

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with CW 1110 – Clause 1.5.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba Canada.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 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 Valves schedule and flow diagram.
 - .7 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 2 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 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.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 CLEANING

- .1 Clean interior and exterior of all systems.

3.2 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests and submit report as described in PART 1 - SUBMITTALS.
 - .1 Operation and sequencing of building heating and ventilation system.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports 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.

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 Trial usage to apply to following equipment and systems:
 - .1 Exhaust fans and associated devices, unit heaters and control systems.
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

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 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
- .2 Related Sections:
 - .1 23 34 25 – Wall Fans
 - .2 23 82 39.01 – Unit Heaters, Electric

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)

Part 2 Products

2.1 GENERAL

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

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

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.

END OF SECTION

Part 1 General

1.1 SUMMARY

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

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.

- .4 Locations:
 - .1 Terminal cabinets, equipment, control panels: use size # 5.

2.3 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.

2.4 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 has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.

3.4 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.

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 30 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
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started 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 seven (7) days prior to start of TAB.

- .2 Start TAB when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB,
 - .2 Application of weatherstripping, sealing, and caulking,
 - .3 Pressure, leakage, other tests specified elsewhere Division 23, and
 - .4 Provisions for TAB installed and operational.
 - .5 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 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .2 Correct fan rotation.
 - .3 Volume control dampers installed and open.
 - .4 Access doors, installed, closed.
 - .3 Outlets installed.

1.10 APPLICATION TOLERANCES

- .1 Do TAB for HVAC systems to minus 5% of the specified design values.

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 the 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 three (3) months of TAB. Provide certificate of calibration to Contract Administrator.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB the 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 Calculation procedures and

.4 Summaries.

1.15 TAB REPORT

- .1 Format in accordance with AABC standards.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings and
 - .2 System schematics.
- .3 Submit 1 copy of TAB Report to Contract Administrator for review, in English in D-ring binders, complete with index tabs and one copy in PDF format.

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 The Contractor to 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 this section or TAB standards of AABC.
- .2 Do TAB of the new exhaust fan (EF-1).
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.
- .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.

- .6 Locations of equipment measurements:
 - .1 Air inlets and outlets to equipment,
 - .2 At controllers and controlled devices.
- .7 Assist in calibration of control system end devices and thermostats by making comparative measurements.

1.20 OTHER TAB REQUIREMENTS

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

1.21 POST-OCCUPANCY TAB

- .1 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period. Submit report to the Contract Administrator of any deficiencies and corrective measures required.

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 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C547, Specification for Mineral Fiber Pipe Insulation.
 - .5 ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .6 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
- .4 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation Polyotrene, Boards and Pipe Covering.

1.2 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" - will mean "not concealed" as defined herein.
 - .3 "INSULATION SYSTEMS" - insulation material, fasteners, jackets, and other accessories.
 - .4 "MINERAL FIBRE" – will mean fibres manufactured of glass, rock or slag processed from a molten state, with or without binders.

1.3 SYSTEM PERFORMANCE

- .1 Insulation materials furnished should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1 "Energy Efficient Design of New Buildings" of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or

personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with CW 1110 – Clause 1.5.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions.
- .2 Installation instructions to include procedures used and installation standards achieved.

1.6 QUALIFICATION ASSURANCE

- .1 Qualifications: Execute work of this section only by certified tradespersons, regularly employed in the application of insulation to ductwork, plenums for building heating, cooling, ventilating and plumbing systems.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 All of the insulation materials and accessories shall be delivered to the job site and stored in a safe dry place with appropriate labels and/or other products identification.
- .2 The Contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during and after installation. No insulation materials shall be installed that has been damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.
- .3 If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install this material, and shall remove it from the job site.
- .4 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .5 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.8 SAFETY PRECAUTIONS

- .1 Insulation Contractor's employees shall be properly protected during installation of all insulation. Protection shall include but not be limited to proper attire when handling and applying insulation materials.

Part 2 Products

2.1 GENERAL

- .1 All insulation systems shall have composite (insulation, jacket and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard ratings as tested under procedure ASTM E 84, NFPA 225, or UL 723.
- .2 Never is asbestos in any form to be used for any type of insulation work. All products must be certified "asbestos free".
- .3 All final pipe and duct installations including insulation, covering and adhesive shall have a flame spread rating of not greater than 25.
- .4 Wire to be 1.2mm (18 ga.) soft annealed, type 304 stainless steel,.
- .5 U.L.C. label or satisfactory certified report from approved testing laboratory is required to demonstrate that the fire hazard ratings for materials proposed for use do not exceed those specified.
- .6 Flame proofing treatments subject to deterioration due to effects of high humidity are not acceptable.
- .7 The Contract Administrator reserves the right to demand test samples of components of insulation systems for fire and smoke hazard ratings.
- .8 Duct systems to be insulated with fibreglass duct insulation with an all-service jacket.
- .9 Special insulation protection shall be considered for areas subject to abuse and moisture, as indicated.

2.2 COMPATIBILITY OF COMPONENTS

- .1 All adhesives, sealers, vapour coating, mastics, laggings and bedding compounds, shall be compatible with materials to which they are applied. They shall not soften, corrode, or otherwise attack such material in either wet or dry state. Materials shall only be those recommended by manufacturer or insulation as suitable for application proposed and be applied within ambient temperature range recommended by the manufacturer.

2.3 INSULATION

- .1 Duct insulation: board
 - .1 ULC listed semi-rigid, un-faced board, nominal density 48 kg/m³. Minimal thermal conductivity of 0.035 W/m°C at a mean temperature of 25°C and a maximum operating temperature to 232°C.
 - .2 Acceptable material: Owens Corning, Johns Manville, Knauf

2.4 JACKETS

- .1 Cladding Tape:
 - .1 A white five ply, self adhesive material to the following:

- .1 Material thickness, 152.4 µm
- .2 Continuous operating temperature range: -34°C to 149°C.
- .3 Flame spread/smoke development: 10/20
- .4 Water vapour permeability: 0.0000 perms
- .2 Acceptable material: VentureClad 1577CW-W

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 SITE INSPECTION

- .1 Before starting work under this section, carefully inspect the site and installed work of other trades and verify that work is complete to the point where installation of the insulating system can begin.
- .2 Verify that all materials and accessories can be installed in accordance with project drawings and specifications and manufacturer's recommendations.
- .3 Verify, by inspecting product labelling, submittal data, and/or certifications which accompany the shipments, that all materials and accessories to be installed on the project comply with the applicable specifications and standards and meet specified thermal and physical properties.

3.3 PREPARATION

- .1 Ensure that all ductwork surfaces over which insulation is to be installed are dry and clean.
- .2 Ensure that insulation is clean, dry and in good mechanical condition. Wet, dirty or damaged insulation shall not be acceptable for installation.

3.4 INSTALLATION

- .1 General:
 - .1 Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
 - .2 Install insulation on ductwork subsequent to installation of acceptance tests.
 - .3 Butt insulation joints firmly to ensure complete, tight fit over all ductwork surfaces.
- .2 Fire Dampers: Terminate installation prior to fire dampers. Insulation not to interfere with operation of fire dampers.

- .3 Multiple Layers: Use two layers with staggered joints when required nominal wall thickness exceeds 25 mm.
- .4 All ductwork insulation ends shall be tapered and sealed with vapour barrier jacket.
- .5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .6 Hangers and Supports: Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .7 Rectangular Ductwork
 - .1 On ducts 600 mm wide and wider apply welded pin fasteners to surface of duct by impaling on weld pins on 300 mm centres. Spot adhesive on 300 mm centres on all sides of duct. Apply insulation with edges tightly butted together. Cut pins after installation of fasteners and apply foil tape to cover completely. Weld pins may be omitted on ducts 575 mm wide or less.

3.5 DUCTWORK INSULATION SCHEDULE

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

	Jacket	Thickness (mm)
Outside air ducts	yes	50
Exhaust ducts	yes	50

END OF SECTION

Part 1 General

1.1 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
 - .2 Quality assurance submittals: submit following.
 - .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.

1.2 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 WIRING

- .1 All wiring, conduits and associated components to be provided by the Electrical Contractor in accordance with Division 26 and 29 requirements.

2.2 CONTROL PANELS

- .1 All control panels to be provided in accordance with Division 26 and 29 requirements.

2.3 THERMOSTAT (LINE VOLTAGE)

- .1 Line voltage, wall-mounted thermostat, NEMA 4 enclosure for heating or cooling with:
 - .1 Full load rating: 16 A at 120 V.
 - .2 Temperature setting range: 0°C to 38°C.
 - .3 Markings in 1°C increments.
 - .4 Differential temperature fixed at 1.8°C.

2.4 DAMPER ACTUATORS

- .1 Proportional actuator, spring return:
 - .1 Power supply: 24, 120 or 230VAC, or 24VDC and Class 2 wiring as dictated by the application.

- .2 Damper control: Proportional in response to 4 to 20 mA control input with the addition of a 500 Ω resistor.
- .3 Operating range: -30° to 50°C
- .4 Mounting: Directly coupled and mounted to damper shaft using a V-bolt with a toothed V-clamp creating a cold weld, positive grip effect. Single point, bolt, or single screw actuator type fastening techniques or direct-coupled actuators requiring field assembly of the universal clamp is not acceptable.
- .5 Rotation: either clockwise or counter-clockwise failsafe operation
- .6 Run time: constant and independent of torque
- .7 Position switch: Two (2) SPDT, 6A, 250 VAC switching points fully adjustable over full actuator rotation.
- .8 UL listed and CSA certified.
- .9 Motor: Brushless DC motor and protected from overload at all angles of rotation
- .10 Acceptable material: Belimo

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 control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.

3.3 CLEANING

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

3.4 SEQUENCE OF OPERATION

- .1 System Description: The heating and cooling system consists of two electric unit heaters, an exhaust fan with associated inlet ductwork and motorized dampers, thermostats and control panel.
 - .1 System Start/Stop:
 - .1 Cooling:
 - .1 On a signal from the thermostat located in the space and if the outside air temperature is above the system switchover temperature the damper for exhaust fan (EF-1) and the associated outside air intake damper will open.
 - .2 When the limit switches on the dampers are engaged the exhaust fan will energize.

- .3 When the temperature in the space decreases below the cooling setpoint, the exhaust fan will de-energize and the associated exhaust damper and outside air intake damper will de-energize and close.
- .4 During a loss of power the exhaust fan will de-energize and the dampers will close. When power is re-established the system will begin start-up if the space temperature is above the cooling setpoint.
- .2 Heating:
 - .1 On a signal from the thermostat located in the space and if the outside air temperature is below the system switchover temperature the unit heaters will be energized.
 - .2 When the temperature in the space is above the setpoint the unit heaters will be de-energized.
 - .3 After a power loss the unit heaters will be energized if the space temperature is below the heating setpoint
- .2 System Setpoints:
 - .1 System switchover: 12°C
 - .2 Heating: 16°C
 - .3 Cooling: 27°C

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 for Testing and Materials International, (ASTM).
 - .1 ASTM A653/A653M-03, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition 1995 and Addendum No. 1, 1997.

1.3 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:
 - .1 Maximum pressure 500 Pa, SMACNA seal class C.
- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with gaskets, sealant, or combination thereof. Longitudinal seams unsealed.
 - .2 Unsealed seams and joints.

2.2 SEALANT

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

2.3 DUCT LEAKAGE

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

2.4 FITTINGS

- .1 Fabrication: to SMACNA unless indicated otherwise.

2.5 GALVANIZED STEEL

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

2.6 HANGERS AND SUPPORTS

- .1 Hangers and Supports:
 - .1 Wall brackets: fabricated from 25 x 25 x 3 galvanized steel angle.

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with SMACNA
- .2 Do not break continuity of insulation vapour barrier with supports.

3.2 HANGERS

- .1 Hanger spacing: in accordance with SMACNA.

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 General exhaust.
 - .2 Fresh air intake.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging as indicated.

3.4 SEALING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.
- .2 Related Sections:
 - .1 Section 01 78 00 - Closeout Submittals.
 - .2 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

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

1.3 SUBMITTALS

- .1 Submittals in accordance with CW 1110 – Clause 1.5.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
 - .1 Duct access doors.
 - .2 Instrument test ports.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

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

2.2 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 complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .1 Hold open devices.
 - .2 300 x 300 mm glass viewing panels.

2.3 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handle 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 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 300 x 300 mm for servicing entry if duct dimension are smaller than 50 mm smaller than dimension of duct.
 - .2 Locations:
 - .1 Control dampers
 - .2 Required by code
 - .3 Elsewhere as indicated
- .2 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Operating dampers for mechanical forced air ventilation and air conditioning systems.
- .2 Related Sections:
 - .1 23 09 33, Electric and Electronic Control for HVAC
 - .2 23 31 13.01, Metal Ducts – Low Pressure to 500 Pa
 - .3 23 33 00, Air Duct Accessories

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate the following:
 - .1 Performance data.
- .2 Quality assurance submittals: submit following in accordance with CW 1110 – Clause 1.5.
 - .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 QUALITY ASSURANCE

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

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 MULTI-LEAF DAMPERS

- .1 Dampers shall be available with either opposed blade action or parallel blade action.
- .2 Construction:
 - .1 Extruded aluminum (6063T5) damper frame shall not be less than 2.03mm in thickness. Damper frame to be 100 mm deep and shall be insulated with polystyrofoam on four sides.
 - .2 Blades to be extruded aluminum (6063T5) profile, internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
 - .3 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.
 - .4 Bearings are to be composed of a Celcon inner bearing fixed to an 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
 - .5 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
 - .6 Dampers shall be made to size required without blanking off free area.
 - .7 Dampers shall be flanged to duct.
- .3 Performance:
 - .1 Dampers are to be designed for operation in temperatures ranging between -40°C and 85°C.
 - .2 Leakage shall not exceed 15.2 l/s/m² against 0.25 kPa differential static pressure.
 - .3 Leakage shall not exceed 25 l/s/m² against 1kPa differential static pressure at -40°C.
 - .4 Pressure drop of a fully open 1200mm x 1200mm damper shall not exceed 0.007kPa at 5.1 m/s.
- .4 Installation of dampers must be in accordance with current manufacturer's installation guidelines.
- .5 Provide intermediate or tubular steel structural support to resist applied pressure loads for dampers that consist of two or more sections in both height and width.
- .6 Standard of acceptance: TAMCO Series 9000 SC
- .7 Operator: to Section 23 09 33 – Electric and Electronic Control System for HVAC.

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.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Roof and wall exhausters.

1.2 REFERENCES

- .1 Air Movement and Control Association (AMCA)
 - .1 AMCA Publication 99-2003, Standards Handbook (Revised 2003).
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/AMCA 210-99, 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. Provide confirmation of testing.
 - .2 Capacity: flow rate, total static pressure Pa, r/min, brake power rpm, model and size as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed to AMCA 99.

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with CW 1110 – Clause 1.5.
 - .2 Include:
 - .1 Fan performance curves showing specified point of operation
 - .2 Materials of construction
- .2 Closeout Submittals
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

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.

1.6 MAINTENANCE

- .1 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.

Part 2 Products

2.1 WALL EXHAUSTERS

- .1 Centrifugal backward inclined fan units, direct driven.
 - .1 Spun aluminum housings, complete with resilient mounted motor and fan.
 - .2 Disconnect switch within fan housing.
 - .3 Stainless steel securing bolts and screws.
- .2 Housings:
 - .1 Provide with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketing.
 - .2 Discharge pattern: away from building.
- .3 Capacity: refer to schedules on drawings.

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 FIELD QUALITY CONTROL

- .1 Prior to the fan being energized the Vendor shall review and provide a letter of approval for the fan installation. Any deficiencies noted by the Vendor shall be corrected by the Contractor and Vendor shall verify upon completion.
- .2 Upon energizing the fan the Vendor shall witness the operation and provide a letter of approval for the fan operation. Any deficiencies noted by the Vendor shall be corrected by the Contractor and Vendor shall verify upon completion.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

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 CW 1110. Include product characteristics, performance criteria, and limitations.
 - .2 Indicate following:
 - .1 Pressure drop
 - .2 Face area
 - .3 Face velocity
 - .4 Materials of construction
 - .5 Rain penetration
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 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: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm, 35 degree angle.

- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, SS washer and aluminum body.
- .7 Screen: 13 mm aluminum birdscreen mounted in removable frame.
- .8 Finish: factory applied enamel. Colour: to match adjacent surface.
- .9 Performance (LV-A):
 - .1 LV-A: E.H. Price DE635
 - .2 Size: 350 wide x 500 high
 - .3 Air flow: 270 l/s
 - .4 Face velocity: 3.8 m/s
 - .5 Static pressure: 20 Pa
 - .6 Free Area: 0.07 m²
- .10 Acceptable material: E.H. Price DE635, Airolite

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.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 23 09 33 - Electric and Electronic Control System for HVAC.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with CW 1110.
- .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 Submit product data sheets for unit heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.
- .4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures and any additional operating instructions.

1.4 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 MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Caloritech, Reznor, Chromalox.

2.2 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.
- .2 Fan type unit heaters with built-in high-heat limit protection.
- .3 Fan motor: permanently lubricated motor with built-in thermal overload protection.
- .4 Hangers: wall mounting bracket.
- .5 Elements: tubular heating elements.
- .6 Cabinet: steel, fitted with brackets for wall mounting.
 - .1 Phosphatized and epoxy finished.
- .7 Capacity: refer to schedule on drawings.

2.3 CONTROLS

- .1 Refer to Section 23 09 33 - Electric and Electronic Control System for HVAC.

Part 3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from wall as indicated.
- .2 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - 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