

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 National Fire Code of Canada (NFCC 2010)
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

PART 2 - PRODUCTS

- 2.1 NOT USED
- .1 Not used.

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 CONNECTIONS TO EQUIPMENT
- .1 In accordance with manufacturer's instructions unless otherwise indicated.
 - .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
 - .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.
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- 3.3 CLEARANCES
- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
 - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

- 3.4 DRAINS
- .1 Install piping with grade in direction of flow except as indicated.
 - .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
 - .3 Pipe each drain valve discharge separately to above floor drain.
 - .1 Discharge to be visible.
 - .4 Drain valves: NPS 3/4 gate or ball valves unless indicated otherwise, with hose end male thread, cap and chain.

- 3.5 AIR VENTS
- .1 Install manual air vents at high points in piping systems.
 - .2 Install drain piping to approved location and terminate where discharge is visible.

- 3.6 DIELECTRIC COUPLINGS
- .1 General: compatible with system, to suit pressure rating of system.
 - .2 Locations: where dissimilar metals are joined.
 - .3 NPS 2 and under: isolating unions or bronze valves.
 - .4 Over NPS 2: isolating flanges.

- 3.7 PIPEWORK INSTALLATION
- .1 Screwed fittings jointed with Teflon tape.
 - .2 Protect openings against entry of foreign material.
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- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .8 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .9 Group piping wherever possible and as indicated.
- .10 Ream pipes, remove scale and other foreign material before assembly.
- .11 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .12 Provide for thermal expansion as indicated.
- .13 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Use gate or ball valves at branch take-offs for isolating purposes except where specified.

3.8 FLUSHING OUT OF
PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02 Cleaning and Start-up of Mechanical Piping Systems.
- .2 Before start-up, clean interior of piping systems as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.9 PRESSURE
TESTING OF
EQUIPMENT AND
PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Hydronic Pipework: test at pressure of 1.5 times normal operating pressure.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.10 EXISTING
SYSTEMS

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

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 SCOPE OF WORK
- .1 Before any modifications to building systems is started, TAB specialist to perform an Existing Conditions Airflow Survey for the following systems, reference attached TAB test procedures in Appendix 1 for further information:
 - .1 28 roof top fume hood type fans.
 - .2 2 centrifugal fans.
 - .3 Supply and exhaust air flows to/from 5 laboratory spaces.
 - .2 Upon completion of roof top fan replacements, TAB specialist to balance 24 new (replaced) roof top fume hood type fans.
 - .3 Upon completion of the laboratory ductwork modifications to 5 laboratory spaces, TAB specialist to perform the following:
 - .1 Rebalance supply air diffusers, exhaust grilles, and VAV boxes as per drawings.
 - .2 Rebalance heating water flow to re-heat coils in 5 VAV boxes.
 - .3 Rebalance 1 centrifugal exhaust fan (3 HP) including sheive changes as required.
 - .4 Provide assistance as required during laboratory commissioning procedures.
 - .5 Provide assistance to controls contractor in establishing static pressure measurments for main AHU supply duct work as detailed in "SCOPE" note # 3 on Dwg M-005.
- 1.3 QUALIFICATIONS OF TAB PERSONNEL
- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
 - .2 Provide documentation confirming qualifications, successful experience.
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- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
 - .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.

1.4 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.

1.5 EXCEPTIONS

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

1.6 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.

1.7 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.

1.8 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.

1.9 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.
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- 1.10 START OF TAB
- .1 Notify Departmental Representative 7 days prior to start of TAB.
 - .2 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 Fire, smoke, volume control dampers installed and open.
 - .4 Coil fins combed, clean.
 - .5 Access doors, installed, closed.
 - .6 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Strainers in place, baskets clean.
 - .3 Isolating and balancing valves installed, open.
 - .4 Calibrated balancing valves installed, at factory settings.
 - .5 Chemical treatment systems complete, operational.
- 1.11 APPLICATION TOLERANCES
- .1 Do TAB to following tolerances of design values:
 - .1 Laboratory HVAC systems: plus 5%, minus 5%.
 - .2 Hydronic systems: plus or minus 10 %.
- 1.12 ACCURACY TOLERANCES
- .1 Measured values accurate to within plus or minus actual values.
- 1.13 INSTRUMENTS
- .1 Prior to TAB, submit to Departmental Representative 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 1 year of TAB. Provide certificate of calibration to Departmental Representative.

1.14 ACTION AND
INFORMATIONAL
SUBMITTALS

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

1.15 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.

1.16 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 1 electronic copy of TAB Report to Departmental Representative for verification and approval.

1.17 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.18 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. Do not eradicate or cover markings.
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1.19 COMPLETION OF TAB .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.20 AIR SYSTEMS .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB or SMACNA.

.2 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB.

.3 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.

.4 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.

.5 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

PART 2 - PRODUCTS

2.1 NOT USED .1 Not used.

PART 3 - EXECUTION

3.1 NOT USED .1 Not used.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
.1 Procedures and cleaning solutions for cleaning mechanical piping systems.
- 1.2 REFERENCES .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS .1 Product Data: .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
.1 Instructions: submit manufacturer's installation instructions.

PART 2 - PRODUCTS

- 2.1 CLEANING SOLUTIONS .1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.
.2 Sodium carbonate: 0.40 kg per 100 L water in system.
.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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.
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3.2 CLEANING
HYDRONIC AND STEAM
SYSTEMS

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
 - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
 - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
 - .1 Cleaning procedures, flow rates, elapsed time.
 - .2 Chemicals and concentrations used.
 - .3 Inhibitors and concentrations.
 - .4 Specific requirements for completion of work.
 - .5 Special precautions for protecting piping system materials and components.
 - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
 - .1 Systems: free from construction debris, dirt and other foreign material.
 - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
 - .3 Strainers: clean prior to initial fill.
 - .4 Install temporary filters on pumps not equipped with permanent filters.
 - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
 - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
 - .1 Isolate new piping from existing system in preparing to flush new piping.
 - .2 Add chemicals under direct supervision of chemical treatment supplier.
 - .3 Circulate system cleaner at 60 degrees C for at least 36 h by tying into drain valves and utilize transfer pump or circulator pump. Drain and fill with water.

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.4 Open isolation valves and operate building circulation pumps to ensure removal of air from the system.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
.1 Copper piping valves and fittings for hydronic systems.
- 1.2 REFERENCES .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
.1 ANSI/AWS A5.8/A5.8M-04, Specification Filler Metals for Brazing and Bronze Welding.
- .2 American Society of Mechanical Engineers (ASME)
.1 ANSI/ASME B16.4-2011, Gray-Iron Threaded Fittings.
.2 ANSI/ASME B16.15-2011, Cast Bronze Threaded Fittings.
.3 ANSI B16.18-2001, Cast Copper Alloy, Solder Joint Pressure Fittings.
.4 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 American Society for Testing and Materials International (ASTM)
.1 ASTM B 32-08, Standard Specification for Solder Metal.
.2 ASTM B 61-08, Standard Specification for Steam or Valve Bronze Castings.
.3 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
.4 ASTM B 88M-05(2011), Standard Specification for Seamless Copper Water Tube.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).
- .5 Manufacturers Standardization Society (MSS)
.1 MSS SP 70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.
.2 MSS SP 71-1997, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
.3 MSS SP 80-2003, Bronze Gate, Globe, Angle and Check Valves.
.4 MSS SP 85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
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1.3 ACTION AND
INFORMATIONAL
SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Type L hard drawn copper tubing: to ASTM B 88.

2.2 FITTINGS

- .1 Cast bronze threaded fittings: to ANSI/ASME B16.15.
- .2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.
- .3 Cast iron threaded fittings: to ANSI/ASME B16.4.
- .4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

- .1 Brass or bronze: threaded.
- .2 Cast iron: threaded.
- .3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B 32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

2.5 VALVES

- .1 Connections:
 - .1 NPS 2 and smaller: ends for soldering or screwed.
- .2 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, or ball valves, male thread hose connections and cap.
- .3 Ball valves:
 - .1 NPS 2 and under:
 - .1 Bronze body, PTFE seal, hard chrome ball, 600 WOG, threaded ends.
 - .2 Acceptable product: Crane F9202.

.3 Other acceptable manufacturers:
Jenkins, RWV.

PART 3 - EXECUTION

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| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet. |
| <u>3.2 PIPING INSTALLATION</u> | .1 | Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated. |
| | .2 | Slope piping in direction of drainage and for positive venting. |
| | .3 | Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting. |
| | .4 | Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings. |
| | .5 | Assemble piping using fittings manufactured to ANSI standards. |
| <u>3.3 VALVE INSTALLATION</u> | .1 | Install rising stem valves in upright position with stem above horizontal. |
| <u>3.4 CIRCUIT BALANCING VALVES</u> | .1 | Tape joints in prefabricated insulation on valves installed in chilled water mains. |
| <u>3.5 FLUSHING AND CLEANING</u> | .1 | Clean as per Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems. |
| <u>3.6 FIELD QUALITY CONTROL</u> | .1 | Testing:
.1 Pressure test system in accordance with Section 23 05 05 - Installation of Pipework. |
| | .2 | Balancing: |
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- .1 Balance water systems to within plus or minus 5% of design output.
- .2 Refer to Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

3.7 CLEANING

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

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of high-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 (ASTM).
 - .1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, ANSI/SMACNA 016-2012.
 - .3 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2nd Edition, ANSI/SMACNA 008-2008.

1.3 ACTION AND INFORMATIONAL 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 to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 DUCTWORK

- .1 Material:
 - .1 Galvanized steel with zinc coating lock forming quality: to ASTM A 653/A 653M.
 - .2 Thickness: to SMACNA.
 - .3 Where indicated on drawing, duct material to be stainless steel with welded joints. Thickness to match existing.
- .2 Construction - round and oval.
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints up to 900mm: slip type with tape and sealants.
 - .3 Transverse joints over 900mm: Vanstone.
 - .4 Fittings:
 - .1 Elbows: five -piece (for 90 degrees) three-piece (for 45 degrees). Centreline radius: 1.5 x diameter.
 - .2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.
- .3 Construction - rectangular:
 - .1 Ducts: to SMACNA.
 - .2 Transverse joints: SMACNA seal Class A.
 - .3 Fittings:
 - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.
 - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow.

2.2 SEAL

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
2500	A
- .2 Seal classification:
 - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.3 SEALANT

- .1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.

2.4 TAPE .1 Polyvinyl treated, open weave fibre glass, 50 mm wide.

PART 3 - EXECUTION

3.1 GENERAL .1 Do work in accordance with ASHRAE and SMACNA.
.2 Do not break continuity of insulation vapour barrier with hangers or rods.

3.2 SEALING AND TAPING .1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.
.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.3 LEAKAGE TESTS .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
.2 Perform leakage tests in sections.
.3 Perform trial leakage tests, as instructed to demonstrate workmanship.
.4 Do not install additional ductwork until trial tests have been achieved.
.5 Complete tests before performing insulation or concealment Work.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
- .1 Roof exhausters (fume hood type exhaust fan).
- 1.2 REFERENCES .1 Air Movement and Control Association (AAMC)
- .1 AMCA Publication 99-10, Standards Handbook.
 - .2 ANSI/AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
 - .3 ANSI/AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)
- .1 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .2 ANSI/AMCA Z9.5-2012, Laboratory Ventilation.
- .3 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. Provide confirmation of testing.
 - .2 Statically and dynamically balanced. Constructed to AMCA 99.
 - .3 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, unit to bear AMCA certified rating seal.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS .1 Shop Drawings:
- .1 Submit shop drawing in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Include :
 - .1 Fan performance curves showing specified point of operation.
 - .2 Sound rating data.
 - .3 Coating information, including type and application requirements by qualified coatings specialist.

- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Submit coating manufacturer's application instructions including surface preparatory work, application method, material thickness, and required environmental conditions for application and curing.
- .3 Closeout Submittals
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 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.

1.8 WARRANTY

- .1 Provide 7 year full coverage warranty that includes fan casing, fan impeller, motor, and complete drive train.

PART 2 - PRODUCTS

2.1 ROOF EXHAUSTERS .1 (FUME HOOD TYPE FAN)

Mixed-flow induced dilution fans:

.1 Impellers shall be mounted directly to the motor shaft to provide a direct drive arrangement 4 type fan. Motors shall be isolated from the primary exhaust air stream and shall be visible and accessible from the fan exterior for inspection and service.

.2 Mixed flow impellers shall consist of combination axial/backward curved blades and shall be of welded steel construction. The impellers shall have non-stall and non-overloading performance characteristics with aerodynamically stable operation at any point on the fan curves.

.3 Fan Performance shall be as stated on the schedule. The Static Pressure stated on the schedule shall be at the inlet to the "Fan System" and does not include any losses of equipment provided by the fan manufacturer.

.4 Fan and all drive components shall have a combined bearing life of up to L10 = 100,000 hours.

.5 Stationary discharge guide vane sections shall be provided to increase fan efficiencies.

.6 Vibration isolation shall be limited to rubber-in-shear pad type isolators unless otherwise specified.

.7 Fan assemblies shall be designed for mounting on existing roof curb without the need for guy wire supports.

.8 Entrainment windbands shall provide secondary induction of outside air. Induction shall take place downstream of the fan impeller and shall not influence BHP or static pressure requirements.

.9 Fan shall be constructed to AMCA "C" standards with a non-ferrous inlet bell, provided in order to reduce sparking in the event of a motor bearing failure.

.10 Fans shall be modular construction and capable of being assembled on the roof.

.11 Chemical resistant gaskets shall be provided at all companion flanged joints.

.12 Fasteners shall be 316 stainless steel.

.13 A bolted access door shall be provided for impeller inspection on each fan.

.14 Fans and accessories shall have internal drain systems to prevent rain water from entering building duct system.

.15 Electric motors shall be TEFC Mill & Chemical duty with a 1.15 service factor. Premium Efficient motors shall have regreasable bearings with grease relief fittings.

.16 Extended motor lube lines of Teflon tubing covered with braided stainless steel shall be provided. Extended lube lines shall be mounted to a bracket located on the fan housing with grease relief fittings on each line.

.17 A NEMA 3R non-fused disconnect switch shall be provided, mounted and wired to the motor.

.2 Accessories:

.1 Inlet mixing plenums shall be provided by the fan manufacturer. Each plenum shall be sized to support the weight and performance requirement of the of fan listed on the schedule. Single fan plenums shall be of continuously welded, heavy gauge steel construction. All plenums shall be capable of supporting the fan(s) without guy wires or supports. The plenums shall include hinged access doors and safety screens over fan inlets. The primary air inlets shall be located on the bottom as noted on construction drawings. Plenums shall be suitable for mounting on existing roof curbs.

.2 Safety screens shall be supplied over inlet of fan.

.1 Bypass dampers shall be provided with all mixing plenums for outside air with primary exhaust. Dampers will be Louver/damper combination, aluminum construction, manual locking quadrant.

.3 Interior coating:

.1 Interior of all surfaces in contact with exhaust air, including fan wheel, casings, plenum and discharge shall be provided with a high solids, high build amine epoxy that will withstand extreme conditions of abrasion, corrosion, and chemical resistance.

.2 Surface preparation: in shop, abrasive blast clean to Sa205 or SSPC-SP10. If oxidation has occurred between blasting and application, the surface is to be reblasted to the specified visual standard.

.3 Application: shop applied, full coat, spray, brush, or roller at DFT thickness of 0.254 mm (10 mil).

.4 Exterior coating:

.1 Provide a high solids, high build amine epoxy that will withstand extreme conditions of abrasion, corrosion, and chemical resistance with a high gloss acrylic polyurethane top coating that provides colour and gloss retention for exterior exposure.

.2 Surface preparation: in shop, abrasive blast clean to Sa205 or SSPC-SP10. If oxidation has occurred between blasting and application, the surface is to be reblasted to the specified visual standard.

.3 Application epoxy coat: shop applied, full coat, spray, brush, or roller at DFT thickness of 0.254 mm (10 mil).

.4 Application top coat: shop applied, full coat, spray, brush, or roller at DFT thickness of 0.0762 mm (3 mil).

.5 Fan capacities, performance and motor information is included in equipment schedule on drawing.

.6 Acceptable make and model are indicated in equipment schedule on drawing.

.7 Other acceptable manufacturers:

.1 Twin City

.2 Greenheck

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.

PART 1 - GENERAL

- 1.1 SUMMARY .1 Section Includes:
.1 Variable volume boxes.
- 1.2 REFERENCES .1 American National Standards Institute (ANSI)
.1 ANSI/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.2 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).
.3 International Organization of Standardization (ISO)
.1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
.4 Underwriter's Laboratories (UL)
.1 UL 181-2005, Factory-Made Air Ducts and Air Connectors.
- 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 certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.
- 1.4 ACTION AND INFORMATIONAL SUBMITTALS .1 Shop Drawings:
.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Indicate the following:
.1 Capacity.
.2 Pressure drop.
.3 Noise rating.
.4 Leakage.
.5 Dimensions.
.2 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.2 VARIABLE VOLUME BOXES

- .1 Pressure independent factory reset to air flow between minimum and maximum air volume.
- .2 Sizes, capacities, differential pressures: as indicated in schedule.
- .3 Differential pressure not to exceed 25 Pa at inlet air velocity of 10 m/s.
- .4 Complete with:
- .1 Multi point averaging diamond flow sensor.
 - .2 Universal control mounting panel.
 - .3 Reheat coil as indicated.
- .5 Casing: constructed of galvanized steel, internally lined with 19 mm, fibre free foam, to UL 181 and ANSI/NFPA 90A. Mount control components inside protective metal shroud.
- .6 Damper: galvanized steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .7 Standard of acceptance is listed in schedule on drawing.
- .8 Other acceptable manufacturers: EH Price, Krueger.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install in accordance with manufacturers recommendations.
.2 Support independently of ductwork.
.3 Install with minimum of four duct diameters of straight inlet duct, same size as inlet.
.4 Locate controls, dampers and access panels for easy access.

