

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia and Province of Prince Edward Island, Canada when requested.
- .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 Procedures: 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.
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- .3 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.
 - .4 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.
 - .5 Approvals:
 - .1 Submit 2 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 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.
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.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.

1.3 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.4 MAINTENANCE

.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

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| <u>3.1 PAINTING REPAIRS
AND RESTORATION</u> | 1 | Prime and touch up marred finished paintwork to match original. |
| | .2 | Restore to new condition, finishes which have been damaged. |
| <u>3.2 DEMONSTRATION</u> | .1 | Departmental Representative 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. |
| <u>3.3 PROTECTION</u> | .1 | Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system. |

PART 1 - GENERAL

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| <u>1.2 GENERAL</u> | .1 | 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. |
| <u>1.3 QUALIFICATIONS OF TAB PERSONNEL</u> | .1 | Names of proposed personnel to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract. |
| | .2 | Provide documentation confirming qualifications, successful experience. |
| <u>1.4 PURPOSE OF TAB</u> | .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 so as 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. |
| <u>1.5 CO-ORDINATION</u> | .1 | Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as 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. |
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1.6 START-UP

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

1.7 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.

1.8 START OF TAB

- .1 Notify Departmental Representative 7 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, caulking.
- .5 All pressure, leakage, other tests specified elsewhere Divisions 22 and 23.
- .6 All 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 Place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Volume control dampers installed and open.
 - .6 Access doors, installed, closed.

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| <u>1.11 APPLICATION
TOLERANCES</u> | .1 | Do TAB to following tolerances of design values:
.1 HVAC systems: plus 10%, minus 10%. |
| <u>1.12 ACCURACY
TOLERANCES</u> | .1 | Measured values to be accurate to within plus or minus 2% of actual values. |
| <u>1.13 INSTRUMENTS</u> | .1 | Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system. |
| | .2 | Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative. |
| <u>1.14 PRELININARY
TAB REPORT</u> | .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. |
| <u>1.15 TAB REPORT</u> | .1 | Format to be 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 Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs. |
| <u>1.16 VERIFICATION</u> | .1 | Reported results subject to verification by Departmental Representative. |
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1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, 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. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.19 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
 - .2 Do TAB of systems, equipment, components, controls specified in Divisions 23.
 - .3 Qualifications: personnel performing TAB to be 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, but not limited to, following 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, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of dampers, filter, fan, other equipment causing changes in conditions.
 - .7 Locations of systems measurements to include, airflow data at exhaust fan.
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1.20 OTHER TAB <u>REQUIREMENTS</u>	.1	General requirements applicable to work specified this paragraph: .1 Qualifications of TAB personnel: as for air systems specified this section.
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PART 2 - PRODUCTS

<u>2.1 NOT USED</u>	.1	Not used.
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PART 3 - EXECUTION

<u>3.1 NOT USED</u>	.1	Not used.
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END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE/IESNA 90.1-2010, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
.2 American Society for Testing and Materials International, (ASTM)
.1 ASTM B 209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
.2 ASTM C 335/C335M-10E1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C 411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
.4 ASTM C 449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
.5 ASTM C 547-12, Specification for Mineral Fiber Pipe Insulation.
.6 ASTM C 553-13, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
.7 ASTM C 612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.
.3 Canadian General Standards Board (CGSB)
.1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).
.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Thermal Insulation
Polyotrene, Boards and Pipe Covering.

1.3 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.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .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 in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.6 QUALIFICATIONS

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .2 Protect from weather and construction traffic.
 - .3 Protect against damage from any source.
 - .4 Store at temperatures and conditions recommended by manufacturer.
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PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102-10:
 - .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° C mean temperature when tested in accordance with ASTM C 335-10E1.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612-10, with or without factory applied vapour retarder jacket to CGSB 51-GP-52MA (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553-13 faced with or without factory applied vapour retarder jacket to CGSB 51-GP-52MA (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C 553-13.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: to ASTM C 553-13.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921-03.
- .2 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
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- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449-07.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921-03 untreated.
- .5 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .6 Contact adhesive: quick-setting
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm stainless steel.
- .9 Banding: 19 mm wide, 0.5mm thick stainless steel.
- .10 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
 - .2 Apply materials in accordance with manufacturer's instructions and as indicated.
 - .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
 - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour
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retarder jacket.

.2 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.5 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Exhaust and Supply duct between dampers and outdoors, or minimum 3 meters	C-1	yes	50

.2 Insulation finishes: conform to the following table:

Location	Finish
Exposed rectangular duct	Canvas

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 29.06 - Health and Safety Requirements.
 - .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

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 A 480/A 480M-13b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-13, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M-13, 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 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-2012, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
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- .6 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.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.
 - .3 IAQ Guideline for Occupied Buildings Under Construction 1995, 1st Edition.
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety: Do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:
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Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

- .2 Seal classification:
- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
 - .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape or combination thereof.
 - .3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or as indicated. Longitudinal seams unsealed.

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| <u>2.2 SEALANT</u> | .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C. |
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| <u>2.3 TAPE</u> | .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide. |
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| <u>2.4 DUCT LEAKAGE</u> | .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual |
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| <u>2.5 FITTINGS</u> | .1 Fabrication: to SMACNA. |
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| <u>2.6 FIRESTOPPING</u> | .1 Retaining angles around duct, on both sides of fire separation. |
| | .2 Fire stopping material and installation must not distort duct. |

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| <u>2.7 GALVANIZED STEEL</u> | .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating. |
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- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 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 ASHRAE and SMACNA.

- .3 Hangers: galvanized steel angle with galvanized steel rods to the following table:

<u>Duct Size</u>	<u>Angle Size</u>	<u>Rod Size</u>
(mm)	(mm)	(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

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

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A, NFPA 90B, ASHRAE, SMACNA and as indicated.
 - .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct. Ensure diffuser is fully seated.
 - .3 Support risers in accordance with SMACNA and as indicated.
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- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

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 ASHRAE, SMACNA and as follows:

Duct Size	Spacing
mm)	(mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes including combustion air systems.
 - .2 Exhaust stacks from base of riser upwards.
 - .3 Elsewhere as indicated.
 - .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 weld 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 trap primer and discharging to open funnel drain.
 - .4 Slope outdoor intake ducts down towards louve to drain outdoors.
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| 3.4 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. |
| 3.5 DUCT
MATERIALS | .1 | Ducts shall be constructed of the following materials unless indicated otherwise |
| | .1 | interior duct systems: galvanized steel. |

PART 1 - GENERAL

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| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| <u>1.2 REFERENCES</u> | .1 | Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Indicate the following:
.1 Flexible connections.
.2 Duct access doors.
.3 Turning vanes.
.4 Instrument test ports. |
| <u>1.4 CERTIFICATION OF RATINGS</u> | .1 | Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards. |

PART 2 - PRODUCTS

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| <u>2.1 GENERAL</u> | .1 | Manufacture in accordance with SMACNA - HVAC Duct Construction Standards. |
| <u>2.2 FLEXIBLE CONNECTIONS</u> | .1 | Frame: galvanized sheet metal frame 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° C to plus 90° C, density of 1.3 kg/m². |
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PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75mm.
 - .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.

PART 1 - GENERAL

<u>1.1 RELATED SECTIONS</u>	.1	Section 23 33 00 - Air Duct Accessories.
<u>1.2 REFERENCES</u>	.1	American Society for Testing and Materials International (ASTM) .1 ASTM A 653/A 653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
<u>1.3 PRODUCT DATA</u>	.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 Indicate the following: .1 Performance data.
<u>1.4 CLOSEOUT SUBMITTALS</u>	.1	Closeout Submittals .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
<u>1.5 QUALITY ASSURANCE</u>	.1	Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
<u>1.6 CERTIFICATION OF RATINGS</u>	.1	Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.
<u>1.7 DELIVERY, STORAGE AND HANDLING</u>	.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 and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Parallel blade type.
- .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 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 12 Pa differential across damper.
 - .2 Pressure drop: at full open position less than Pa differential across damper at 4 m/s.
- .6 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.

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated multi leaf aluminum construction with nylon bearings and counterweighted operation sized per exhaust fan capacity.
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- 2.3 ELECTRICAL CONTROL .1 Requirements:
DAMPER ACTUATORS
- .1 Direct mount, on/off type.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 120 VAC.
 - .5 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

PART 3 - EXECUTION

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

- 3.2 INSTALLATION
- .1 Install on exhaust discharge and outside air inlet.
 - .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.

PART 1 - GENERAL

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| <u>1.1 RELATED SECTIONS</u> | .1 | Section 23 05 13 - Common Motor Requirements for HVAC Equipment. |
| | .2 | Section 23 33 00 - Air Duct Accessories. |
| <u>1.2 REFERENCES</u> | .1 | AMCA 99-10, Standards Handbook. |
| | .2 | ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Rating. |
| | .3 | AMCA 300-08, Reverberant Room Method for Sound Testing of Fans. |
| | .4 | AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data. |
| | .5 | ANSI/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Rating. |
| <u>1.3 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Provide :
.1 Fan performance curves showing point of operation, BHP kW and efficiency.
.2 Sound rating data at point of operation. |
| | .3 | Indicate:
.1 Motors, sheaves, bearings, shaft details
.2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate. |
| <u>1.4 CLOSEOUT SUBMITTALS</u> | .1 | Provide operation and maintenance data for incorporation into manual specified in Section 01 77 00 - Closeout Procedures. |
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- 1.5 EXTRA MATERIALS .1 Provide maintenance materials in accordance with Section 01 77 00 - Closeout Procedures.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- 1.6 MANUFACTURED ITEMS .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

PART 2 - PRODUCTS

- 2.1 SYSTEM GENERAL .1 Performance Requirements:
- .1 Cataloged 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: 165L/s, external static pressure of 62 Pa, 1725rpm, operating power of 194W, 120V 1 phase, sound ratings of 51LwA at 250Hz, 47LwA at 1000Hz, 38LwA at 4000Hz.
- 2.2 WALL EXHAUSTER EF-1 .1 Centrifugal backward inclined units, direct driven.
- .1 Epoxy coated, spun aluminum housing, complete with resilient mounted motor and fan.
- .2 12 mm mesh 2.0 mm diameter aluminum birdscreen.
- .3 Automatic gasketted aluminum backdraft dampers.
- .4 Disconnect switch within fan housing.
- .5 Stainless steel securing bolts and screws.
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- .2 Wall Housings:
 - .1 Provided with rubber or neoprene grommets for wiring passages, integral attachment collar, or angle ring mounted to mating flanged wall sleeve with full gasketting.
- .3 Discharge pattern: away from building

PART 3 - EXECUTION

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.
- .5 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

PART 1 - GENERAL

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| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal procedures. |
| <u>1.2 REFERENCES</u> | .1 | American National Standards Institute (ANSI)/
National Fire Protection Association (NFPA)
.1 ANSI/NFPA 96, Standard for Ventilation
Control and Fire Protection of Commercial
Cooking Operations. |
| | .2 | American Society for Testing and Materials
(ASTM)
.1 ASTM E 90-09, Method for Laboratory
Measurement of Airborne Sound Transmission
Loss of Building Partitions and Elements. |
| | .3 | Sheet Metal and Air Conditioning Contractors'
National Association (SMACNA) |
| | .4 | Society of Automotive Engineers (SAE) |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section
01 33 00 - Submittal Procedures. |
| | .2 | Indicate the following:
.1 Pressure drop.
.2 Face area.
.3 Free area. |
| <u>1.4 TEST REPORTS</u> | .1 | Submit certified data from independent
laboratory substantiating acoustic and
aerodynamic performance to ASTM E 90-09. |
| <u>1.5 CERTIFICATION OF RATINGS</u> | .1 | Catalogued or published ratings shall be those
obtained from tests carried out by
manufacturer or those ordered by him from
independent testing agency signifying
adherence to codes and standards. |
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PART 2 - PRODUCTS

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| <u>2.1 WEATHER HOODS</u> | .1 | Thickness: to SMACNA. |
| | .2 | Fabrication: to SMACNA. |
| | .3 | Joints: to SMACNA or proprietary manufactured duct joint. |
| | .4 | Complete with integral birdscreen of 2.7 mm diameter aluminum. Use 12 mm mesh on exhaust, 19 mm mesh on intake. |
| | .5 | Motorized damper on face. |

PART 3 - EXECUTION

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| <u>3.1 INSTALLATION</u> | .1 | In accordance with manufacturer's and SMACNA recommendations. |
| | .2 | Reinforce and brace as indicated. |
| | .3 | Anchor securely into opening. Seal with caulking around to ensure weather tightness. |