

Part 1 General

1.1 SUBMITTALS

- .1 Submittals: in accordance with [Section 01 33 00 - Submittal Procedures](#).
- .2 Shop drawings; submit drawings.
- .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 referred to in [Section 01 33 00 - Submittal Procedure](#) 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, Departmental Representative before final inspection or observation.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.

- .3 Special performance data as specified.
- .4 Testing, adjusting and balancing reports as specified in [Section 23 05 93 - Testing, Adjusting and Balancing for HVAC](#).
- .6 Approvals:
 - .1 Submit three copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .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 On a designated set of drawings mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, electrical systems, control systems and low voltage control wiring.
 - .2 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 Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed as-built drawings with Operating and Maintenance Manuals.
- .10 Submit set of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with [Section 01 45 00 - Quality Control](#).

1.3 MAINTENANCE

- .1 Furnish spare parts in accordance with [Section 01 78 00 - Closeout Submittals](#) as follows:
 - .1 One supply air filter and one exhaust air filter for each crawlspace ventilation fan.
- .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](#).

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse, recycling or disposal in accordance with [Section 01 74 21 - Construction/Demolition Waste Management and Disposal](#).

Part 2 Products

2.1 MATERIALS

- .1 Materials and products in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems.

3.3 DEMONSTRATION

- .1 Departmental Representative 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 Crawlspace ventilation 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, devices 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 Hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A307-12, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 ANSI/MSS SP58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
- .4 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into ductwork or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 SUBMITTALS

- .1 Submittals: in accordance with [Section 01 33 00 - Submittal Procedures](#).
- .2 Submit shop drawings and product data for following items:
 - .1 Hangers and supports.
 - .2 Connections to equipment and structure.

- .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.
- .4 Closeout Submittals:
 - .1 Provide 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.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for, reuse, recycling or disposal in accordance with [Section 01 74 21 - Construction/Demolition Waste Management and Disposal](#).

Part 2 Products

2.1 GENERAL

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

2.2 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

2.3 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

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:
 - .1 Manufacturer's instructions and recommendations.
- .2 Provide supplementary structural steelwork where structural bearings do not exist.
- .3 Use approved constant support type hangers where:
 - .1 vertical movement of ductwork is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that hanger is vertical under operating conditions.
 - .2 Equalize loads.

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 Departmental Representative within 15 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, 6th Edition, 2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems, 7th Edition, 2005.
 - .3 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.
- .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.

1.6 PRE-TAB REVIEW

- .1 Confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative 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 Departmental Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Departmental Representative seven days prior to start of TAB.
- .2 Start TAB when Work, other than spray-applied polyurethane, is completed, including:
 - .1 Installation of doors and other construction affecting TAB.
 - .2 Application of weatherstripping, sealing, caulking and smoke sealing.

- .3 Pressure, leakage, other tests specified elsewhere Division 23.
- .4 Supply air ducts discharging air into the crawlspace have been capped and sealed.
- .5 Provisions for TAB installed and operational.
- .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 New crawlspace ventilation 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 Departmental Representative:
 - .1 List of instruments proposed and their serial numbers.
 - .2 Calibration interval and calibration due date of proposed instruments.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Provide certificate of calibration to Departmental Representative.

1.13 SUBMITTALS

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

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, 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 six copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Number and location of verified results as directed by Departmental Representative.
- .3 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, 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 Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of AABC or NEBB.
- .2 Do TAB of following systems:
 - .1 New crawlspace ventilation systems.
- .3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .4 Quality assurance: perform TAB under direction of person qualified to standards of 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, noise, vibration.

- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlets and outlets of ventilation unit.
 - .2 Exhaust air discharge wall hood.
 - .3 Outdoor air intake wall hood.
- .7 Locations of systems measurements to include: ventilation unit inlet and outlet, outdoor air supply hood, exhaust air discharge hood.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Reference Standards:
 - .1 ASTM International Inc.
 - .1 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .3 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
 - .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
 - .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-037, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: competent in performing work of this section .

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle to protect from damage, deterioration and contamination.
- .2 Protect on site stored or installed insulation material from moisture exposure, adsorption or absorption.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name.

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 Flexible, 12 kg/m³ density, reinforced foil faced vapour seal duct insulation.
- .2 Thermal conductivity ("k" factor) not to exceed 0.035 W/(m·°K) at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 Vapour permeance of vapour retarder facing not to exceed 1.724 ng/(Pa·s·m²).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C553.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C553.

2.3 ACCESSORIES

- .1 Contact adhesive: quick-setting
 - .1 Maximum VOC limit 50 g/L to SCAQMD Rule 1168.
- .2 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .3 Tie wire: 1.5 mm stainless steel.

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 Mechanically fasten joints and connections in accordance with [Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.](#)
- .2 Ensure surfaces are clean, dry, free from foreign material.
- .3 Seal duct joints and connections in accordance with [Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.](#)

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Adhere insulation to duct surfaces with application-specific insulation adhesive applied in strips approximately 100 mm wide on 200 mm centres.
- .4 Tightly butt all joints.
- .5 Seal all joints with self-adhesive vapour barrier tape.
- .6 Secure insulation with tie wire applied in helix pattern.
- .7 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .8 Hangers and supports in accordance with [Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.](#)

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Outdoor air intake ducts within crawlspaces.	C-2	yes	50
Exhaust air discharge ducts.	C-2	yes	50

3.5 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Separate waste materials for recycling or disposal and deliver each to appropriate facilities.

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 A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005 and errata.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
 - .3 IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition, 2007.
- .6 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 SUBMITTALS

- .1 Submit product data for duct sealant in accordance with [Section 01 33 00 - Submittal Procedures](#).
- .2 Submit MSDS - Material Safety Data Sheets for duct sealant.
- .3 Submit Indoor Air Quality (IAQ) Management Plan in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).

1.4 QUALITY ASSURANCE

- .1 Indoor Air Quality (IAQ) Management Plan.
 - .1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Section 01 47 15 - Sustainable Requirements: Construction that

describes how the air quality in occupied spaces will be safeguarded and maintained during construction and re-occupancy phases of construction.

- .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

- .2 Sustainable Requirements:

- .1 Construction requirements: in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Store and manage hazardous materials in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse, recycling or disposal in accordance with [Section 01 47 19 - Construction/Demolition Waste Management and Disposal](#).
 - .2 Remove from site and deliver separated materials to appropriate facilities.
 - .3 Separate for recycling metal waste in accordance with Waste Management Plan.
 - .4 Place materials defined as hazardous or toxic in designated containers.
 - .5 Handle and dispose of hazardous materials in accordance with applicable regulations.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and resources in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).

2.2 DUCTWORK SEALING

- .1 Sealing requirements:
 - .1 Longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.3 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.
 - .1 Maximum VOC limit 75 g/L to SCAQMD 1168.

2.4 TAPE

- .1 Tape: pressure sensitive soft aluminum foil coated on one side with rubber based adhesive:

- .1 50 mm wide.
- .2 2.1 mil adhesive thickness.
- .3 To CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.
- .4 Temperature range: minus 36°C to 82°C.

2.5 DUCT LEAKAGE

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

2.6 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows.
 - .1 Round: smooth radius. Centreline radius: 2 times diameter.
- .3 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .4 Offsets:
 - .1 Full radiused elbows.
- .5 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.7 GALVANIZED STEEL

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

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with [Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment](#).
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .2 Hanger configuration: to SMACNA.

Part 3 Execution

3.1 GENERAL

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

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Hanger spacing: in accordance with SMACNA

3.3 SEALING AND TAPING

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

3.4 LEAKAGE INSPECTION

- .1 Inspect sealed seams, joints, penetrations, connections and joints for leakage.
- .2 Complete inspection before performance insulation or concealment Work.

3.5 DUCTWORK IDENTIFICATION

- .1 After installation of ductwork insulation:
 - .1 Label outside air intake duct and exhaust air discharge duct with self adhesive labels having 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
 - .2 Colours: black printing on white background
 - .3 Wording:
 - .1 "Crawlspace Ventilation Unit Outdoor Air Intake"
 - .2 "Crawlspace Ventilation Unit Exhaust Air Discharge"
- .2

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Balancing dampers for crawlspace ventilation systems.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005

1.3 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet for damper and frame assembly in accordance with [Section 01 33 00 - Submittal Procedures](#). Include product characteristics, performance criteria, and limitations.

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 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse, recycling or disposal in accordance with [Section 01 74 21 - Construction/Demolition Waste Management and Disposal](#).
- .3

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS - ROUND

- .1 Pre-assembled manual balancing damper and frame.
- .2 1 mm (20 gauge) galvanized steel blade and frame.
- .3 Operator: 10 mm (3/8 in.) square locking manual quadrant.
- .4 Axle: 10 mm (3/8 in.) plated steel.
- .5 Axle Bearings: Synthetic (Acetal) sleeve.

- .6 Size to fit ductwork as shown.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing damper in exhaust air discharge duct and in outdoor air intake duct.
- .4 Dampers: vibration free.
- .5 Ensure damper operators are observable and accessible.

3.3 CLEANING

- .1 Install only products in accordance with SMACNA duct cleanliness level B, Intermediate Level.
- .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 Crawlspace ventilation fans and controls.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors Association (AMCA)

- .1 AMCA 201-02 (R2011), Fans and Systems.
- .2 AMCA 300-2008, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .4 AMCA 302-73 (R2012), Application of Sone Ratings for Non-Ducted Air Moving Devices.
- .5 AMCA 303-79 (R2012), Application of Sound Power Level Ratings for Fans.

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

- .1 ANSI/AMCA 210-2007 | ANSI/ASHRAE 51-07, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

.3 Home Ventilating Institute

- .1 HVI 915 2009 Loudness Testing and Rating Procedure
- .2 HVI 916 2009 Airflow Test procedure
- .3 HVI 920 2009 Product Performance Certification Procedure Including Verification and Challenge.
- .4 CAN/CSA-C439-09 - Standard Laboratory Methods of Test for Rating the Performance of Heat/Energy-Recovery Ventilators.

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

- .1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

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

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.
 - .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](#).
- .2 Shop Drawings:
 - .1 Submit shop drawings 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.
- .4 Closeout Submittals
 - .1 Provide 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](#).
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Filters
 - .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.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse, recycling or disposal in accordance with [Section 01 74 21 - Construction/Demolition Waste Management and Disposal](#).

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with [Section 01 47 15 - Sustainable Requirements: Construction](#).

2.2 FANS - GENERAL

- .1 Standard of rating:
 - .1 HVI 915
 - .2 HVI 916
 - .3 CSA-C439
- .2 Sound level ratings to comply with AMCA 301, tested to AMCA 300.
- .3 Maximum loudness: 5 sones.

2.3 CRAWLSPACE VENTILATION FAN

- .1 Ceiling mount energy or heat recovery ventilator. Power rating: 120 volt, 60 Hz.
- .3 Totally enclosed AC condensor type motor rated for continuous run, equipped with thermal cut-off fuse control.
- .4 Rust resistant paint finish, galvanized steel housing and mounting bracket.
- .5 Dual 100 mm intake and exhaust duct adaptors with duct collars.
- .6 Washable filters on supply and exhaust air.
- .7 Integral automatic operation frost prevention mode.
- .8 Integral backdraft damper in exhaust air duct.
- .9 Sizes and capacity:
 - .1 Field selectable 14.1, 9.4 and 4.7 L/s supply air volume settings at 25 Pa.
 - .2 Field selectable 18.9, 9.4 and 4.7 L/s exhaust air volume settings at 25 Pa.
- .10 Control: dehumidistat control.
- .11 Grille: plastic.
- .12 Exhaust air wall cap: plastic with 12 mm mesh, 2 mm diameter aluminum wire bird screen.
- .13 Outside air intake wall cap: plastic with 19 mm mesh, 2 mm diameter aluminum wire bird screen.

2.4 VENTILATION FAN CONTROL

- .1 Line voltage, wall-mounted dehumidistat for control of ventilation fan:
 - .1 Voltage: 120 V.
 - .2 Adjustable range: 20% to 80% relative humidity.
 - .3 RH differential: 4% to 6% relative humidity.
 - .4 Contact rating: 7.5 amps
 - .5 Switch type: Single pole, single throw, normally open
 - .6 Switch action: closes on humidity rise, opens on humidity fall
 - .7 Metal adapter plate for vertical switch box mounting.
 - .8 CSA certified, UL listed.

2.5 VENTILATION FAN SEQUENCE OF OPERATION

- .1 When the disconnect switch is in the closed position and the dehumidistat senses that the crawlspace relative humidity is at or above the setpoint, the dehumidistat switch makes contact and allows power supply to the ventilation fan.
- .2 When the dehumidistat senses that the crawlspace relative humidity has decreased to the setpoint (minus the differential), the dehumidistat switch breaks contact and stops power supply to the ventilation fan.
- .3 When the disconnect switch is in the open position, the dehumidistat switch is open, regardless of the crawlspace relative humidity value.

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 recommendations.

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.

3.4 PROTECTION

- .1 Protect crawlspace ventilation system equipment, components and devices from damage or deterioration and from spray-foam, sealants or other substances during subsequent work.

- .2 Operation or use of new crawlspace ventilation systems for ventilation of work spaces not permitted at any time.

END OF SECTION