

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Points of operation on performance curves.
 - .3 Manufacturer to certify current model production.
 - .4 Certification of compliance to applicable codes.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Operation instruction for systems and component.
 - .4 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 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .6 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. 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 As-built drawings:
 - .1 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).

- .2 Submit to Contract Administrator for approval and make corrections as directed.
- .3 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .8 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 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.

Part 2 Products

2.1 MATERIALS

- .1 Not Applicable.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems. Vacuum interior of ductwork, fan, and filter.

3.3 DEMONSTRATION

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of duct work, actuators, and controllers, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 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.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

2.5 CONTROLLERS

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

2.6 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.

2.7 LANGUAGE

- .1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 23 - Painting has been completed.

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 LOCATION OF IDENTIFICATION ON DUCTWORK SYSTEMS

- .1 On both sides of visual obstruction or where run is difficult to follow.
- .2 At point immediately upstream of major manually operated or automatically controlled dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .3 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 CONTROLLERS

- .1 Controllers: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams and equipment schedule mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

3.6 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Testing, Adjusting, and Balancing (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.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 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 and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

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

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 3 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of doors and other construction affecting TAB,
 - .2 Application of weather-stripping, sealing, and caulking.
- .3 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 are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Volume control dampers installed and open.

- .6 Access doors, installed, closed.
- .7 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 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Contract Administrator for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Contract Administrator.
- .2 Provide personnel and instrumentation to verify 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 approved by Contract Administrator.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC and SMACNA.
- .2 Do TAB of following systems, equipment, components, controls:
 - .1 Fans.
 - .2 Dampers.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Definitions:
 - .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
 - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-13, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C449/C449M-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .4 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .5 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Thermal Insulation Association of Canada (TIAC): Mechanical Insulation Best Practices Guide (2013).
 - .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 SUBMITTALS

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

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturers' Instructions:
 - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

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, member of TIAC.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

- .1 Mineral fibre: fibreglass type RFFRK rigid duct insulation, thickness as specified on drawings.

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.

2.4 ACCESSORIES

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick-setting
- .3 Canvas adhesive: washable.
- .4 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Ensure surfaces are clean, dry, free from foreign material.
- .3 Apply so the finished application has the full specified thickness or insulation. Flexible duct insulation applied too tightly will be removed and reapplied properly.
- .4 Impale rigid and board style insulation on No. 9 insulation pins at 300 mm (12") on centre and secured with 50 mm (2") diameter speed washers.
- .5 All exposed fibreglass ductwork insulation to be finished with 6 ounce canvas and two coats of adhesive to form a fire retardant jacket.

3.2 SEALING

- .1 Seal all exterior foil type vapour jacket duct insulation with 100 mm (4") wide RFFRK self adhesive tape applied over all retaining pins, longitudinal and butt joints, and along other breaks in the vapour barrier to provide a continuous vapour seal.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation procedures for control of air flow rates.

1.2 SUBMITTALS

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

1.3 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 DAMPERS

- .1 Operating type dampers are specified in Section 23 33 15.

2.2 DAMPER OPERATORS

- .1 Product requirements for damper operators are specified in Section 40 92 00.

2.3 ELECTRIC DUCT HEATER HCE-L63 CONTROL

- .1 Product requirements for electric duct heater HCE-L63 control are specified in Section 40 92 00.

2.4 UNIT HEATER UH-L64 CONTROLS

- .1 Product requirements for unit heaters UH-L64 controls are specified in Section 40 92 00.

2.5 AIR HANDLING UNIT AHU-L65 CONTROLS

- .1 Product requirements for air handling unit AHU-L65 controls are specified in Section 40 92 00.

Part 3 Execution

3.1 IDENTIFICATION

- .1 Provide in accordance with Section 23 05 54 - Mechanical Identification.

3.2 MANUFACTURER'S INSTRUCTIONS

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

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

.2 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.

.3 Canadian Standards Association (CSA International)

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

.4 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.

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

- .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .2 Indicate on manufacturer's catalogue literature following: valves.

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

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 NATURAL GAS SERVICE

- .1 Arrange with the local utility for the provision of a gas service to 34.5 kPa supply pressure.

.1 Manitoba Hydro Contact: Brian Adamyk
Energy Services Coordinator
204.360.7588

Part 2 Products

2.1 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

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 approved, lubricated plug type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

- .1 Install in accordance with applicable codes, CAN/CSA B149.1, supplemented as specified.
- .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 approved 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/Inspection:
 - .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 product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.
- .3 Obtain reports within three (3) days of review and submit immediately to Contract Administrator.

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 approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems CAN/CSA B149.1 supplemented as specified.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .2 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A368-15, Standard Specification for Stainless Steel Wire Strand
- .3 CSA International
 - .1 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Pressure Range (Pa)	SMACNA Seal Class
500 to 750	B
250 to 500	C
125 to 250	C
- .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 tape.
- .3 Class C: transverse joints and connections made air tight with tape. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 GALVANIZED STEEL DUCTWORK

- .1 Lock forming quality: to .2 ASTM A653/A653M 15.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.3 TAPE

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

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Mitred elbows, rectangular:
 - .1 600 mm or less:
 - .1 double thickness turning vanes.
 - .2 55 mm wide rails spaced on 50 mm centers.
 - .2 Greater than 600 mm:
 - .1 double thickness turning vanes.
 - .2 115 mm wide rails spaced on 115 mm centers
- .3 Branches:
 - .1 Provide volume control damper in branch duct near connection to main duct.
- .4 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .5 Offsets:
 - .1 Short radiused elbows as indicated.

2.5 DUCT SEALANTS

- .1 Water-based, vinyl acetate duct sealant designed for sealing joints in low and high pressure systems.
- .2 Formulated for indoor and outdoor use, remains flexible, non-flammable.
- .3 Acceptable materials: Duro Dyne DDS181 or approved equal in accordance with B7.

2.6 DUCT AND PLENUM ACCESS DOORS

- .1 Insulated access doors with latches and hinges.
- .2 Frames secured to ductwork using sheet metal screws at 150 mm (6") on center.

- .3 Where hinged access doors are inconvenient, removable doors with 4 cam locks are acceptable.
- .4 All access doors shall have 25 mm (1") internal glass fiber insulation.

2.7 FLEXIBLE DUCT CONNECTIONS

- .1 Neoprene coated fiberglass 150 mm (6") wide with 75 mm (3") galvanized metal for the connections.

2.8 HANGERS

- .1 Support all horizontal ductwork with non-perforated, galvanized steel, or rods and angle iron passing under ducts according to the following schedule:

Longest Dimension of Duct	Round Hangers	Trapeze Strap Hangers	Shelf Angles	Maximum Spacing
Up to 450 mm (18")	6 mm (1/4") Rod	25 mm (1") x 18 Ga.	25x25x3 mm (1"x1"x1/8")	3000 mm (10'-0")
475 thru 750 mm (19"-30")	6 mm (1/4") Rod	25 mm (1") x 16 Ga.	25x25x3 mm (1"x1"x1/8")	3000 mm (10'-0")
775 thru 1050 mm (31"-42")	6 mm (1/4") Rod	25 mm (1") x 16 Ga.	38x33x3 mm (1 1/2" x 1 1/2" x 1/8")	3000 mm (10'-0")
1175 thru 1500 mm (43"-60")	10 mm (3/8") Rod	38 mm (1 1/2") x 16 Ga.	38x38x3 mm (1 1/2" x 1 1/2" x 1/8")	3000 mm (10'-0")
1525 thru 2100 mm (61"-84")	10 mm (3/8") Rod	38 mm (1 1/2") x 16 Ga.	50x50x3 mm (2"x2"x1/8")	2400 mm (8'-0")
2125 thru 2400 mm (85"-96")	12 mm (1/2") Rod	38 mm (1 1/2") x 16 Ga.	50x50x5 mm (2"x2"x3/16")	2400 mm (8'-0")
Over 2425 mm (97")	12 mm (1/2") Rod	38 mm (1 1/2") x 16 Ga.	50x50x6 mm (2"x2"x1/4")	2400 mm (8'-0")

Execution

2.9 GENERAL

- .1 Do work in accordance with SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA.

2.10 FLEXIBLE DUCT CONNECTIONS

- .1 Provide flexible connections wherever ductwork and plenums are connected to fans or fan equipment

2.11 DUCTWORK

- .1 Sheet metal ductwork installed in accordance with the recommendations of the SMACNA Low Velocity Ductwork Standards. Double thickness turning vanes installed in all 90° square turn elbows having no change in dimension through turn.
- .2 Where duct elbows are round, use a radius dimension of 1 1/2 times the width of duct (in the plane of the turn) to the centerline of the duct.
- .3 No turning vanes installed in duct elbows that are branch duct connections to plenums or directly behind return air grilles.
- .4 Variation of duct sizes will be permitted only after obtaining written permission of the Contract Administrator.
- .5 Rectangular ductwork exceeding 450 mm (18") in any dimension stiffened by breaking the sheets diagonally. Cross breaking may be omitted for insulated ductwork, provided ducts are 2 gauges heavier than scheduled.
- .6 Rectangular ducts constructed by breaking the corners and grooving the longitudinal seams using Pittsburg seam or other approved airtight seam.
- .7 All laps in sheet metal in the direction of air flow. All edges and slips hammered down to leave a smooth interior duct.

2.12 HANGERS

- .1 Angle hangers and Unistrut: complete with locking nuts and washers.
- .2 Hanger spacing: in accordance with SMACNA.

2.13 DUCT JOINT SEALING

- .1 Clean all ductwork prior to application of sealer to ensure that it is dry and free of grease, etc. Seal to consist of a 6 mm (1/4") bead of the material along all joints, which when dry to be minimum 3 mm (1/8") thick at joints and seams and to extend a minimum of 13 mm (1/2") on each side of the joint.
- .2 Apply in strict accordance with the sealant manufacturer's recommendations. Samples to be submitted to the Contract Administrator on request.

2.14 ACCESS PANELS AND DOORS

- .1 Provide airtight duct access doors at all automatic dampers, coils, filters, and fire dampers to facilitate inspections and servicing. Minimum size of access to be 25% of damper area or 200 x 200 mm (8" x 8"), whichever is larger. Doors in ducts smaller than 200 x 200 mm (8" x 8") to be duct size.

2.15 SUPPORTS AND HANGERS

- .1 Supports to secure ducts and equipment, prevent sway, sag and duct vibrations, provide for expansion and contraction, and to have a neat appearance.
- .2 Supports to be designed for strength and rigidity in a manner which does not stress the

building construction.

- .3 Take care not to weaken concrete or penetrate waterproofing.
- .4 Vertical ducts to be supported at each floor unless otherwise required by expansion conditions or otherwise directed. Ducts to be supported by means of angle iron collars bearing on each floor slab.
- .5 If possible, hangers and supports for covered ducts shall not injure or pierce insulation. If there is no alternative, the insulation covering to be repaired to Contract Administrator's satisfaction.

Provide sheet metal shields to protect insulation at areas of contact with hangers and supports.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2006.

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
- .3 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

- .1 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 with 75 mm (3") galvanized metal for connections.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks.

- .5 Where hinged access doors are inconvenient, removable doors with 4 cam locks are acceptable.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 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:
 - .1 200 x 200 mm for viewing; where space is available.
 - .2 Locations:
 - .1 Control dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
 - .4 Heating coils.
 - .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 approved by Contract Administrator.
- .3 At inlet and outlet of coils.
- .4 Downstream of junctions of two converging air streams of different temperatures.
- .5 And as indicated.

3.3 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for dry well supply and exhaust air system.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 BALANCE DAMPERS

- .1 Material: 304 stainless steel, factory manufactured.
- .2 Opposed blade: 1.6 mm thick 304 stainless steel, symmetrical about pivot point.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: stainless steel sleeve pressed into cast housing bolted to the damper frame.
- .5 Linkage: located in jamb out of airstream and constructed of minimum 3.5 mm stainless steel double clevis arms with 4.8 x 19 stainless steel tie bars pivoting on 9.5 mm diameter stainless steel pivot pins with lock type retainers.

- .6 Blade Seals: TPE, mechanically attached to blade.
- .7 Channel frame: 16 ga. hat channel, 304 stainless steel.
- .8 Acceptable Materials: Ruskin, Greenheck or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Dampers: vibration free.
- .4 Ensure damper operators are observable and accessible.
- .5 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .6 Corrections and adjustments as directed by Contract Administrator.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate the following:
 - .1 Performance data.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 OUTDOOR AIR AND EXHAUST DAMPERS AND DAMPER OPERATORS

- .1 Multi-blade type, opposed or parallel as indicated on schedule.
- .2 Frame:
 - .1 Extruded aluminum (6063-T5) not be less than 0.080" (2.03 mm) in thickness.
 - .2 101.6 mm deep x 25.4 mm, with duct mounting flanges on both sides of frame.
 - .3 50.8 mm mounting flange on the rear of the damper.
 - .4 Assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.

- .3 Blades:
 - .1 Maximum 162.6 mm deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 1.52mm.
 - .2 Internally insulated with expanded polyurethane foam; thermally broken.
 - .3 Insulating factor of R-2.29 and a temperature index of 55 (tested to AAMA 1502.7 Test Method).
- .4 Blade seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum blade extrusions.
 - .2 Mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
- .5 Frame seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- .6 Bearings:
 - .1 Dual bearing system composed of a Celcon inner bearing (fixed around a 11.1 mm aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame.
 - .2 Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
- .7 Hexagonal control shaft:
 - .1 Size: 11.1 mm.
 - .2 Adjustable length; integral part of the blade axle. A field-applied control shaft shall not be acceptable.
 - .3 All parts zinc-plated steel.
- .8 Linkage hardware:
 - .1 Aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation.
 - .2 Complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.
- .9 Performance:
 - .1 Designed for operation in temperatures ranging from -40°C to 100°C.
 - .2 AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- .10 Dampers shall be custom made to required size, with blade stops not exceeding 31.7 mm in height.
- .11 Acceptable materials: Tamco 9000SC or approved equal in accordance with B7.

- .12 Operators:
 - .1 Refer to Section 40 92 00.

2.2 MIXED AIR DAMPER AND DAMPER OPERATORS

- .1 Multi-blade, opposed or parallel as indicated on schedule.
- .2 Frame:
 - .1 Extruded aluminum (6063-T5) not be less than 0.080" (2.03 mm) in thickness.
 - .2 101.6 mm deep x 25.4 mm, with duct_mounting flanges on both sides of frame.
 - .3 50.8 mm mounting flange on the rear of the damper.
 - .4 Assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.
- .3 Blades:
 - .1 Maximum 162.6 mm deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 1.52 mm.
- .4 Blade seals:
 - .1 Extruded EPDM, secured in an integral slot within the aluminum blade extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
- .5 Frame seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum frame extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- .6 Bearings:
 - .1 Dual bearing system composed of a Celcon inner bearing (fixed around a 11.1 mm aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame.
 - .2 Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.
- .7 Hexagonal control shaft:
 - .1 Size: 11.1 mm.
 - .2 Adjustable length; integral part of the blade axle. A field-applied control shaft shall not be acceptable.
 - .3 All parts zinc-plated steel.
- .8 Linkage hardware:
 - .1 Aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation.
 - .2 Complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.
- .9 Performance:
 - .1 Designed for operation in temperatures ranging from -40°C to 100°C.

- .2 AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.
- .10 Dampers shall be custom made to required size, with blade stops not exceeding 31.7 mm in height.
- .11 Acceptable materials: Tamco 1000 or approved equal in accordance with B7.
- .12 Operators:
 - .1 Refer to Section 40 92 00.

2.3 BACK DRAFT DAMPERS

- .1 Frame:
 - .1 Extruded aluminum (6063-T5) not be less than 0.060" (1.52 mm) in thickness.
 - .2 63.5 mm deep.
 - .3 Assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.
- .2 Blades:
 - .1 Maximum 127 mm deep extruded aluminum (6063-T5) profiles with a minimum wall thickness of 1.52 mm.
- .3 Blade seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum blade extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals are not acceptable.
- .4 Frame seals:
 - .1 Extruded silicone, secured in an integral slot within the aluminum frame extrusions; mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.
- .5 Bearings:
 - .1 Maintenance-free bearings system composed of a 12.7 mm aluminum pivot point rotating in a Celcon bearing.
- .6 Linkage hardware:
 - .1 Hard alloy aluminum (6005-T6) crank arms fastened to aluminum pivot rods and secured within a channel running along top of blades.
 - .2 Large diameter, 8.73 mm, hard alloy aluminum (6065-T6C) linkage rod connect the crank arms by means of a zinc-plated steel trunnion.
 - .3 Complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.
- .7 Performance:
 - .1 Designed for operation in temperatures ranging from -40°C to 100°C.
 - .2 AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

- .8 Provide weights to maintain backpressure of 25 Pa (adj.) as per Section 40 92 00 of the specifications.
- .9 Dampers to be custom made to required size.
- .10 Acceptable materials: Tamco 7000WT or approved equal in accordance with B7

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Ensure dampers are observable and accessible.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

- .1 Fans, motors, accessories and hardware for commercial use.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-2008, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-2006, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

- .1 ANSI/AMCA 210-2007, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

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, kW, 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.
- .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal.

1.4 SUBMITTALS

.1 Product Data:

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

.2 Shop Drawings:

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

- .3 Provide :
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Spare parts to include:
 - .1 One set of filters to be installed after TAB.
 - .2 One set of spare filters.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Bearings and seals.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 FANS GENERAL

- .1 Motors:
 - .1 Sizes as indicated.
- .2 Factory primed before assembly in colour standard to manufacturer.

- .3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .4 Vibration isolation: hanging spring isolators
- .5 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 CENTRIFUGAL FANS

- .1 General
 - .1 Base fan performance at standard conditions.
 - .2 Performance capabilities as per schedule.
 - .3 Permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number on cabinet.
 - .4 Fan wheels:
 - .1 Non-overloading, backward inclined centrifugal wheel.
 - .2 Constructed of aluminum.
 - .3 Statically and dynamically balanced in accordance to AMCA Standard 204-05.
 - .4 Wheel cone and fan inlet matched and have precise running tolerances for maximum performance and operating efficiency.
 - .5 Single thickness blades securely riveted or welded to a heavy gauge back plate and wheel cone.
 - .5 Motor
 - .1 Electronic Commutation type motor (ECM) (as per schedule)
 - .1 Motor enclosure: Open type.
 - .2 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 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.
 - .5 Motor speed controllable down to 20% of full speed (80% turndown).
 - .6 Speed controlled by a factory supplied, two speed controller, each discreet speed adjusted by a potentiometer.
 - .2 Induction
 - .1 Motor enclosure: TEFC.
 - .2 Permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the scheduled voltage and phase.
- .6 Local On/Off switch

- .2 Inline Centrifugal
 - .1 Housing/Cabinet Construction
 - .1 Square design constructed of heavy gauge galvanized steel, includes square duct mounting collars.
 - .2 Housing and bearing supports constructed of heavy gauge bolted and welded steel to prevent vibration and rigidly support shaft and bearing assembly.
 - .3 Housing supports constructed of structural steel with formed flanges.
 - .4 Drive frame supporting the motor constructed of welded steel.
 - .5 Access panels: Two sided, located perpendicular to motor mounting panel, permit easy access to all internal components.
 - .6 Insulation: 25 mm fibreglass liner.
 - .2 Acceptable materials: Greenheck BSQ/SQ-VG or approved equal in accordance with B7.
- .3 Utility Centrifugal
 - .1 Housing
 - .1 Discharge position specified on equipment schedule.
 - .2 Constructed of heavy gauge galvanized steel, painted steel, or aluminum with air tight lock formed seams.
 - .3 Shall be easily rotated in the field to any of the eight standard discharge positions.
 - .2 Housing Supports and Drive Frame
 - .1 Housing supports are constructed of heavy gauge galvanized or painted steel with formed flanges.
 - .2 Drive frame is constructed of heavy gauge galvanized or painted steel to support the motor and provide reinforcement for the housing.
 - .3 Prepunched mounting holes for installation.
 - .3 Access Door
 - .1 Bolted.
 - .2 Provides access for inspection and cleaning of wheel.
 - .4 Drain Connection
 - .1 Threaded.
 - .2 Provided to drain moisture from the bottom of the fan housing.
 - .5 Shaft Seal
 - .1 Shaft seal is on aluminum rub ring which seals around the shaft.
 - .6 Isolation
 - .1 Neoprene mount.

2.3 AIR CONDITIONER

- .1 General
 - .1 Furnish and install a self-contained, vertical, exterior wall mount, through-the-wall air conditioner.
 - .2 Unit shall be factory assembled, pre-charged, pre-wired, tested and ready to operate. Unit performance shall be certified in accordance with the

Air Conditioning Heating and Refrigeration Institute (AHRI) Standard 390-2003 for Single Package Vertical Units. Unit efficiency shall be specified by EER.

- .3 Capacities shall be as indicated on drawings.
- .2 Construction features
 - .1 Cabinet
 - .1 Construction shall be a single, enclosed, weatherproof casing constructed of 20-gauge galvanized steel, stainless steel, or aluminum. Unit base is constructed of 16-gauge galvanized steel for painted and aluminum cabinets, stainless steel for stainless cabinets. Each exterior casing panel to be bonderized and finished with baked-on exterior polyester enamel paint prior to assembly. The baked-on cured paint finish shall pass the industry rub test with a minimum of 72 rubs MEK (Methyl Ethyl Ketone) or standard rub test of a minimum of 100 rubs using Toluene. Cooling section shall be fully insulated with 1-inch fiberglass to prevent sweating and to muffle sounds. Openings shall be provided for power connections. Access openings appropriate for outside structure to all fan motors and compressor for making repairs and for removing internal components without removing unit from its permanent installation. Fresh air intake and outdoor coil shall be protected from intrusions by a sturdy metal grating with less than 1/4 inch openings.
 - .2 Insulation shall be foil faced for ease of cleaning.
 - .3 Full-length side mounting brackets shall be an integral part of the cabinet. Bottom mounting bracket shall be provided.
 - .4 The unit shall use a high efficiency scroll compressor. The compressor shall be covered by a 5-year parts warranty. The refrigeration circuit shall be equipped with factory installed high and low pressure controls and liquid line filter dryer. The refrigeration control shall be a factory installed capillary tube. Compressor shall be mounted on rubber grommets. Unit shall be provided with R-410A (HFC) non-ozone depleting refrigerant.
 - .5 The condenser fan, motor and shroud shall be of slide out configuration for easy access.
 - .6 The indoor blower motor shall be twin wheels with forward curve blades. Motor shall be high efficiency PSC type.
 - .7 Electrical components are easily accessible for routine inspection and maintenance through front service panels. Circuit breaker is standard on all 208/230-volt models. Circuit breaker/toggle disconnect access is through lockable access panel.
 - .3 Heating
 - .1 The air conditioner shall have a factory installed 9kW electric resistance heater. Heater shall include automatic limit safety controls.
 - .4 Economizer
 - .1 The Economizer is internally mounted and allows outside air to be used for free-cooling when temperature and humidity conditions are

favorable. The amount of exhaust air varies in response to the system controls and settings defined by the user. It includes a built-in exhaust air damper. The economizer is designed to provide free-cooling when outside conditions are cool and dry enough to satisfy cooling requirements without operating the compressor, providing lower operating costs while extending the life of the compressor.

- .2 Standard Features:
 - .1 Fully modulating
 - .2 Hi-torque 44 lb-in. actuator
 - .3 Simple single blade design
 - .4 Positive shut-off with non-stick gaskets
- .3 Filter
 - .1 2" Pleated – MERV 8
- .5 Power supply: 208V, 3 phase, 60 Hz.
- .6 Acceptable materials: Bard W36LA or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with spring isolators, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Bearings and extension tubes to be easily accessible.
- .3 Access doors and access panels to be easily accessible.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Outdoor air and exhaust louvers for commercial and industrial 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 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

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

Part 2 Products

2.1 Louvers

- .1 General
 - .1 Louvers as specified on drawings or in schedules.
 - .2 All diffusion equipment shall be rigidly constructed with rubber gaskets installed to prevent leakage between the outlet and duct.
- .2 Size: as per schedule.
 - .1 Construction:
 - .1 Extruded aluminum, alloy, 6063-T5, minimum 2.0 mm thick, welded.
 - .2 Blades: 38 mm thick, stationary, straight profile.

- .3 Insect screen” 18 x 16 x 0.3 mm aluminum, removable.
- .3 Finish:
 - .1 Mill finish.
- .4 Performance:
 - .1 Designed to withstand 120 Pa wind load (equiv. to 160 kph wind).
 - .2 Free area: 65% or greater.
- .5 Acceptable materials: Price DE635/ZE439 or approved equal in accordance with B7.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 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.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

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

1.4 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Grilles and diffusers of same generic type.

2.2 SUPPLY GRILLES

- .1 Furnish and install supply registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be single deflection type with one set of fully adjustable deflection blades spaced 3/4 in. [19mm] on center. The blades shall run parallel to the (long/short) dimension of the registers, as indicated in the outlet schedule. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. The grille shall be finished in (B15 Aluminum Powder Coat).
- .2 Acceptable materials: Price 510/D/F/L/A or approved equal in accordance with B7.

2.3 RETURN GRILLES

- .1 Furnish and install exhaust registers of the sizes and mounting types indicated on the plans and outlet schedule. Grilles shall be 0 degree deflection fixed louver type with blades spaced 3/4 in. [19mm] on center. The blades shall run parallel to the (long / short) dimension of the register. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the diffuser face.
- .2 Acceptable materials: Price 510/Z/D/A/L, Bard RG-3 or approved equal in accordance with B7

2.4 SUPPLY DIFFUSERS

- .1 Furnish and install round ceiling diffusers of size and capacities shown on the plans and air distribution schedule. Diffusers shall have round neck inlets and face with a removable inner assembly of cones that extend below the diffuser face. The diffuser air flow discharge pattern shall be field adjustable by the removal and repositioning of the cone assembly. Finish shall be B12 white powder coat. Paint finish shall pass 500 hours of salt spray exposure with no measurable creep in accordance with ASTM D1654 and 1000 hours with no rusting or blistering as per ASTM D610 and ASTM D714.
- .2 Acceptable materials: Price RCDE or approved equal in accordance with B7

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.

3.3 CLEANING

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

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
 - .2 ANSI B18.2.1-96(R2005), Square and Hex Bolts and Screws - Inch Series.
 - .3 ANSI B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM D1784-08, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - .2 ASTM D1785-06, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - .3 ASTM D2466-06, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - .4 ASTM D2564-04(R2009), Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - .5 ASTM D2855-96(R2010), Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B137 SERIES-09, Thermoplastic Pressure Piping Compendium.
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA Thermoplastic Duct (PVC) Duct Construction Manual, 2nd Edition 1995.

1.2 SUBMITTALS

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

1.3 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 PVC DUCTWORK

- .1 General:
 - .1 Piping, fittings, flanges, flange gaskets, primer, cement to be product of one manufacturer.
- .2 Polyvinyl Chloride (PVC): to ASTM D1784.

- .3 Fabricate from unplasticized rigid PVC sheets, to following thicknesses:

Largest dimension (round or rectangular)	Wall thickness (mm)
Up to 450 mm	3.2 mm
451 to 750 mm	5.0 mm
- .4 Construction standard:
 - .1 Construction to be to SMACNA "Standards of Construction for PVC Duct Systems" except where specified otherwise herein.
 - .2 Maximum operating static pressure: 500Pa.
- .5 Welding: hot gas, filler rod welding ONLY throughout.
- .6 Straight ductwork heat formed with butt-welded longitudinal seams.
- .7 Round ductwork:
 - .1 Moulded to form perfect round shape within tolerances specified in standard.
- .8 Sections and fittings:
 - .1 Connected by sleeves welded to ducts.
- .9 Fittings:
 - .1 Round elbows: centreline radius at least 2 x diameter, 5-piece, mitred construction.
 - .2 Branches, connections to main ducts: at 45 degrees to main duct.
 - .3 Reducers, round-to-rectangular transformations: Minimum taper 3:1 length: change in diameter.
 - .4 Offsets: 45 degrees to centreline of straight duct.
- .10 Flanges:
 - .1 Welded to ducts where indicated and elsewhere as required for cleaning or access to interior of ducting.
 - .2 Fabricated from 6.4 mm thick PVC at least 50 mm wide.
 - .3 Gaskets: full face type, 3.2 mm thick of plasticized PVC.
 - .4 Flange bolts, nuts and washers: 7.2 mm dia. type 316 stainless steel.
- .11 Important notice: No metals to penetrate duct system.
- .12 Supports, hangers:
 - .1 Vertical ducts: use structural channels, suitable clamps under 13 mm PVC flanges welded to outside of duct.
 - .2 Horizontal ducts: steel split rings and rod hangers. Rings not to compress duct when closed.
 - .3 Use galvanized steel for supports and hangers.
- .13 Drains:
 - .1 Install at lowest point in system.
 - .2 PVC drain pocket with 25 mm PVC pipe connection.

- .3 All connections to be threaded.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION OF PVC DUCTWORK

- .1 In accordance with ASHRAE and SMACNA.
- .2 Hangers: complete with locking nuts and washers.
- .3 Support spacing:
 - .1 Vertical ducts: at every floor and at roof.
 - .2 Horizontal ducts: to SMACNA.
 - .3 Supports:
 - .1 Support heavy accessories independently from adjacent ductwork.
- .4 Joints:
 - .1 Solvent weld throughout except at flanges and unions.
 - .2 Threaded joints not permitted.
 - .3 Make joints in accordance with ASTM D2855, and to manufacturer's recommendations, using both primer and solvent welding cement.
 - .4 Make connections to other materials or fittings using appropriate adapters and to manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.18- M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
- .3 Underwriters' Laboratories of Canada
 - .1 ULC -S111- 07, "Fire Tests for Air Filter Units".

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.5 EXTRA MATERIALS

- .1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Contract Administrator, supply 1 complete set of filters for each filter unit or filter bank in accordance with section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 ACCESSORIES

- .1 Holding frames: permanent channel section construction of extruded aluminum, 1.6 mm thick, except where specified otherwise.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side.

2.3 COTTON PANEL FILTERS

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance:
 - .1 MERV 8 to ASHRAE 52.2.
- .4 Fire Rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.
- .6 Acceptable material: Camfil Farr 30/30 or approved equal in accordance with B7.

2.4 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure.
- .3 Acceptable material: Dwyer Magnehelic, or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.2 REPLACEMENT MEDIA

- .1 Replace all media with new upon acceptance.
- .2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 FILTER GAUGES

- .1 Install type as indicated across each filter bank in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No.46-M1998(R2001), Electric Air-Heaters.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and include:
 - .1 Element support details.
 - .2 Heater: total kW rating, voltage, phase.
 - .3 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.

Part 2 Products

2.1 DUCT HEATERS

- .1 Duct heaters: Insert type.
- .2 Elements:
 - .1 Open coil.
- .3 Staging:
 - .1 Staged heaters: balanced line current at each stage.
 - .2 Each stage: uniform face distribution.
- .4 Maximum temperature at discharge: 66 degrees Celsius.

- .5 Controls:
 - .1 Remote control via remote 0-10V signal, which proportionally controls the heat output, 0 – 100%.
 - .2 Controls mounted in a CSA Type enclosure and to include:
 - .1 Integral disconnect switch.
 - .2 Magnetic contactors.
 - .3 Control transformers.
 - .4 SCR controller.
 - .3 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
 - .4 High temperature cut-out and air proving switch.
- .6 Electrical:
 - .1 Size as indicated.
 - .2 575V, 3Ø.
- .7 Main isolation disconnect switch.
- .8 Acceptable materials: Caloritech, E.H. Price, Thermolec or approved equal in accordance with B7.

Part 3 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 26 05 01 - 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

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.2 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 UNIT HEATERS

- .1 Capacity: as per schedule.
- .2 General:
 - .1 Cabinet: 18 and 20 gauge steel, epoxy/polyester powder coated.
 - .2 Horizontal mount with factory supplied mounting brackets.
- .3 Fan Motor:
 - .1 Mounted in cold compartment.
 - .2 Thermally protected.
 - .3 Totally enclosed and factory-lubricated ball bearings.
- .4 Elements:
 - .1 Tubular stainless steel.
- .5 Control:
 - .1 Heater supplied with relay to allow 24 VAC control.
 - .2 Factory supplied, wall mounted thermostat.
 - .3 24 VAC, mechanical.
 - .4 Part # T822D2642 or approved equal in accordance with B7.

- .6 Approvals:
 - .1 All components and entire unit CSA or ULc approved and must bear the label.
- .7 Acceptable materials: Ouellet OAS or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from wall as indicated.
- .2 Install thermostats in location indicated.
- .3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

END OF SECTION