

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 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, 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 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Colour coding chart.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .6 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 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Contract Administrator for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

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 - Interior 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 including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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.
- .5 Contract Administrator will record these demonstrations on video tape for future reference.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Closeout Submittals
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 GENERAL

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

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

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

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.-
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

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

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

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

1.2 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:

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 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.

2.4 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.

2.5 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 - Interior 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 PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.

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

3.5 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Contract Administrator within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .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.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

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

1.9 START OF TAB

- .1 Notify Contract Administrator 3 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.

- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .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 Fan.
 - .2 Grilles.
 - .3 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 90.1-07, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .3 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .4 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .5 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
 - .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
- .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: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM 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 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 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 in space being served			none
Outside air ducts to mixing plenum	C-1	yes	50
Exhaust duct between dampers and louvres	C-1	no	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 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 A480/A480M-10, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A635/A635M-09, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 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:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with tape. Longitudinal seams unsealed.

2.2 SEALANT

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

2.3 TAPE

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

2.4 DUCT LEAKAGE

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

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Round: five piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct.
 - .2 Round main and branch: enter main duct at 45 degrees with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Short radiused elbows as indicated.

2.6 GALVANIZED STEEL

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

2.7 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
- .2 Hanger configuration: to SMACNA.

Hangers: galvanized steel angle with galvanized steel rods to Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10

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

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.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000

3.3 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

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 Instructions: submit manufacturer's installation instructions.
 - .4 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 Frame: galvanized sheet metal frame 75 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS

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

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

2.4 TURNING VANES

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

2.5 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

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:
 - .1 150 x 150 mm for viewing.
 - .2 Locations:

- .1 Control dampers.
 - .2 Devices requiring maintenance.
 - .3 Required by code.
 - .4 Heating coils.
- .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.
- .4 Turning vanes:
- .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Operating dampers for mechanical forced air ventilation and air conditioning 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.
 - .1 Contract Administrator will make available 1 copy of systems supplier's installation instructions.
- .3 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.3 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 MULTI-LEAF DAMPERS

- .1 Opposed or parallel blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.

- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator:
 - .1 Provide spring return for "fail-safe" in normally closed position.
 - .2 Size operators to control dampers against maximum pressure or dynamic closing pressure, whichever is greater.
 - .3 Provide operators with adjustable spring and stroke. Provide adjustable external stops to limit stroke in either direction.
- .6 Performance:
 - .1 Leakage: in closed position less than 15.2 l/s/m² of rated air flow at 250 Pa differential across damper.
 - .2 Pressure drop: at full open position less than 7 Pa differential across damper at 5.08 m/s.
- .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
- .8 Acceptable materials: Nailor, Price, Tamco or approved equal in accordance with B6.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

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

3.3 CLEANING

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

END OF SECTION

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.
 - .1 Contract Administrator will make available 1 copy of systems supplier'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 Matched sets of belts.
 - .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 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
- .2 For use with variable speed controllers.
- .3 Sizes as indicated.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .5 Vibration isolation: hanging spring isolators
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 IN-LINE CENTRIFUGAL FANS

- .1 Fan wheels:
 - .1 Welded steel or aluminum construction.
 - .2 Maximum operating speed of centrifugal fans not more than 50 % of first critical speed.
 - .3 Forward curved blades, as indicated.
- .2 Bearings: split pillow-block grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 h.
- .3 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, steel or aluminum for smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
- .4 Provide latched airtight access doors with handles. Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard outside casing.
- .5 Fabricate casing of zinc coated or phosphate treated steel of 1.21 mm thickness reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CGSB 1-GP-181M. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 12 mm thick rigid acoustic insulation.
- .6 Acceptable material: Greenheck, Loren Cook, Penn or approved equal in accordance with B6.

2.3 PROPELLER FANS

- .1 Fabricate multibladed propellers of aluminum of airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct driven, complete with motor as indicated.
- .2 Provide blade guard and bird screen, with gasketed edges.
- .3 Acceptable material: Greenheck, Loren Cook, Penn or approved equal in accordance with B6.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 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 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.3 CLEANING

- .1 Proceed in accordance with Section 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 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

1.2 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

.1 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 Samples:

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

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

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
 - .1 Contract Administrator will make available 1 copy of systems supplier'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.

1.5 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 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as directed by Contract Administrator.

2.2 MANUFACTURED UNITS

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

2.3 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Type SC: steel, 32 mm border, single deflection with airfoil shape horizontal face bars. Finish: White powder coat. Acceptable materials: Price 510D or acceptable equal in accordance with B6.

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Type RA: steel 32 mm border, single 45 degrees deflection, horizontal face bars. Finish: White powder coat. Acceptable materials: Price 530D or acceptable equal in accordance with B6.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with manufacturers 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 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers.

1.2 REFERENCES

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

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
- .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 Contract Administrator will make available 1 copy of systems supplier's installation instructions.

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 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: Z-style blades, 45° angle, 127 mm blade spacing.
- .4 Frame, head, sill and jamb: 100 mm deep one piece extruded aluminum, minimum 2.1 mm thick.
- .5 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .6 Screen: 19 mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .7 Finish: factory applied enamel. Colour: to Contract Administrator's approval.
- .8 Acceptable materials: E.H. Price, Ventex or approved equal in accordance with B6.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 CLEANING

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

END OF SECTION

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 B6.

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 B6.

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: flange type.
- .2 Elements:
 - .1 Finned tubular.
- .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 B6.

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