

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.
- .4 Instruction duration time requirements as specified in appropriate sections.

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, equipment, actuators, and controllers, including the installation and location of identification systems.

1.2 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.

1.3 QUALITY ASSURANCE

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

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 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.

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: back, 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 Ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 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.
- .7 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 weatherstripping, 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 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: 25 or 50 mm thick, material as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

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.

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 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 manufacturer's instructions and as indicated.
- .3 Hangers and supports in accordance with Section 23 31 14 - Metal Ducts - Low Pressure to 500 Pa.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .4 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)
Supply and return ducts exposed on main floor level	C-1	yes	25
Outside air ducts to mixing plenum	C-1	yes	50
Exhaust duct between dampers and louvers	C-1	yes	50

3.5 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 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 ROOM PRESSURE CONTROLLER, PDIC-A600

- .1 Product requirements for pressure controller PDIC-A600 are specified in Section 40 92 00.

2.4 ROOM TEMPERATURE CONTROLLER, TIC-A610

- .1 Product requirements for temperature controller TIC-A610 are specified in Section 40 92 00.

2.5 IDENTIFICATION

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

Part 3 Execution

3.1 UNIT HEATER CONTROL

- .1 Execution requirements for unit heater control are specified in Section 40 92 00.

3.2 ELECTRIC DUCT HEATER HCE-A61 CONTROL

- .1 Execution requirements for electric duct heater HCE-A61 control are specified in Section 40 92 00.

3.3 ROOM PRESSURE CONTROLLER PDIT-A600

- .1 Execution requirements for Temperature Controller PDIT-A600 are specified in Section 40 92 00.

3.4 TEMPERATURE CONTROLLER TIC-A610

- .1 Execution requirements for Temperature Controller TIC-A610 are specified in Section 40 92 00.

3.5 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 of low-pressure metallic ductwork, stacks, 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 A480/A480M-15, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-15, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-15, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - .4 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
- .1 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 TAPE

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

2.3 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.

2.4 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.

2.5 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.

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")

Part 3 Execution

3.1 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.

3.2 FLEXIBLE DUCT CONNECTIONS

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

3.3 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.

3.4 HANGERS

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

3.5 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.

3.6 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.

3.7 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.

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.

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 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/RETURN 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/RELIEF DAMPERS

.1 Frame:

.1 Extruded aluminum (6063-T5) not be less than 1.52 mm (0.060") in thickness.

.2 63.5 mm deep with duct mounting flange as specified in schedule.

.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) air-foil 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 shall be composed of a 1/2" (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 connecting the crank arms by means of a zinc-plated steel trunnion. Linkage consisting of metal rubbing metal will not be approved.

.3 Trunnions to be zinc-plated to provide a hard, smooth and long-lasting rotating surface for the bearing and secured to the linkage by cup-point screws to prevent linkage slippage.

.7 Performance:

.1 Designed for operation in temperatures ranging from -40°C to 100°C.

.2 Air leakage not to exceed 21.95 l/s/m² against 25 Pa differential static pressure. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.8 Dampers shall be custom made to required size, with blade stops not exceeding 31.7 mm in height.

- .9 Acceptable materials: Tamco 7000 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.

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 or base mounted spring isolators as required.

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

2.2 IN-LINE 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.

.2 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.

.3 Motor

- .1 Electronically Commutated Motor (ECM):
 - .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 0 – 10 VDC signal from two (2) speed controller.
- .2 Induction:
 - .1 Motor enclosures: TEFC,
 - .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/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.

- .5 Acceptable materials: Greenheck SQ/BSQ 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 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 Assembly 150mm thick, blades 35°, stationary, drainable.

- .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 AMCA Certified and bearing sticker.
- .5 Acceptable materials: Price DE635 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, registers and diffusers of same generic type, products of one manufacturer.

2.2 SUPPLY GRILLES AND REGISTERS

- .1 General: Single deflection register with opposed blade, steel damper.
- .2 Grille: Aluminum, 32 mm border, single deflection with airfoil shape horizontal face bars, mill finish.
- .3 Damper: opposed blade, steel construction,
- .4 Acceptable materials: Price 610D or 635D or acceptable 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.
- .2 Install with oval head cadmium plated screws in countersunk holes where fastenings are visible.

3.3 CLEANING

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

END OF SECTION

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° C.

2.2 V-BANK AIR FILTER HOUSING (FIL-A61)

- .1 Filter housing:

- .1 Single stage,
 - .2 16-gauge galvanized steel enclosure, pre-drilled standing flanges to facilitate attachment to other system components.
 - .3 Aluminum filter mounting tracks in a v-bank configuration,
 - .4 Dual-access doors, static pressure tap, filter sealing gaskets and door seals.
 - .5 In-line housing depth not to exceed 710 mm.
 - .6 Capable of holding a single stage of 50 mm deep nominal filters without modification to the housing,
 - .7 Pneumatic fittings to allow the installation of a static pressure gauge to evaluate pressure drop across any combination of installed filters.
- .2 Filter Tracks:
- .1 Aluminum construction,
 - .2 Integral component of housing,
 - .3 Constructed with fin seals to eliminate filter air bypass and ribs to allow filters to slide easily in the filter track.
- .3 Dual access doors:
- .1 Swing-open type,
 - .2 High-memory sponge neoprene gasket to facilitate a door-to-filter seal,
 - .3 Each door equipped with adjustable and replaceable positive sealing UV-resistant star-style knobs and replaceable door hinges.
- .4 Performance:
- .1 Leakage at rated airflow, upstream to downstream of filter, shall be less than 1% at 750 Pa. Leakage into or out of the housing shall be less than one half of 1% at 750 Pa.
 - .2 Accuracy of pneumatic pressure fitting, when used to evaluate a single-stage shall be accurate within $\pm 3\%$ at 150 Pa.
- .5 Acceptable Materials:
- .1 Camfil Farr V-Bank Glide/Pack or approved equal.

2.3 COTTON PANEL FILTERS

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Performance:
 - .1 MERV 8 to ASHRAE 52.2.
- .3 Fire Rated: to ULC -S111.
- .4 Nominal thickness: 50 mm.
- .5 Acceptable material: Camfil Farr 30/30 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and application of electric duct heaters.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 26 05 00 - Common Work Results - for Electrical.

1.2 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and include:
 - .1 Heater: total kW rating, voltage, phase.
 - .2 Number of stages.
 - .3 Rating of stage: rating, voltage, phase.
 - .4 Heater element watt/density and maximum sheath temperature.
 - .5 Maximum discharge temperature.
 - .6 Physical size.
 - .7 Unit support.
 - .8 Performance limitations.
 - .9 Clearance from combustible materials.
 - .10 Internal components wiring diagrams.
 - .11 Minimum operating airflow.
 - .12 Pressure drop at operating airflow.

Part 2 Products

2.1 DUCT HEATERS

- .1 Duct heaters: flange type.
- .2 Capacity: as per schedule.
- .3 Elements: Tubular.
- .4 Cabinet: galvanized steel.
 - .1 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA. Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the frame. Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing

- .5 Controls:
 - .1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to temperature controller.
 - .2 Magnetic contactors.
 - .3 Control transformers.
 - .4 SCR controller; heater to modulate based on a 0 – 10V input.
- .6 Electrical:
 - .1 CSA or ULc approved and bears the label.
 - .2 Fail safe, automatic reset and manual reset disc-type thermal cut-outs. Cut-outs shielded from accidental impact and de-energize the heater in case of insufficient airflow.
 - .3 Magnetic contactors, factory wired 24V transformer.
 - .4 Main disconnect switch supplied by Division 26.
 - .5 NEMA 1 enclosure.
- .7 Provide electric heating coils with sizes and capacities as shown on drawings.
- .8 Heating unit shall be equipped with magnetic contactors as required, factory-wired 24 volts transformer, airflow sensor, built-in modulating controller and sensor, disconnect switch and protective screen.
- .9 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA. Coils shall be made of high grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the frame. Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing.
- .10 Acceptable materials: Price, Nailor, Thermolec, Titus or approved equal in accordance with B7.

Part 3 Execution

3.1 INSTALLATION

- .1 Install heater in accordance with manufacturer's instructions.
- .2 Make power and control connections to CSA C22.2 No.46.

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.

- .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