAL

.1 Unit must be CSA approved.

2.2 CABINET

.1 Cabinet shall be constructed from .050 aluminum with a painted white enamel finish.
.2 Cabinet shall be fully insulated with 25 mm foil-faced insulation.
.3 The unit shall be equipped with a top-hinged access door that can be completely removed for machine service.
.4 The unit shall be equipped with an aluminum drain pan and shall have a minimum of two (2) condensate drains. Drain plugs shall be 16 mm.
.5 Access door shall be equipped with a disconnect switch to disengage the motors when the door is opened.

2.3 HEAT RECOVERY CORE AND FILTERS

.1 The heat exchanger shall be a plate type enthalpy cross-flow core.
.2 The core shall have cross leakage of less than 2%.
.3 12 mm polyester filters shall be located in each airstream before the heat exchanger core and must be completely accessible for cleaning or replacement. They shall have an average arrestance of 85% as tested in accordance with ASHRAE 52.2.

2.4 MOTORS

.1 Unit shall be equipped with 2 (two) forward curve, dual inlet impellers using permanently sealed bearings.
.2 Motors of HRV shall be capable of operating at two speeds. Low speed shall be field-adjustable using the on-board microprocessor to between 40% and 70% of high speed.

2.5 ELECTRICAL

.1 Unit shall have a three foot power cord connection operating on 115 volt/1 phase/60 Hz.
.2 The unit shall be equipped with contacts powered with 24 VAC input for external control by building management system.
.3 Unit shall be provided with a microprocessor having 24V circuit protection and a self-resetting fuse.
.4 Unit shall operate in high speed on 170 Watts.

2.6 DEFROST

.1 A temperature activated and timed defrost system shall be factory installed, wired, and tested.
.2 Unit shall be equipped with damper defrost/fan shut-down defrost system.
.3 Unit shall have a field selectable Arctic mode for extreme climates.

2.7 WARRANTY

.1 Unit shall have a two (2) year non-prorated warranty on parts, and a fifteen (15) year polypropylene core warranty or a two (2) year enthalpy core warranty.

2.8 SPECIFIC PERFORMANCE

.1 The unit shall be capable of moving 95 L/s at an external static pressure of 75 Pa and have a minimum apparent sensible effectiveness of 70%.

3.0 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 recommendations.
.2 Support independently of adjacent ductwork with flexible connections.
.3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct site tests in accordance with Section 23 05 00 - Common Work Results For HVAC and submit report to Contract Administrator for review.

3.4 CLEANING

.1 Proceed in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 REFERENCES

.1 The most current edition of the following:
.2 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  .1 ANSI/ARI 430-99(R2002), Central-Station Air-Handling Units.
.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
  .1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
  .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
.3 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 23 05 00 - Common Work Results For HVAC.

1.4 MAINTENANCE

.1 Provide maintenance materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading: in accordance with Section 23 05 00 - Common Work Results For HVAC.
.2 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

2.0 Products

2.1 GENERAL

.1 Factory assembled components to form units supplying air at designed conditions, as indicated.
.2 Certify ratings: CSA approved and as specified herein.
.3 Horizontal type, as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, dampers, mixing box and heating section as indicated.

2.2 GAS FIRED MAKE-UP AIR UNITS

.1 General:
  .1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the HVAC Unit Schedule.
  .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 Part B - Bidding Procedures, must address these factors.

.3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal in accordance with Part B - Bidding Procedures. All equipment shall where specified and applicable, be pre-wired, and factory certified by an accepted testing agency such as CETL, ETLUS, UL, CSA prior to shipment.

.4 Pre-wired air handling units shall bear an accepted label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code.

.5 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.6 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.

.2 Construction:

.1 Unit casing shall be of minimum 1.3 mm (18 ga.) 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 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.

.3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.4 Units shall be provided with:

.1 Hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles.

.2 Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

.5 All units shall be internally insulated with 25 mm thick 24 kg./cu.m. density insulation.

.6 24 kg/cu.m. insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 400 mm o/c. 48 kg/cu.m. insulation is secured with steel angles. 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 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 Single low pressure forward curved fans of 457 mm or less diameter, shall be equipped with permanently lubricated cartridge ball bearings, supported by a 3

point "spider" bearing bracket in the fan inlets. All other forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 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.

.4 Provide full section return air fan(s) as indicated. The use of power exhaust propeller or centrifugal fan arrangements will not be considered.

.5 For spark resistant applications, fans shall be provided with aluminum wheels and aluminum inlet cones. Bearings shall be located in air stream.

.6 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.

.7 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. 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.

.8 Provide single extended grease line from far side to access side bearing.

.9 Fan motors shall be ODP (open drip proof) Super-E high efficiency. Compatible with a variable frequency drive.

.10 The make-up air unit shall be complete with a variable frequency drive as manufactured by Danfoss or equal in accordance with Part B - Bidding Procedures.

.11 The Drive shall be capable of switch between minimum and maximum speeds based on digital input from a third party control switch.

.12 The drive shall be capable with a built in program to modulate speed based on a 0-10VDC signal from a third party static pressure controller.

.13 VFD shall be complete with line and load reactors. Factory mounted on the unit.

.14 VFD shall have a built in disconnect.

.4 Gas Heat Section:

.1 Heating units shall be indirect natural gas fired approved for both sea level and high altitude areas. 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 Heat exchanger shall be a primary cylindrical drum of welded titanium stainless steel with multi-tube stainless steel secondary complete with multi-plane metal turbulators. Heat exchanger must utilize a floating suspension system to allow free thermal expansion and contraction without stress. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 25 mm of insulation between the outer cabinet and heat reflective galvanized steel inner liner. Diamond shaped heat exchangers are not acceptable. Dual or triple blower assemblies shall be provided, as required, to ensure even air distribution across the heat exchangers. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.

.3 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating the G-TRAC module shall have an interrupted pilot ignition system to provide a high seasonal efficiency. Units incorporating continuous or intermittent pilots are not acceptable.

.4 Flame surveillance shall be with a solid state programmed flame relay complete with flame rod. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

.5 Heat exchanger / burner assembly shall have a 20:1 turndown providing that the minimum input is at least 150 MBH.

.6 Installation and venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction. Type A, L, and/or PS venting is required on indoor units.

.7 Units requiring sidewall venting shall be CETL, ETLUS approved for use with a sidewall ventor. The sidewall ventor shall be supplied by the unit manufacturer. The unit manufacturer must also supply the air proving switch, wall cap, double acting barometric damper, and all necessary control interlocks.. Support is to be independent of the unit.

.8 Control: High Turndown Natural Gas shall be a electronic G-TRAC (Modulating Fuel w/ Modulating Combustion Air) complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Controllers shall include the following standard features:

.1 Service analyzer with diagnostic lights for ease of set-up and service .

.2 Self check on start-up to make sure air proving and discharge air sensors are operating within design tolerances to make sure air switches are not shorted or jumpered.

.3 -40 degree C minimum operating ambient temperature.

.4 Built in pre-purge.

.5 Maintained purge to decrease temperature cycles.

.6 Built in post purge.

.7 Interrupted pilot.

.8 Low fire start.

.9 Inlet damper control.

.10 Economizer enable control.

.11 Built-in alternate blower and damper functions and set back temperatures for unoccupied mode operation using a single room thermostat.

.12 Damper contact that allows fan to start after dampers opens, damper to close after fan stops and damper to close on flame failure.

.13 Ambient reset and night setback features.

.14 Non-recycling auto bypass low limit with alarm contacts and built in sensor checking.

.15 Blower contact that starts fan after burner pre-purge.

.16 Controlled burner start-up and shut down.

.17 Built in electronic linearization of the combustion air damper and gas valve producing higher efficiencies and reduced inputs.

.18 Separate gas and air actuators independently controlled to give the correct air to fuel ratio though out the entire firing range. Single operator with mechanical linkage is not acceptable.

.9 Heating control function shall be modulating discharge air complete with sensor and integral selector.

.10 Controllers for heating only units to incorporate low limit feature.

.11 Discharge air sensor shall be field mounted in supply ductwork.

.12 Provide a make up air reverse airflow high limit switch in series with the standard high limit switch mounted in the blower discharge.

.5 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 The filter modules shall be designed to slide out of the unit. Side removal 50 mm filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 50 mm Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.6 Dampers:

.1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 13 mm aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.

.2 Blades shall be 1.3 mm (18 ga.) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 1219 mm. Damper linkage brackets shall be constructed of galvanized metal.

.3 Dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketting. Outdoor air dampers also include an all weather PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center.

.4 Inlet damper shall be parallel blade type.

.5 Makeup Air Inlet Damper Control shall provide a two position, normally closed electric damper operator. This damper operator shall be interlocked so that when the unit is shut down, or on a power failure, the damper shall return to the closed position.

.6 For blow through make-up air applications (indirect fired gas fired units) provide a flow compensator damper package consisting of opposed blade inlet air dampers, three position damper operator, minimum positioner, and ambient setback thermostat to maintain constant air flows at various ambient conditions.

.7 Factory Supplied Controls:

.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 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.3 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.

.4 Remote Panel: Provide for each air handling unit a remote mounted control panel for the purpose of switching and visual indication of operations. Each panel to include the following items:

.1 Sticker faceplate
.2 System ON-OFF switch
.3 System ON light
.4 Heat ON Light

.5 Provide 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.

.8 Acceptable Materials: as indicated.

2.3 ELECTRIC AIR HANDLER UNITS

.1 General:

.1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the HVAC Unit Schedule.

.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 Part B - Bidding Procedures, must address these factors.

.3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal in accordance with Part B - Bidding Procedures. All equipment shall where specified and applicable, be pre-wired, and factory certified by an accepted testing agency such as CETL, ETLUS, UL, CSA prior to shipment.

.4 Pre-wired air handling units shall bear an accepted label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code.

.5 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.6 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.

.2 Construction:

.1 Unit casing shall be of minimum 1.3 mm (18 ga.) 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 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.

.3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, heating coil compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.4 Units shall be provided with:

.1 Hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles.

.2 Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

.5 All units shall be internally insulated with 25 mm thick 24 kg./cu.m. density insulation.

.6 24 kg/cu.m. insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 400 mm. 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 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 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.

.3 Provide full section return air fan as indicated. The use of power exhaust propeller or centrifugal fan arrangements will not be considered.

.4 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 230 to 380 mm diameters forward curve fans. 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.

.5 Provide single extended grease line from far side to access side bearing.

.6 Fan motors shall be ODP (open drip proof) Super-E high efficiency.

.4 Electric Heat:

.1 Electric resistance heaters shall be provided in the capacities, voltage, and steps of control as noted in the Schedules and shall bear a listing or certification mark from an authorized agency.

.2 Heater elements shall be installed a minimum of 305 mm downstream from air filters. Insulation in heating sections shall be fiber-reinforced foil faced. Should discharge air exceed 40 degrees C, employ motors in air stream with Class F insulation. Over 65 degrees C discharge air temperature, mount motors out of the heated air stream.

.3 Heater element wiring shall terminate in a full height enclosure at one end of the heater. All internal wiring shall terminate on clearly identified terminal blocks. A wiring diagram shall be provided on the enclosure cover.

.4 Heaters shall be equipped with an automatic reset disc type thermal cut-out.

.5 Heater elements shall be open type nickel-chromium construction, (2/3 Ni, 1/3 Cr) with a maximum of 2.1 kW/m2 (22.5 kW/ft2). Coil terminal pins shall be mechanically secured and insulated from the frame by means of non-rotating ceramic bushings.

.6 Heating coil casings shall be corrosion resistant and made of galvanized steel of suitable gauge as required by approval agency.

.7 Heaters shall be supplied with aluminum protective screens on inlet and outlet sides.

.8 Electric Heat Control shall be complete with Discharge air control with Silicon Controlled Rectifier (SCR) performing time based sine wave phase control. The SCR shall be controlled by a factory installed solid-state proportional integral controller.

.5 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 50 mm Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.3 Where filters are provided in air handling units for make-up air applications and where hoar frost may occur, only steel frame filters are acceptable. Where indicated, units shall have both summer (upstream of heating coil) and winter (downstream of heating coil) filter sections. Only one set of filters is installed depending on ambient conditions.

.6 Dampers:

.1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 13 mm aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.

.2 Blades shall be 1.3 mm (18 ga.) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 1219 mm. Damper linkage brackets shall be constructed of galvanized metal.

.3 Dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketting. Outdoor air dampers also include an all weather PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center.

.4 Mixing dampers shall be parallel blade type.

.5 Mixing Box Controls shall provide a modulating normally closed damper operator. The unit controls will monitor a Dry contact signal from external space sensor and set damper to 3 positions as follows:

.1 Damper 100% Closed Unit Off

.2 Damper 100% Open Unit Call for ventilation

.3 Damper Set to Minimum Outside air (Minimum position internal to unit)

.5 Refer to control sequence Section 23 09 33 - Electric and Electronic Control System for HVAC for air volumes and further details.

.7 Factory Supplied Controls:

.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 Electric heat units shall also include fan access door switch (to shut heater off when door is opened), auxiliary high limit, control circuit disconnect switch, fan-off delay relay, airflow switch and heating contactors.

.3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.4 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.

.5 Remote Panel: Provide for each air handling unit a remote mounted control panel for the purpose of switching and visual indication of operations. Each panel to include the following items:

.1 Sticker faceplate

.2 System ON-OFF switch

.3 System ON light

.4 Heat ON Light

.6 Provide 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.

.8 Acceptable Materials: as indicated.

3.0 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 Provide appropriate protection apparatus.
.2 Install units in accordance with manufacturer's instructions and as indicated.
.3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

.1 Install fan sheaves required for final air balance.
.2 Install flexible connections at fan inlet and fan outlets.
.3 Install vibration isolators.

3.4 DRIP PANS

.1 Install deep seal P-traps and trap seal primer on drip lines.
  .1 Depth of water seal to be 1.5 times static pressure at this point.

3.5 CLEANING

.1 Clean in accordance with Section 23 05 00 - Common Work Results For HVAC.

END OF SECTION

1.0 General

1.1 REFERENCES

.1 The most current edition of the following:
.2 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
  .1 CSA ANSI Z83.8 / CSA 2.6, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces.
.3 National Fire Protection Association (NFPA)
  .1 NFPA (Fire) 54, National Fuel Gas Code.
  .2 NFPA (Fire) 70, National Electrical Code (NEC).

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.4 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 23 05 00 - Common Work Results For HVAC.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Waste Management and Disposal:
  .1 Dispose of waste materials in accordance with Section 23 05 00 - Common Work Results For HVAC.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements:
  .1 Conform to ANSI Z83.8 / CSA 2.6 and provide evidence that the unit heater and its control system have been found in compliance with these standards by a nationally recognized testing laboratory.
  .2 Work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial /Territorial regulations.
.2 Manufacturing the products specified in this section (gas-fired unit heaters) with a minimum of ten (10) years documented experience. Equipment shall be the standard product of the manufacturer and shall have complete catalogued data.
.2 Installer Qualifications:
  .1 All installation and service of unit heaters must be performed by a contractor qualified in the installation and service of said products with proof of a minimum of three years documented experience.
.3 Factory Testing:
  .1 Each unit heater shall be factory tested. Testing shall consist of verification of correct operation of burners, manifold, control assembly and electrical components.
  .2 Certificates:
    .1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.7 WARRANTY

.1 The product shall have a manufacturer's limited warranty of at least 24 months, subject to the manufacturer's standard warranty limitations.

2.0 Products

2.1 MANUFACTURED UNITS

.1 Unit: Gas-fired, power-vented unit heater with tubular heat exchanger. Units shall have a minimum of 82% thermal efficiency. The standard unit shall consist of a non-separated combustion design with an aluminized heat exchanger. Design and heat exchanger alternatives shall be offered as follows:
- .1 Separated Combustion: A separated combustion unit shall consist of an enclosed sealed burner box to which combustion air is vented through a piece of internal flexible air duct. This duct terminates at an exterior cabinet flange to which a vent run to the outside of the heated space should be attached.
- .2 Stainless Steel Heat Exchanger: A stainless steel heat exchanger unit shall consist of heat exchanger tubes, heat exchanger tube supports, heat exchanger tube plates and a vent box produced of 409 stainless steel.

2.2 FABRICATION

.1 Casing and Components:
- .1 Galvannealed steel panels, minimum 20 gauge.
- .2 All panels shall be lined with a minimum of 10 mm thick insulation.

.2 Access Door:
- .1 Door shall be provided for easy service of all critical components.

.3 Finish:
- .1 Standard finish is a heavy-duty white powder-coat.

.4 Louvers:
- .1 The cabinet shall be equipped with horizontal louvers.
- .2 Louvers shall be spring-held and adjustable for directing airflow.

2.3 HEAT EXCHANGERS, BURNERS AND GAS TRAIN

.1 Heat Exchangers:
- .1 For units 125 MBH Input and under: heat exchanger tubes shall be of a six-pass design with 38 mm outer diameter 409 stainless steel tube.
- .2 For units above 125 MBH Input: heat exchanger tubes shall be of a four-pass design with 44 mm outer diameter 409 stainless steel tube. Heat exchangers shall not be clamshell design. The heat exchanger tubes shall be dimpled to provide efficient heat transfer. The tube plates shall be made of 409 stainless steel. The tube supports shall be made of 409 stainless steel.

.2 Burners:
- .1 The burners shall be in-shot type, directly firing each heat exchanger tube individually.
- .2 Burners shall be capable of burning natural gas.

.3 Gas Train:
- .1 The gas train is constructed of black pipe and includes a single-stage gas valve.
- .2 The valve provides the regulator, main gas and manual shutoff functions.

2.4 COMBUSTION AIR AND VENTING COMPONENTS

.1 Vent Box:
  .1 The vent box shall be of 409 stainless steel.
.2 Flue Fan:
  .1 Each unit shall have a factory-installed flue fan to draw combustion gases through the heat exchanger and into the flue venting.
  .2 No unit shall be gravity vented.
  .3 The flue fan shall be internally mounted by the manufacturer.
  .4 No combustion draft inducers shall be mounted outside of heater cabinet.
.3 Combustion Air:
  .1 The combustion air shall be drawn from outside the heated space into the unit's enclosed burner box through a piece of flexible duct that terminates at an exterior cabinet flange.
  .2 Ductwork shall be run from that flange to the building penetration.
.4 Flue and Combustion Air Connections:
  .1 The flue collar and combustion air collar shall be located on the rear of the unit.
  .2 Heater design shall allow for the shifting of the venting and combustion air collars to the top of the cabinet in the field.

2.5 AXIAL FAN

.1 Fan: Each unit is supplied with one axial fan.
.2 Fan Guard:
  .1 Each axial fan is covered with a fan guard.
  .2 The guard shall protect against objects 12 mm and greater in diameter.
.3 Motor:
  .1 The motor shall be an open drip-proof (ODP), standard efficiency design, wired for 120 V/ 1 Ø / 60 Hz.
  .2 The motor shall be permanent split capacitor (PSC).

2.6 CONTROL SYSTEM

.1 Factory Testing:
  .1 The complete control system and burner and gas manifold functions shall be factory tested for proper operation and to simplify field commissioning.
.2 Control Enclosure:
  .1 Burner controls (transformer, ignition module, gas valve, safety switches) shall be internally mounted by the manufacturer.
  .2 No burner controls or gas train components shall be mounted outside of heater cabinet.
.3 Safety Controls:
  .1 Air Flow Switch:
    .1 The air flow switch measures air pressure differential across the heat exchangers to verify blower operation and the presence of an adequate supply of combustion air.
    .2 The gas valve cannot open until the air flow switch is satisfied.
  .2 High Temperature Limit Switch:
    .1 The high temperature limit switch shall turn the burners off when air is discharged above its set point.
    .2 The switch ensures unit shut down in case of axial fan failure or any problem which may result in overheating.
.4 Controls System:
  .1 Units shall be equipped for use with 120 V / 1 Ø / 60 Hz power supply.
  .2 All units shall be factory equipped with a 24 V thermostat control terminal strip on

the outside of the cabinet, pre-wired to heater internal controls.

.3 Thermostat control terminal shall allow for 2-wire heating control or 4-wire heating and "fan only" control.

2.7 ACCESSORIES

.1 Concentric Vent Kit:

.1 The concentric vent kit allows the flue and combustion air to be consolidated into a single concentric vent, thereby minimizing the number of required wall/roof penetrations.

.2 The kit consists of a concentric vent box, a 101 mm vent terminal with baffle plate and a 152 mm combustion air terminal.

3.0 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 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 Natural Gas fired units: install in accordance with CAN/CSA B149.1.

.5 Provide supplementary suspension steel as required.

.6 Install thermostats in locations indicated.

.7 Before acceptance, set discharge patterns and fan speeds to suit requirements.

END OF SECTION